GLOBAL WATER LAW SYSTEMS;

papers presented at the international conference on global water law systems, Valencia, Spain, 1-7 Sept., 1975

CONTENTS

FOREWORD

The idea for convening a conference on major global water law systems originated in 1972. Part of its motivation can be traced to prevailing difficulties experienced by practitioners in the field of water legislation and administration in locating appropriate material and insightful information on water management control practices and alternative systems. Faced with the proposition of taking a "traditional" approach, i.e., that of providing advice based primarily upon knowledge of one's own system, the alternative of gathering relevant materials on other systems in order to provide a multi-disciplinary line of attack was preferred. This involves the creation of a spectrum of alternative control approaches to resolve particular water resources problems and insure proper water resources development and management. Thus, the present Conference exemplifies this broader commitment. Through the strong interest and support from several agencies and foundations and the enthusiastic response from Spain to host the Conference, the project materialized.

One of the critical factors of any effort to bring together experts and others working in a field is that a solid foundation of material be presented and discussed. Thanks to the Rockefeller Foundation, financial support was made available to prepare a pre-conference publication of key reports on the topics to be discussed. This report which contains the contracted and contributed reports of some twenty-five specialists in water resources areas, contains in varying detail the substance of positions to be presented and discussed at the International Conference on Global Water Law Systems in Valencia, Spain from 1-7 September 1975. The authors have worked hard to report on their topics according to a pre-set outline and agreed-upon common line of exposition. The Conference Committee welcomes and requests any comments on the reports or information and materials or topics covered herein or relevant to the legal aspects of improving water development and management.

Valencia, Spain was selected as an appropriate area for convening the Conference because it sits at the crossroads of three major water law systems, it has an active and effective local system for water management, and a unique and ancient institution, the Tribunal of Waters, for resolving water disputes summarily and inexpensively. At the same time, the physical terrain in the valley of Valencia provides a range of irrigated agriculture from olive trees to rice paddies and a poignant example of the role of proper water managment in transforming, through appropriate interventions, the semi-arid ecosystem into a highly productive agricultural and industrial area.

Other support has been received from USAID, NSF, CID, SCU, and USU. The Conference is being convened with cooperation from ILA and IAWL, with participation by the Center for Natural Resources, Energy and Transport of the United Nations Secretariat of New York. These organizations and agencies share with all of us the concern on

managing efficiently and effectively a precious natural resource and in developing through cross-cultural experiences a commonly shared store-house of human knowledge about water resources of our planet.

The committee wishes to express their appreciation to the authors of the reports contained herein, to Miguel Solanes, Conference Research Associate, and to the two Conference secretaries and the many other secretaries who so graciously and diligently worked under impossible time constraints to prepare for the Conference and this report.

LIST OF TERMS

INTERNATIONAL CONFERENCE ON
GLOBAL WATER LAW SYSTEMS

VALENCIA, SPAIN

September 1975

Spanish-English
English-Spanish

Abandono	Abandonment
Abastecimento de Poblaciones	Urban Supply
Abrevadero	Watering Place
Aceite de Esquistos	Oil Shale
Acto de Imposición de Contribución	Assessments
Acueducto	Aqueduct
Acuífero	Acquifer
Adjudicación	Adjudication
Administración	Administration
Administración de Aguas	Water Administration
Administrativo	Administrative
Aforar	To Gauge
Agricultura	Agriculture
Aguas de Desagüe	Sewage Waters; Waste Waters
Aguas Difusas	Diffused Surface Waters
Aguas de Lluvia	Rain Waters
Aguas Edaficas	Edafic Waters
Aguas Internacionales	International Waters
Aguas Meteóricas	Meteoric Waters
Aguas Minerales	Mineral Waters
Aguas Privadas	Private Waters
Aguas Públicas	Public Waters
Aguas Salvadas	Salvaged Waters
Aguas Sobrantes	Surplus Waters
Aguas Subterráneas	Underground Waters
Aguas Termales	Thermal Waters
Aguas Territoriales	Territorial Waters
Altamar	High Seas
Alternativas	Alternatives

Amenidad	Amenity
Apelación	Appeal
Aplicación o Petición	Application
Apropiación	Appropriation
Aprovechamiento	Exploitation
Abritral	Arbitration
Arbitro	Arbitrator
Archivo	File
Area; Cuenca de Origen	Area of Origin; Basin of Origin
Area Hidrografica	Hydrographic Area
Arena	Sand
Arido	Arid
Arroyo	Brook
Artificial	Artificial
Asignación	Allocation
Asociaciones de Usuarios	Users (water) Associations; Consortiums
Audiencia	Hearing
Aumentación; Incremento	Augmentation
Autarquica/o	Autarchic
Autónomo	Autonomous
Autoridad	Authority
Autorización	Authorization
Boquera	Field Turn Out
Bombas	Pumps
Beneficio Costo	Cost Benefit
Beneficios Secundarios	Secondary Benefits

Canal	Canal
Canal de Retorno	Return Ditch
Cantidad	Quality
Carga	Charge
Carga de la Prueba	Burden of Proof
Cargados	Charged
Cequia	Irrigation Canal
Civilizaciones Hidraúlicas	Hydraulic Civilizations
Código Civil	Civil Code
Código Penal	Criminal Code
Colectivo	Collective
Colonización	Colonization
Comisión	Commission
Comité	Committee
Compensación, Indemnización	Compensation
Competencia	Competence
Compuertas	Gates
Concesión	Concession
Cono de Depresion	Cone of Depression
Constitución	Constitution
Construcción	Construction
Contribución	Contribution
Control	Control
Convención	Convention
Convenios, Pactos, Contratos	Covenants
Cooperativo/a	Cooperative
Costa	Seashore
Costo Efectividad	Cost-Effectiveness
Corte Local Basada en Costumbres	Jirga (Local Customary Court)

Corriente	Runoff
Corriente de Retorno	Return Flow
Cualidad, Calidad	Quality
Cuenca	Basin
Cuenca Hidrica	Watershed
Curso de Agua	Watercourse
Curso de Agua Temporal	Ephemeral Stream
Custodia Pública	Public Trust Doctrine
Debida Diligencia	Due Diligence
Decreto	Decree
Decreto Condicional	Conditional Decree
Delegación	Delegation
Demandado	Defendant
Demandas	Demands
Departamento	Department
Dependiendo de	Depending From
Deplecion	Depletion
Depurar	Purify
Derecho Administrativo	Administrative Right
Derecho Común	Common Law
Derechos Correlativos	Correlative Rights
Derecho A Litigar	Standing to Sue
Derecho Estatutario	Statutory Law
Derechos de Aguas	Water Rights
Derechos de Ribereño	Riparian Rights
Derechos Reservados	Reserved Rights
Derecho Precario	Precarious Right
Desagüe	Sewage

Desagues	Sewers
Desalinización	Desalinization
Desarrollo	Development
Descarga	Discharge
Desecación	Desecation
Deseconomías Internas	Internal Diseconomies
Desperdicios	Waste
Dique	Dam
Dirección	Direction
Distribución	Distribution
Distribución Equitable	Equitable Apportionment
Distrito	District
Distritos de Conservación	Conservancy Districts, Conservation Districts
Distrito de Riego	Irrigation Districts
Diversión	Diversion
Doctrina de la Reservación	Reservation Doctrine
Dominio Eminente	Eminent Domain
Dotaciones de Aguas	Water Allotments
Drenage	Drainage
Drene	Drain
Efecto de Depresión	Draw-down Effect, Depressive Effect
Eficiencia	Efficiency
Efluente	Effluent
Energía	Energy
Energía Hidraúlica	Hydraulic Energy
Entidades	Entities
Entidad de Administración	Administrative Body
Entreface	Interface

Erosión	Erosion
Estación de Aforo	Gaging Station
Estación de Bombeo	Pumping Station
Estado	State
Estética	Esthetics
Estuarios	Estuaries
Espectro de Alternativas	Spectrum of Alternatives
Evapotranspiracion	Evapotranspiration
Exploracion	Exploration
Expropiación	Expropriation; Condemnation
Externalidad	Externalities
Extracción de Agua	Abstraction of Water
Fábricas	Factories
Federal	Federal
Ferrocarriles	Railroads
Finanzas	Finance
Fondo del Mar	Seabottom
Forfeiture, Lapse	Caducity
Freatoficas	Phreatophyte
Fuente	Spring
Fueros	Laws of the Realm
Función de Produccion	Production Function
Ganado	Stock - Cattle
Gastos	Expenses
Geotermal	Geothermal
Hidrógrafo	Hydrograph

Hidrológico	Hydrologic
Húmedo	Humid
Impuestos	Taxes
Industria	Industry
Infiltración	Infiltration
Inherente	Appurtenant
Inspección	Inspection
Intendente	Intendant
Interdependiente	Interdependent
Interés Público	Public Interest
Interjurisdiccional	Interjurisdictional
Internacional	Transnational
Internalización	Internalization
Intersectorial	Intersectoral
Intrusión de Agua Salada	Salt Water Intrusion
Inundación	Flood
Judicial	Judicial
Juez	Judge
Junta	Board
Junta de Aguas	Water Board
Kanat	Kanat, Quanat
Lagos	Lakes
Laguna	Lagoon
Laudo	Award
Lavado de Suelos	Leaching

Lecho de las Aguas	Streambed
Legislativo	Legislative
Ley de Aguas	Water Law
Licencia	License
Limitacion-obstáculo	Constraint
Línea de Rivera	Riverline
Litigio	Litigation
Litros por Segundo	Liters per Second
Manejo	Management
Manejo de Recurso	Resources Management
Mar	Sea
Mareas	Tides
Márgenes	Riverside
Más Baja Marca de las Aguas	Lowest Water Mark
Medida	Measure
Medio Ambiente	Environment
Metro Corriente	Current Meter
Metros Segundo	Meters per Second
Minando	Mining
Modificación de Clima	Weather Modification
Multas	Fines
Musulmán	Moslem
Mutuales de Agua	Mutual Water Companies
Naturaleza Jurídica	Juridical Condition
Navegable	Navigable
Nivel Freatico	Water Table
Noria	Persian Wheel

Nube	Cloud
Obras Hidraúlicas	Water Works (Structures)
Optimo de Pareto	Pareto Optimality
Orden que Compele	Mandamus
Organizacion	Organization
Otorgamiento de Derecho de Agua	Granting of Water Rights
Pactos Entre Estados	Interstate Compacts
Pagos	Payment
Pantanos	Ponds
Pater Potestas/Potestad del Padre	"Parens Patrea" Doctrine
Pearmeabilidad	Permeability
Pendiente de Escurrimiento	Gradient Flow
Percolación, Filtración	Seepage, Percolation
Perdida de Derecho	Forfeiture
Preferencia/s	Preference/s
Perforar	To Drill
Permiso	Permit
Pesca	Fishing
Pesquerías	Fisheries
Pez	Fish
Pie por Acre	Acre-Foot
Pies Cubicos	Cubic Feet
Piletas - Estanques	Pools
Planeamiento	Planning
Planicie de Inundación	Flood Plain
Plano Aluvial	Alluvial Plane (or fill)
Planta de Tratamiento	Treatment Plant

Poder de Policía	Police Power
Polución - Contaminacion	Pollution
Poner el Precio de Agua Segun su Costo Marginal /	Marginal - Cost Pricing
Pozo	Well
Pozo Artesiano	Well (Artesian)
Pozo Ordinario	Well (Ordinary)
Prescripción	Prescription
Presión	Pressure
Prevención	Prevention
Previa	Prior
Prioridades	Priorities
Principio de Compensación	Compensation Principle
Privativo/a	Private - Particular, Exclusive
Procedimientos	Procedures
Produccion/Rendimiento que no Perjudica el Elemento Productivo /	Safe Yield
Propiedad	Property; Ownership
Propiedad Comunal	Community Property
Propiedad de las Aguas	Water Domain
Provincia	Province
Pruebas	Proofs
Puerto	Harbor
Recarga	Recharge
Reciclar	Recycling
Reclamación	Reclamation
Recreación	Recreation
Referida/o	Referred
Regadío	Irrigated Land
Régimen	Regime

Registros	Registers
Regulación de Aguas, Reglamento de Aguas /	Water Regulation
Relación al Pasado	Relation Back
Remoción	Removal
Reparto de Aguas	Delivery of Waters
Reservas	Reserves
Resoluciones	Resolutions
Restricciones, Limitaciones	Restrictions
Riego; Irrigación	Irrigation
Riego por Asperción	Sprinkler Irrigation
Riego por Gotas	Trickle Irrigation
Piego por Inundación	Flood Irrigation
Riego por Surco	Furrow Irrigation
Río	River
Rural	Rural
Sal	Salt
Salinización	Salinization
Salud	Health
"Salvo Derechos de Terceros"	"Safe Acquired Water Rights"
Sanciones	Punishments
Saturación	Saturation
Sectorial	Sectoral
Sedimento	Sediment
Separación	Severance
Sequía	Drought
Servicios	Services
Servidumbre	Easement
Sérvidumbre de Paso	Rights of Way

Servidumbres	Servitudes
"Sin Daño de Terceros"	"Without Prejudice of Third Persons"
Sistema de Distribución	Delivery System
Sistema de la Riberaneidad	Riparian System
Sistema de Riego	Irrigation System
Subsidio	Subsidy
Suministro	Supply
Supervision	Supervision
Suspensión	Suspension

Tasas, Contribuciones, Cargas Financieras	Rates, Fees
Tecnología Intermedia	Sofeware Technology, Intermediate Technology
Termal	Thermal
Términos	Terms
Toma de Aguas	Diversion Point
Tópicos	Topics
Trabajos de Saneamiento	Sanitation Works
Transferencia	Transfer
Transferencia de Cuenca	Basin Transfer
Transferencia/Transvase de Cuencas	Interbasin Transfers
Transferencia/Transvase a Traves de Montañas	Transmountain Diversion
Transferencias de Mercado/Asignaciones	Market Transfers, Allocations
Transpiración	Transpiration
Tratado	Treaty
Tratamiento Primario, Secundo y Terciario	Primary, Secondary, & Tertiary Treatment
Trayectoria	Trajectory
Tribunal de Aguas	Water Court
Turno de Irrigación	Irrigation Turn

Unidad Hidrológica	Hydrologic Unit
Urbanización	Urbanization
Usina	Power Plant
Uso Benefico	Beneficial Use
Uso Conjunto	Conjunctive Use
Uso Consumptivo	Consumptive Use
Uso Integrado	Integrated Use
Usario de Aguas	Water User
Valor	Value
Vapor	Steam
Volúmenes Mínimos	Minimum Flow

Abandonment	Abandono
Abstraction of Water	Extracción de Agua
Acquifer	Acuífero
Acre-foot	Pie por Acre
Adjudication	Adjudicación
Administration	Administración
Administrative	Administrativo
Administrative Body	Entidad de Administración
Administrative Right	Derecho Administrativo
Agriculture	Agricultura
Allocation	Asignación
Alluvial Plane (or fill)	Plano Aluvial
Alternatives	Alternativas
Amenity	Amenidad
Appeal	Apelación
Application	Aplicación o Petición
Appropriation	Apropiación
Appurtenant	Inherente
Aqueduct	Acueducto
Arbitration	Arbitral
Arbitrator	Arbitro
Area of Origin; Basin of Origin	Area; Cuenca de Origen
Arid	Arido
Artificial	Artificial
Assessments	Acto de Imposición de Contribución
Augmentation	Aumentación; Incremento
Autarchic	Autarquica/o
Authority	Autoridad
Authorization	Autorización

Autonomous	Autónomo
Award	Laudo
Basin	Cuenca
Basin Transfer	Transferencia de Cuenca
Beneficial Use	Uso Benéfico
Board	Junta
Brook	Arroyo
Burden of Proof	Carga de la Prueba
Caducity	Forfeiture, Lapse
Canal	Canal
Charge	Carga
Charged	Cargados
Civil Code	Código Civil
Cloud	Nube
Collective	Colectivo
Colonization	Colonización
Commission	Comisión
Committee	Comité
Common Law	Derecho Común
Community Property	Propiedad Comunal
Compensation	Compensación, Indemnización
Compensation Principle	Principio de Compensación
Competence	Competencia
Concession	Concesión
Condemnation	Expropiación
Conditional Decree	Decreto Condicional
Cone of Depression	Cono de Depresión

Consortiums	Asociaciones de Usuarios
Conjunctive Use	Uso Conjunto
Conservancy Districts	Distritos de Conservación
Conservation Districts	Distritos de Conservación
Constitution	Constitución
Constraint	Limitación-obstáculo
Construction	Construcción
Consumptive Use	Uso Consumptivo
Contribution	Contribución
Control	Control
Convention	Convención
Cooperative	Cooperativo/a
Correlative Rights	Derechos Correlativos
Cost Benefit	Beneficio Costo
Cost-Effectiveness	Costo Efectividad
Covenants	Convenios, Pactos, Contratos
Criminal Code	Código Penal
Cubic Feet	Pies Cúbicos
Current Meter	Metro Corriente
Dam	Dique
Decree	Decreto
Defendant	Demandado
Delegation	Delegación
Delivery System	Sistema de Distribución
Delivery of Waters	Reparto de Aguas
Demands	Demandas
Department	Departamento
Depending From	Dependiendo de

Depletion	Depleción
Desalinization	Desalinización
Desecation	Desecación
Development	Desarrollo
Diffused Surface Waters	Aguas Difusas
Direction	Dirección
Discharge	Descarga
Distribution	Distribución
District	Distrito
Diversion	Diversión
Diversion Point	Toma de Aguas
Drain	Drene
Drainage	Drenage
Draw-down Effect, Depressive Effect	Efecto de Depresión
To Drill	Perforar
Drought	Sequía
Due Diligence	Debida Diligencia
Easement	Servidumbre
Edafic Waters	Aguas Edáficas
Efficiency	Eficiencia
Effluent	Efluente
Eminent Domain	Dominio Eminente
Energy	Energía
Entities	Entidades
Environment	Medio Ambiente
Ephemeral Stream	Curso de Agua Temporal
Equitable Apportionment	Distribución Equitable
Erosion	Erosión

Esthetics	Estetica
Estuaries	Estuarios
Evapotranspiration	Evapotranspiración
Expenses	Gastos
Exploitation	Aprovechamiento
Exploration	Exploración
Expropriation	Expropiación
Externalities	Externalidad
Factories	Fabricas
Federal	Federal
Field Turn Out	Boquera
File	Archivo
Finance	Finanzas
Fines	Multas
Fish	Pez
Fisheries	Pesquerías
Fishing	Pesca
Flood	Inundación
Flood Irrigation	Riego por Inundación
Flood Plain	Planicie de Inundación
Forfeiture	Perdida de Derecho
Furrow Irrigation	Riego por Surco
Gaging Station	Estación de Aforo
Gates	Compuertas
To Gauge	Aforar
Geothermal	Geotermal
Gradient Flow	Pendiente de Escurrimiento

Granting of Water Rights	Otorgamiento de Derecho de Agua
Harbor	Puerto
Health	Salud
Hearing	Audiencia
High Seas	Altamar
Humid	Húmedo
Hydraulic Civilizations	Civilizaciónes Hidraúlicas
Hydraulic Energy	Energia Hidraúlica
Hydrograph	Hidrógrafo
Hydrographic Area	Area Hidrográfica
Hydrologic	Hidrológico
Hydrologic Unit	Unidad Hidrológica
Industry	Industria
Infiltration	Infiltración
Inspection	Inspección
Integrated Use	Uso Integrado
Intendant	Intendente
Interbasin Transfers	Transferencia/Transvase de Cuencas
Interdependent	Interdependiente
Interface	Entreface
Interjurisdictional	Interjurisdiccional
Internal Diseconomies	Deseconomías Internas
Internalization	Internalización
International Waters	Aguas Internacionales
Intersectoral	Intersectorial
Interstate Compacts	Pactos Entre Estados
Irrigation	Riego; Irrigacion

Irrigation Canal	Cequia
Irrigation Districts	Distrito de Riego
Irrigated Land	Regadío
Irrigation System	Sistema de Riego
Irrigation Turn	Turno de Irrigacion
Jirga (Local Customary Court)	Corte Local Basada en Costumbres
Judge	Juez
Judicial	Judicial
Juridical Condition	Naturaleza Jurídica
Kanat, Quanat	Kanat
Lagoon	Laguna
Lakes	Lagos
Laws of the Realm	Fueros
Leaching	Lavado de Suelos
Legislative	Legislativo
License	Licencia
Liters per Second	Litros por Segundo
Litigation	Litigio
Lowest Water Mark	Mas Baja Marca de las Aguas
Management	Manejo
Mandamus	Orden que Compele
Marginal - Cost Pricing	Poner el Precio del Agua Segun su Costo Marginal
Market Transfers, Allocations	Transferencias de Mercado/Asignaciones
Measure	Medida
Meteoric Waters	Aguas Meteóricas

Meters per Second	Metros Segundo
Mineral Waters	Aguas Minerales
Minimum Flow	Volumenes Mínimos
Mining	Minando
Moslem	Musulmán
Mutual Water Companies	Mutuales de Agua
Navigable	Navegable
Oil Shale	Aceite de Esquistos
Organization	Organización
Ownership	Propiedad
"Parens Patrae" Doctrine	Pater Potestas/Potestad del Padre
Pareto Optimality	Optimo de Pareto
Payment	Pagos
Percolation	Percolación
Permeability	Pearmeabilidad
Permit	Permiso
Persian Wheel	Noria
Phreatophyte	Freatoficas
Plaintiff	Demandante
Planning	Planeamiento
Police Power	Poder de Policía
Pollution	Polución - Contaminación
Ponds	Pantanos
Pools	Piletas - Estanques
Power Plant	Usina

Precarious Right	Derecho Precario
Preference	Preferencia
Preferences	Preferencias
Prescription	Prescripción
Pressure	Presión
Prevention	Prevención
Primary, Secondary & Tertiary Treatment /	Tratamiento Primario, Secundario y Erciario
Prior	Previa
Priorities	Prioridades
Private - Particular, Exclusive	Privativo/a
Private Waters	Aguas Privadas
Procedures	Procedimientos
Production Function	Función de Produccion
Proofs	Pruebas
Property	Propiedad
Province	Provincia
Public Interest	Interés Público
Public Trust Doctrine	Doctrina de la Custodia Pública
Public Waters	Aguas Públicas
Pumps	Bombas
Pumping Station	Estación de Bombeo
Punishments	Sanciones
Purify	Depurar
Quality	Cualidad, Calidad
Quantity	Cantidad
Railroads	Ferrocarriles

Rain Waters	Aguas de Lluvia
Rates, Fees	Tasas, Contribuciones, Cargas Financieras
Recharge	Recarga
Reclamation	Reclamación
Recreation	Recreación
Recycling	Reciclar
Referred	Referida/o
Regime	Régimen
Registers	Registros
Relation Back	Relación al Pasado
Removal	Remoción
Reservation Doctrine	Doctrina de la Reservación
Reserved Rights	Derechos Reservados
Reserves	Reservas
Resolutions	Resoluciones
Resources Management	Manejo de Recurso
Restrictions	Restricciones, Limitaciones
Return Ditch	Canal de Retorno
Return Flow	Corriente de Retorno
Rights of Way	Servidumbre de Paso
Riparian Rights	Derechos del Ribereño
Riparian System	Sistema de la Riberaneidad
River	Río
Riverline	Línea de Rivera
Riverside	Márgenes
Runoff	Corriente
Rural	Rural

"Safe Acquired Water Rights" "Salvo Derechos de Terceros"

Safe Yield	Producción/Rendimiento que no Perjudica el Elemento Productivo
Salinization	Salinización
Salt	Sal
Salt Balance	Balance de Sal
Salt Water Intrusion	Intrusión de Agua Salada
Salvaged Waters	Aguas Salvadas
Sand	Arena
Sanitation Works	Trabajos de Saneamiento
Saturation	Saturación
Sea	Mar
Seabottom	Fondo del Mar
Seashore	Costa
Secondary Benefits	Beneficios Secundarios
Sectoral	Sectorial
Sediment	Sedimento
Seepage	Percolación, Filtración
Services	Servicios
Servitudes	Servidumbres
Severance	Separacion
Sewage	Desagüe
Sewage Waters	Aguas de Desagüe
Sewers	Desagües
Software Technology, Intermediate Technology	Tecnología Intermedia
Spectrum of Alternatives	Espectro de Alternativas
Spring	Fuente
Sprinkler Irrigation	Riego por Asperción
Standing to Sue	Derecho a Litigar
State	Estado

Statutory Law	Derecho Estatutario
Steam	Vapor
Stock - Cattle	Ganado
Streambed	Lecho de las Aguas
Supervision	Supervision
Subsidy	Subsidio
Supply	Suministro
Surplus Waters	Aguas Sobrantes
Suspension	Suspensión
Taxes	Impuestos
Terms	Términos
Territorial Waters	Aguas Territoriales
Thermal	Termal
Thermal Waters	Aguas Termales
Tides	Mareas
Topics	Tópicos
Transfer	Transferencia
Transmountain Diversion	Transferencia/Transvase a Traves de Montañas
Transnational	Internacional
Transpiration	Transpiracion
Treatment Plant	Planta de Tratamiento
Treaty	Tratado
Trickle Irrigation	Riego por Gotas
Trajectory	Trayectoria
Underground Waters	Aguas Subterráneas
Urbanization	Urbanización
Urban Supply	Abastecimento de Poblaciones

Users (water) Associations	Asociaciones de Usuarios
Value	Valor
Waste	Desperdicios
Waste Waters	Aguas de Desagüe
Water Administration	Administración de Aguas
Water Allotments	Dotaciones de Aguas
Water Board	Junta de Aguas
Watercourse	Curso de Agua
Water Court	Tribunal de Aguas
Water Domain	Propiedad de las Aguas
Water Law	Ley de Aguas
Water Regulation	Regulación de Aguas, Reglamento de Aguas
Water Rights	Derechos de Aguas
Watershed	Cuenca Hídrica
Water Table	Nivel Freatico
Water User	Usuario de Aguas
Water Works (Structures)	Obras Hidraúlicas
Watering Place	Abrevadero
Weather Modification	Modificación de Clima
Well	Pozo
Well (Artesian)	Pozo Artesiano
Well (Ordinary)	Pozo Ordinario
"Without Prejudice of Third Persons"	"Sin Daño de Terceros"

INTERNATIONAL CONFERENCE ON GLOBAL WATER LAW SYSTEMS

Program

Hour	31 August Sunday	1 September Monday	2 September Tuesday	3 September Wednesday	4 September Thursday	5 September Friday	6 September Saturday	7 September Sunday
0900		Registration	PART II - (Cont.) F-French G-Soviet	Tour of Valencia's Water Use and Administration System	PART III - (Cont.) E-French F-Soviet G-North American Discussion	PART IV - (Cont.) E-Transmountain Diversions F-Water Resources Economics G-New Technologies Coffee Break H-Integrated Systems I-Resources Plan. J-Water Legis. K-Code Assistance	PART V - Panel Seminar	Tour From Valencia To Irrigation Project In Western Spain 7-11 (OPTIONAL)
1000		PART I - A-Opening Remarks B-Delineation of Conf. Objective C-Role of Water Law D-Tribunal of Waters	H-North American Coffee Break I-Asia & Australia J-Hindu-Bali K-South American L-Israeli Discussion		Film & Observation: Tribunal of Waters			
1100								
1200					Lunch		Summary & Concluding Remarks	
1300	Registration And Tours of Valencia (Optional)	Luncheon Banquet	Lunch			Lunch	Luncheon Banquet at Hotel Monte Picayo by the Municipality and Deputies	
1400				Lunch at Gandia				
1500		PART II - Substantive Water Law A-Ancient Systems B-Roman/Italian C-Spanish D-Moslem E-United Kingdom	PART III - Organizational Alternatives A-Roman/Italian B-Spanish C-Moslem D-United Kingdom	Cultural Exhibits	PART IV - The Environment & Water Management A-Socio-Cultural B-Agricultural C-Urban/Rural D-Conjunctive Use	Workshops & Discussions		
1600								
1700						Role of IAWL		
1800						IAWL Meeting		
1900								
2000								

ROSTER OF EXPERTS
AND SPEAKERS
FOR THE INTERNATIONAL CONFERENCE
ON GLOBAL WATER LAW SYSTEMS

Sr. VICENTE GINER Abogado Plaza Crespins 1 Valencia 3, Spain	Tribunal of Waters
Dr. GEORGE E. RADOSEVICH Attorney & Water & Environmental Law Specialist Colorado State University Fort Collins, Colorado U.S.A.	North American System
Sr. CARLOS ARRIETA Abogado Secretariat Direccion General de Obras Hidraulicas Ministerio de Obras Publicas Nuevos Ministerios Madrid, Spain	Spanish Water Law System and Conjunctive Use of Ground and Surface Water
Dr. VLADIMIR BAUM Director Resources and Transport Division United Nations New York, New York U.S.A.	The Role of Bi-lateral & Multi-lateral Agencies in Providing Assistance in Revision & Preparation of Nat'l Water Codes & Implementing Organizations
Dr. ASIT BISWAS Director Environmental Systems Branch Planning and Finance Environment Canada Ottawa, Canada KIA OH3	Integrated Water Systems: Engineering, Legal & Socio-Economic Parameters
Dr. STEPHEN BURCHI Water Law Specialist Rome, Italy	Modern Italian System
Dr. GUILLERMO J. CANO President International Association for Water Law calle Arenales 2040 7-B Buenos Aires, Argentina	The Historical Evolution & Role of Water Law in Administration & Developing & Managing a Nation's Water Resources

Dr. J. M. MARTIN MENDILUCE Director Center for Hydrographic Studies Paseo Bajo del la Virgen del Puerto 3 Madrid, Spain	Transmountain Diversions and the Law of Water: Technical Considerations
Dr. K. C. NOBE Chairman Department of Economics Colorado State University Fort Collins, Colorado U.S.A.	Water Resources Economics, Externalities, and Income Redistribution Through Water Reallocation and the Law
H. J. RICHARDSON Assistant Solicitor Department of Environment 2 Marsham Street London SW1, Great Britain	United Kingdom System
Prof. GAYLORD V. SKOGERBOE Department of Agricultural Engineering Colorado State University Fort Collins, Colorado U.S.A.	Agricultural Practices Affected by Water Law, Particularly On-Farm Water Management & the Effects of Water Laws Upon the Design & Operation of Irrigation & Drainage Systems
Mrs. ORA TAMIR Legal Advisor Water Commission Ministry of Agriculture 12 D St Hakiria Talaviv POB 7043, Israel	Israeli System
Dr. FRANK J. TRELEASE Professor of Law College of Law University of Wyoming Laramie, Wyoming U.S.A.	New Water Legislation
Prof. STAVROS A. TRIANTAFYLLIDIS Honorary Director General of Public Works 8 Rethymnou Athens (147), Greece	Effects of Water Laws on the Design & Operation of Urban Water Supply and Wastewater Systems

Dr. DANTE CAPONERA Chief Legislative Branch F.A.O. Rome, Italy	Ancient Roman Systems
Dr. SANFORD CLARK Professor of Law University of Melbourne Parkville, Australia	Southeast Asia & Australian Systems
Dr. DAVID R. DAINES Attorney & Water Law Specialist Utah State University Logan, Utah U.S.A.	North American Systems
Dr. MICHEL DESPAX Professeur a l'Universite des Sciences Sociales de Toulouse I 186, av. de Muret (31300 - Toulouse) France	French System
Dr. LUCIEN DUCKSTEIN Professor Systems & Industrial Engineering & Hydrology & Water Resources University of Arizona Tucson, Arizona U.S.A.	The Role of New Technologies for Improved Water Management & Related Effects on Water Law Systems
Dr. OLEG S. KOLBASOV Director, Institute of State and Law U.S.S.R. Academy of Sciences Moscow, U.S.S.R.	Soviet System
Dr. JOAQUIN LOPEZ Profesor de Leyes Universidad de Mendoza Mendoza, Argentina	Hispano-Latin American Systems
Dr. A. M. A. MAKTARI Professor of Law P. O. Box 111 Sana'a, Yemen Arab Republic	Moslem (Islamic) System

Dr. EVAN VLACHOS
Professor of Sociology
Department of Sociology
Colorado State University
Fort Collins, Colorado
U.S.A.

Culture & Water Law in Humid & Arid Environments & the Societal Implications & Cultural Consequences of Water Laws & Improved Water Management

Mr. BERNARD WOHLWEND
Legal Officer
F.A.O.
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Hindu-Bali System

ABSTRACTS

EL TRIBUNAL DE LAS AGUAS DE VALENCIA Y SU PROCESO

by Victor Fairen Guillen*

The report begins with the ordinated enumeration of the sources of the Law of the Tribunal of Waters of Valencia and its procedures. The sources extend from the Law of the Organic Bases of the justice, of November 28, 1974 (Bose 2-12); through the decree of April 5, 1932, to the privileges granted by the Kings of Aragon Jaime I and Jaime II. Among the latter, the most relevant are, without forgetting the precedents before the reconquest of the City of Valencia from the Moors, the one of 1250, granting express jurisdiction to the Tribunal, and the ones of 1318 and 1326, in which the King made a clear distinction among the jurisdiction of the Tribunal and other jurisdictions.

The Tribunal is constituted of the Syndics (Presidents) of the eight communities of irrigators which integrate the "Vega of Valencia." These communities are TORMOS, MESTALLA, RASCANA, CUART, BENACHER and FAINTANAR, MISLATA, FAVARA and ROVELLA. The syndics are elected by the members of the communities they represent, and remain in office two or three years. The Tribunal has administrative attributes as director of the Syndicate of Waters of la Vega of Valencia, but we are interested here about its jurisdictional attributes.

Each community has its own Ordinances, most of them dating from the XVIII and XIX centuries. The Ordinances are the material law used by the Tribunal to pronounce sentence. The procedural law has been constituted by the Tribunal through customary practices. The jurisdiction of the Tribunal and its procedures can be extended, as established by its Ordinances, to third persons even when not members of a community (user). It shows that the Ordinances are not"simple covenants among communities members," but, approved by the King in almost all cases. They are obligatory for all persons perpetrating infractions in the terrains of each community, regardless of the condition of water user. It is a case of a truly special jurisdiction.

The procedure before the Tribunal (which meets publicly each Thursday of the year at the Apostols Gates of the Cathedral of Valencia) is very simple and economical, even in the cases of grave infractions of difficult solution.

The procedures begin with a preliminary investigation when the Syndic/Judge of one of the eight communities knows of an infraction. He initiates a preliminary oral investigation, in which the "visura," or view of the place in which the infractions have been perpetrated, is very important.

The Syndic orders the Guard to summon the affected persons to appear before the Water Tribunal on the next Thursday, at noon, and informs the Tribunal on his findings.

* Catedratico de Derecho procesal en la Universidad de Valencia.

The proceedings are always oral, in the particular dialect of Valencia. They begin with the exposition of the accusations made by the Guard of the Acequia (who performs a role quite like of a Public Attorney), or by the particular accuser.

The accused responds, also orally (the intervention of attorneys or procurators is not admitted),and both parties offer proofs, which are orally produced during the session, without being recorded in any record of the proceedings. The proceedings are suspended only for witness who have not been brought before the Tribunal by the interested party or when the Tribunal has to order a view. The proceedings are suspended until the next Thursday. The cases of suspension are very rare. After the proof has been produced under the Direction of the President or the Vicepresident of the Tribunal, who can also interrogate the parties, the witnesses and the experts. The Tribunal discusses in "low voice" but in public, when a decision is reached. The verdict is pronounced by the President in loud voice. A brief of the sentence is recorded, in writing, by the Secretary of the Tribunal as soon as the proceedings are finished. One duplicate of the sentence is filed, and the other is given to the representative of the interested Community, who must execute the verdict. The Secretary does not actively participate in the proceedings.

The Syndic Judge of the interested Community is present at the proceedings of the Tribunal but he does not have voice or vote.

This Syndic must execute the sentence. The forced execution of the sentences is a very rare event. Usually the parties execute them voluntarily due to the high "autorictas" or respect in the Roman sense, of the Tribunal.

The sentence, in the cases of forced executions, is executive title. The execution can be carried out in two manners:

a) suspending the water supply to the condemned until compliance of the sentence;

2) confiscating goods of the condemned and selling them in public auction, using the produced to pay the amount of the verdict.

It must be repeated, however, that forced execution is very rare, because usually the sentences are voluntarily complied.

There is no appeal against the verdict of the Tribunal. The costs of each law suit are very low. They are limited to the payment of the summons made by the Guards (first and second, which are oral) and by the Bailiff (the third, which is written and compels the accused to appear before the Tribunal, or to be judged by default). The proceedings of the Tribunal correspond to the modern procedural principles of "adequateness" and "practicability," or "utility" of the proceedings, without superfluous formalisms which extend and raise the costs of the law suits.

The procedures also follow the modern principles of orality, concentration, contiguity, general publicity before all the people, without limitation of space because they are carried out in an open place--and "reasonable term"

for their finalization. The procedures with preliminary investigation and forced execution take less than one month; the oral proceedings take only a few mintues, except for complicated cases.

We have verified the excellence of the system in connection with the most modern procedural doctrines, and for this reason we believe that it constitutes the most adequate type, not only to solve problems of irrigation or industrial waters, but also as a world-wide model to solve all classes of non-criminal conflicts.

Comienza el Trabajo, con la enumeración ordenada de las fuentes de Derecho del Tribunal de las Aguas de Valencia y de su proceso; desde la Ley de Bases Orgánica de la Justicia de 28 de Noviembre de 1974 (Base 2-12), pasando por el Decreto de 5 de Abril de 1932, hasta remontarse a los Privilegios otorgados por los Reyes de Aragon, Jaime I y Jaime II, de los que destaca-n (sin olvidar precedentes anteriores a la reconquista de la ciudad de Valencia a los moros) el de 1250, por el que claramente se atribuye jurisdicción a dicho Tribunal, y los de 1318 y 1326, por los que el Rey diferenciaba claramente a esta jurisdicción, de las demás.

El Tribunal, está constituído por los Síndicos de las ocho Comunidades de Rega-ntes que integran la "Vega de Valencia": las de Tormos, Mestalla, Rascaña, Cuart, Benacher y Faitanar, Mislata, Favara y Rovella, elegidos por los comuneros por plazos de dos o tres años, por votación. Tiene actuación administrativa, como director que es el Sindicato de Aguas de la Vega de Valencia, pero las que nos interesan aquí, son sus atribuciones jurisdiccionales.

Cada una de las Comunidades, tiene sus propias Ordenanzas casi todas, de los Siglos XVIII y XIX', las cuales constituyen el Derecho material que sirve al Tribunal para dictar sus sentencias; en Cuanto al ordenamiento procesal, lo ha construido el propio Tribunal , de modo consuetudinario.

Tiene este Tribunal y tiene su proceso, la particularidad importante, de que, segun sus Ordenanzas, su jurisdicción puede extenderse a personas que no sean comuneros, sino terceras personas; lo cual indica que estas Ordenanzas no son "simples pactos entre los comuneros," sino que, aprobadas por la autoridad real en casi todos los casos, obligan a todos aquellos que cometieren infracciones en terrenos de cada Comunidad, sean o no comuneros. Se trata, en resumen, de una verdadera jurisdicción especial.

El proceso que ante este Tribunal se desarrolla (reunido cada jueves del año, en plena vía pública, a la Puerta de los Apóstoles

de la Catedral de Valencia), es muy sencillo y económico, aunque las infracciones sean en ocasiones graves y difíciles de aclarar.

Comienza por una instrucción: cuando el Síndico-Juez de una de las ocho Comunidades, conoce de una fraccion a través de una denuncia, practica una investigacion preliminar oral, en la que tiene gran importancia la "visura" o inspeccion ocular de los lugares en que han ocurrido los hechos denunciados.

El Síndico, ordena al Guarda que cite a los Interesados a comparecer ante el Tribunal de las Aguas el jueves siguiente, a mediodía, y da cuenta al Tribunal de su investigación.

Todos los jueves, el Tribunal se constituye a dicha hora.

Comienza el juicio, siempre oral, y desarrollado en valenciano, por la exposición de la denuncia, hecha por el Guarda de la Acequia (que viene a representar un papel muy parecido al del Ministerio Publico) o por el denunciante particular.

Contesta, tambien oralmente, el denunciado (no se admite la intervencion de abogados ni de procuradores), y ambas partes, en su caso, proponen prueba, la cual tambien se practica en el acto, y oralmente, sin reflejarse en acta alguna (tan solo cuando se trata de una prueba testifical y la parte interesada no ha traido a sus testigos, o de una "visura" a efectuar por el propio Tribunal, se suspende el juicio hasta el jueves próximo; y ello ocurre muy raras veces).

Practicada la prueba -siempre dirigida por el Presidente o por el Vicepresidente del Tribunal, que puede interrogar a las partes, testigos y peritos- el Tribunal delibera "en voz baja" y en público; y el Presidente, profiere el fallo en alta voz.

La sentencia, se protocoliza en resumen, por escrito, en la Secretaría del Tribunal, apenas terminado el juicio (el Secretario, no asiste a él), y un duplicado de la misma se archiva, entregándose el otro ejemplar al representante de la Comunidad interesada para que proceda a la ejecución.

Durante el desarrollo del juicio, el Síndico-juez de la Comunidad interesada en concreto, se halla en el seno del Tribunal; pero sin voz ni voto.

Corresponde a dicho Síndico la ejecución forzosa de las sentencias (a la cual se llega en muy rara ocasiones, ya que las partes se someten voluntaria-mente a las mismas; y ello ocurre por la alta "auctoritas" -en sentido romano- del Tribunal).

La sentencia, en caso de haberse de ejecutar de modo forzoso, es el título ejecutivo. Y la ejecución, puede seguir dos vías:

1ª) la de "quitar el agua al condenado" hasta que no la cumpla; institución que tiene semejanza con la "sequestration" anglo-sajona.

2ª) Proceder a embargar bienes-y a venderlos en pública subasta-del condenado, para hacer pago del importe de la sentencia.

Se repite, la ejecucion forzosa es rarísima, por someterse voluntariamente las partes a las sentencias del Tribunal.

Contra tales sentencias, no cabe recurso alguno.

Las costas de cada juicio, son muy bajas; se limitan al pago de las citaciones efectuadas por los Guardas (primera y segunda, tambien orales) y por el Alguacil (la tercera, por escrito, conminando al denunciando que, de no comparecer ante el Tribunal, será juzgado en rebeldía).

Este proceso, responde al moderno sistema de principios procesales que nos llevan a los de "adecuación" y de "practicabilidad," o sea de "utilidad" del mismo, prescindiendo de formalismos superfluos que lo alarguen o encarezcan.

Responde a los principios modernos -anhelo compartido por la doctrina procesal de todo el mundo- de oralidad, concentración, inmediacion, publicidad general -ante todo el pueblo, sin limitación de locales, pues se desarrolla en la via pública- y "plazo razonable" para su finalización (que su duración, contando con la instrucción y la ejecución forzosa, si ha lugar, no llega a un mes; y el juicio oral, tiene tan solo unos minutos de duración, salvo casos complicados).

Hemos comprobado la bondad de este proceso poniéndolo en contacto con la doctrina procesal más moderna; y por ello, entendemos constituir el tipo más adecuado, no solamente para resolver conflictos de aguas de irrigación agrícola o industrial, sino que también tiene posibilidad de llegar a constituir un modelo mundial para resolver otra clase de conflictos no penales.

SPAIN'S LEGAL WATER ORDINANCE SYSTEM

SUMMARY

by Carlos C. Arrieta*

The introduction of the study describes the orographic, climatic and publiometric characteristics of Spain, and the distribution of the river discharges in the Mediterranean and Atlantic basin. The production and demand of the various uses of supplies, irrigations, hydroelectric energy are also described, and the work carried out to obtain the large hydraulic works to meet the economic and social development needs, and correct the hydrographic off-balance.

The current legislation is then analysed, essentially contained in the Civil Code and Law on Waters, with an express mention of complementary legislation that has been passed to this effect.

The problem of the legal nature of water is discussed, based on the public and private distinction, and the juridicial classification established by Law for waters.

The common uses of the special and the eventual waters are distinguished regarding water uses and rights, indicating their original title depending on whether this is a concession or purchasing prescription.

The order of priorities in the enjoyment of the waters is subject to a special study, analysing each of them according to the classification established by Law.

The promotion work is discussed in its various facets: defense works, drying of lakes and natural and artificial variations of basins and currents.

In its various reglamentary aspects: health and hygiene and water protection, the water and river policy is studied according to the special legislation that has been passed for this purpose.

In view of the special nature of the underground waters, an exegesis of the problem is made, relating it to the general texts and by-laws and those especially ruled for specific regions in the land. Mining legislation is also considered due to its relationship with these kinds of waters.

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*Lawyer, Secretary, General Direction of Hydraulic Waterworks, Ministry of Public Works, Madrid, Spain

Legislation on the control and protection of installations and hydraulic works is analysed in detail, from a constructive point of view and as regards future and permanent inspection.

The same analysis is made regarding legislation for protected areas or zones, from an operative and an institutional point of view.

The organic, central and regional structure is studied in detail regarding the administration's organization of the waters, on the basis of the State Institution represented by the Ministry of Public Works, General Hydraulic Works Board, Water Commissions and Hydrographic Confederations.

As autonomous organisms, the Hydrographic Confederations are subject to a special study, analysing the functional content of their governing boards, Government Delegate, General Assembly and Government Board, and also their internal organizations, the Commissions on Dams, Exploitation Boards and Works Boards.

The functional organization carried out by the International Commissions for a developed use of the border rivers is also studied.

Special attention is also paid to the legislation on economic and financial aspects of water resources, whether the works are executed exclusively by the State or by the State but with the help of the parties concerned. The amortization procedures of the works applying the fiscal legislation of Taxes, royalties and irrigation tariffs should also be mentioned, and the State subsidies and aid.

The Irrigants' Communities are special organisms of an autonomous nature for water development uses. These institutions are deeply embedded in Spain's tradition, with their own sovereign faculties in a legislative, executive and legal sense. Their various general communities are studied, Central Syndicates and Users Communities with their corresponding classifications.

The Public Waters Developments Register, and the scope and legal content of same is treated with special interest in the declaration of water development use rights.

The Administration's scope and jurisdiction regarding public and private waters are analysed thoroughly, and also the Administration's faculties regarding the protection and best use made of the waters.

Finally, the study contains a critical examination of current legislation, and the need to confront a reform. It accordingly sets out certain basic principals or criteria on this matter.

THE FRENCH WATER LAW

Plan and summing up of the report presented by Michel Despax, professor of the University of Law and Economic Science (University of Social Science of Toulousse).

I

WATER STATUTE

SECTION I: Water classification

SECTION II: Water rights

A - Non-patrimonial water

1st - The appropriation of non-running water

2nd - The use of running water

B - Patrimonial water

SECTION III: The juridical protection of water: the fight against contamination.

A - About the penal plan

B - Preventive laws

II

The administration of water

SECTION I: The Ministries concerned

SECTION II: Financial river-basin agencies.

THE FRENCH WATER LAW

It is formed by legislative contributions and successive rules, and it is of a relative complexity.

Certain dispositions among the most ancient, have been inserted in the civil code which dates back to 1804. The rural code contains, in the same way, very important dispositions on the matter and they have been inserted in the articles 97 and ss in the same manner and in article 103 and the successive ones. The law of 16th December, 1964 about the regime and distribution of water and the fight against contamination has been renewed profoundly, in modern times in the French water law, without having abolished the anterior texts. This law marks a very important stage in an avolution where an individualistic juridical regime has given its place up little by little, partially, to a collective economic negotiation system of water resources. The water status I has been greatly modified, to such a point that it seems necessary in our days, to create and impose a real water administration.(II)

I

THE WATER STATUTE

A study of the water statute in France, obliges it to be given, in the first place, the information which refers to water classification (section I), after defining the water rights well (section II) before the juridical water protection system against contamination is described (section III)

SECTION I WATER CLASSIFICATION

The fundamental distinction still remains maintaining a classical division between non-patrimonial water and patri-

monial water, or it may be preferred, that on one part, the appropriation and private use regime, and on the other part, the appropriation and public use regime of water which belongs to the public dominion of the state or the councils.

Patrimonial water.- Up to the moment of the law of December 16th, 1964, the water of the state's public dominion was essentially constituted by the tributaries, navigable or floatable rivers. These water courses were determined by decrees and the public dominion depended essentially on the notion of navigability or floatability. Article 28 and ss, of the law of 16th December, 1964, had to abandon the material criterion of navigability or floatability to found the public dominion of the water courses on a formal concept, taken from the classification operation. Then, as before, this modification of our positive right, the essential characteristic of the fluvial public dominion, is constituted by the water of the navigable or floatable water courses, by the water of the tributaries and more important rivers, for their flow and the length of their course. We shall also observe that the law of 16th December has introduced a distinction which is unknown up to the moment, as a positive right; articles 35 and 39 of the mentioned law of 16th December 1964, establish mixed "water courses"; this is really a category of intermediate water courses between the patrimonial water courses which form part of the public dominion and the non-patrimonial water courses. They are water courses to which the right of water use belongs to the riverians. With regard to the non-patrimonial water which can constitute an appropriation or a private use, they are those water courses which have not been classified as patrimonial water courses or as mixed water courses and also non-running water "stagnant water", spring-water, subterranean water, which has been traditionally in

positive right considered as a complement of private property.

SECTION II WATER RIGHTS

The nature of the rights which can be practised on water is evidently in function of the juridical qualification of the mentioned water. Once again, we come across the fundamental distinction, anteriorly evoked of non-patrimonial and patrimonial water.

As we are referring to non-patrimonial water, the French law, admits in a traditional manner, the appropriation of non-running water. According to the terms of article 641 of the civil code "every proprietor has the right of using and disposing of rain water which falls on his fund" and in virtue of article 642 "he who has a water-spring on his fund, can always take as much water as he wishes." The practise of the proprietor's right cannot come to an abuse in any way; the code points out that the proprietor of a water spring, cannot use it any more than in the limits and for the necessities of his property (article 642). On the other hand,he cannot use it in the way of taking from the inhabitants of a council or town or village, the water which they need (article 642, 3rd paragraph apart.) The same article 643 of the civil code, makes even more precise that "if the spring-water forms a water course from its starting point, which has the characteristics of public running-water, the proprietor cannot detract it from its natural course, thus harming the inferior users. In the same way, with reference to subterranean water, if the proprietor of the land has, by applying article 552 of the civil code, the right of appropriating himself, because of the rising, of the water which is of any use to him, (without being so, it is

necessary to make him figure as proprietor of the water-proof layer), he is bound to let the administration know and to put it under vigilancy, according to the conditions defined by the decree of the state counsel.

With regard to the running-water of the non-patrimonial water courses, this water is in the French traditional juridical conception, something which is common. First of all, they are closed to private appropriation. While the channels for non-patrimonial water courses belong to the proprietors of the two sides, (article 90 of the rural code), the riverians have only, by application of article 644 of the civil code, one right which they can use of the same. This right does not only include uses like drawing out, watering animals or sailing, but according to the jurisdiction, it also includes the industrial use. First, the riverians have no right on water from the non-patrimonial water courses. For them, the use of water, reduces itself to the possibility (excepting the riverian's opposition.) of taking out water, of bathing, of washing clothes, of watering animals and of sailing.

The use of non-patrimonial running-water must be done in the conciliation of the diverse interests present, whether they are the riverians' interests or general interests. Article 644. paragraph apart of the civil code disposes that "he whose property is crossed by water, can use it during the course of the same in his property, but binding himself to give it back, when it leaves his property, to its ordinary course.

In order to conciliate the existing interests, it may be necessary to elaborate rules or orders on water usage. Article 645 of the CC bestows the ordinary tribunals with an authority to rule everything which is really exceptional, to establish rules,

or juridical water orders. The objective of these rules is to conciliate the interests of the different proprietors (or users) riverians.

The limits of the right of use of the riverians also result, and above all the police power (for water) who are given the administrative authority. Article 97 of the rural code points out in effect that "the riverians do not have the right to use running-water which borders or crosses their property, but in the limits determined by the law. They are bound to adjust themselves, in the practice of this right, to the dispositions and rules and the authorisations emanated or conferred by the administration. This administrative police carried out essentially, all the actions which are susceptible to reduce the volume of the water available, to modify the flow of the course of water of its characteristics (article 103 to 111 of the rural code.)

You will notice finally that the right of use of one part of the water can be taken out by the riverians. We find ourselves before such a situation as to the continuation of declared works of public use or which have to regulate or increase the flow of the water course, a supplementary course called "affected flow" it is detracted and its right of use belongs to the state. The riverians can therefore, only practise their rights on the natural flow of the so-called "reserved flow" (article 26 of the law of December 16th, 1964, article 97-1st of the rural code). This relatively recent disposition has not been applied very often up until now.

With reference to patrimonial water, it is clearly the property of the state and of private communities, but is is of a special property called "affectation property". They are meant

to be used collectively by the public, in the same way as public roads, tracks etc. This use can be granted for navigation, without being necessary to apply for autherisation beforehand or to pay taxes, individuals can take some of that water or bathe. However, if it is for private use, especially when an individual wants to take out water through the channel of a dam, such utilization or use would not be legal unless the individual had previously applied for and obtained autherisation, and paid a tax while he was using the water.

SECTION III The juridical protection of water: the fight against contamination.

The juridical water protection; the fight against contamination.

The legislator was not totally unaware, in the past of the danger of the contamination of water, but it is now in the modern era when he is really worried.

Two classes of rules, one preventive, the other repressive, contribute to the protection of water against contamination.

In repressive matter, the basical text is article 434-1 of the rural code in virtue of which: anybody who has thrown, spilt or dropped any substance into the direct or indirect course of the water, whose action or reaction has destroyed fish or endangered their nutrition, reproduction of food value, will be santioned with a fine of 500 to 5,000 francs plus imprisonment from 10 days to 1 year or with only one of these punishments." This text has been the object in jurisprudence, of numerour applications; chemical contamination, but also "mechanical"contamination and thermal contamination, are equally sanctioned by the tribunals. The death of fish is not necessary in order that this repressive text may be applied. There

are sufficient motives if the reproduction of fish has been endangered or disturbed, or if its food value (like food on the market) is inferior because of the contamination.

The law of 16th December, 1964 and its application texts, give public authority, sufficient weapons to stop contamination. The decree of 26th February, 1973 rules pouring or throwing, direct or indirect deposits of water or any material could alter the quality of the water. These pourings are put under autherisation. The interministerial resolutions of 13th May, 1975, have ruled the technical conditions to which the pouring, casting, spilling, or deposits, have to be subordinated, according to the application of the decree of 23rd February, 1973.

II
THE WATER ADMINISTRATION

A real water law cannot be defined and practised but for the intervention of a specialized administration. Keeping in mind the importance that the negotiation problems have gone through in the modern era, and the guarantee of its quality, it would have been opportune to create a specialized ministry with its own authority. The weight of the administrative traditions and the multiplication of interests in game has led the legislator to adopt a different solution, at least at a national level. At the river-basin level, the law of 16th December, 1964, has in effect, very opportunely allowed specialized institutions with their own authority, to be set up.

SECTION I: The national plan: The ministries concerned.

The competent ministerial water authorities in water matters are very numerous. The ministry of agriculture, the ministry of housing, the ministry of public health, the ministry of

industrial and scientific development, the Home office, all practise under different titles, competencies in water matters. Before concentrating the unattached attributions under only one authority, the government authorities have orientated themselves towards an inter-ministerial co-ordination, carried out at present by "the ministry of the quality of life". (It was in 1971, when the first ministry for protection of nature and environment was created, and was transformed in 1974 to the "ministry of the quality of life".)

The essential decisions are made by the inter-ministerial committee of enviromnent or "inter-ministerial action committee for nature and environment," which have been prepared by a series of specialized organisms which are the central step "the inter-ministerial water mission and the permanent secretariate for the study of water problems." A national water committee whose creation has been imposed by the 15th article of the law of 16th December, 1964, plays the role of an advisory organism. Its mission is to give its opinion on all matters which become object of the 1964 law.

SECTION II At the river-basin level = Financial river-basin agencies. The law of 16th December, 1964, has kept in mind, on the judicial and administrative plan, the unity of the hydrographical river-basin and of the solidarity of its users, who until then, had practically not been taken into consider-ation on the juridical and administrative plan. A resolution dated 14th September, 1966, has divided France into six river-basins according to the line of water division.

-Bassin Artois Ricardie
-Bassin - Rhin-Meuse
-Bassin-Seine-Normandie
-Bassin-Rhone-Med-Corse
-Bassin Loire-Bretagne
-Bassin Adour-Garonne

Each one of these river-basins has been gifted with their own organisms (River-basin committee, delegated river, basin-mission, technical water committee, etc.....)

The 14th article of the law of 16th December, 1964, has previewed the creation of a financial agency at the level of each river-basin or group of river-basins. The financial agencies are organised under the form of public administrative state establishment.

The administration of the agency is entrusted to an administrator counsel (which is composed of sixteen representative state members, representatives of the local communities and representatives of the different categories of users, in the number of 8, of 4 and of 4, respectively.

In the terms of the 9th article of the decree of 14th Septembr 1966, "the administration council rules, deliberately, the matters of the agency; the director of the agency who is in charge of the set up services and the negotiation of personnel, is named by resolution of the Ministry of the quality of life.

The agancy's objective is to act diversely on the river-basin's common interests, in view of ensuring the equilibrium of the resources and water necessities, to reach the quality objectives fixed by the rules, and to improve and increase the water resources of which the users can dispose. This contributes to the carrying out of all the work, the construction or exploitation of all the work which comes into thi s objective. It plays the double role of study engineer and public water bank, the financial river-basin agency has the authority of establishing and to perceive a tax on public or private persons (14th article of the law of 16th December, 1964). These taxes can be claimed on private or public persons (private

contaminators or municipalities which do not purify the tributaries before rejecting them in the natural means) who intervene in the necessary or useful agency, because they contribute to the deterioration of the quality of water (contamination census, or because they extract from the water resource (extraction or consumption tax; or because they modify the water regime in every part of the river-basin. The taxes can equally be claimed on public or private persons who benefit from the work or building carried out in the course of the agency. The administration counsel of the agency fixes the limits under which there is no tax, and establishes the r rules to be applied in what concerns the collecting of the mentioned taxes when they are due by the users. The ready-reckoners and all the deliberations relative to the registry of the taxes are subdued, by accepted notice, to the river-basin committees according to the 14th article of the law of 16th December, 1964. The river-basin committee is composed in equal parts by representatives of the different categories of users and competent persons, the representatives who are appointed by the local communities and, finally, by the administration representatives. It is a kind of a small water parliament, whose role together with that of the financial river-basin agency, is essential when applying the law of 16th December, 1964.

WATER LAW AND ADMINISTRATION IN THE UNITED STATES OF AMERICA

Dr. George E. Radosevich*
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ABSTRACT

Water law in the United States is a federated system of complex proportions. Federal (national) and state water laws exist in both the water quantity and quality aspects of this resource. At the federal level, jurisdiction over water originates with the Constitution. The Property, Commerce, General Welfare, Treaty and Compact Clauses provide the basis for federal involvement in navigation, pollution abatement and allocation and management of water resources. Particular laws have been enacted to provide the substantive control and organizational structures to carry out federal policies and programs.

State water laws are less cognizant of the hydrologic aspects of water resources. Each state, being an autonomous political entity has rights to develop policies, laws and organizations according to local and state needs. Thus, there are virtually 50 separate water law systems for quantity and quality control, often with the lack of uniformity between states causing interstate conflicts. The states are primarily concerned with methods of allocation, distribution and administration of ground and surface waters given the particular and wide range of geographical conditions in the county.

The past 10 years has witnessed the emergence of federal involvement from water development to management in the national and regional interests. Population shifts in a mobile society, industrialization, energy development, increased needs for food and fiber, conflicts and complementarities of water use with the interface of economic sectors, and new technologies have brought about this involvement.

States, faced with the same issues at a more concentrated and grass roots level have likewise been experiencing a significant evolution in their quantity and quality control laws with an emphasis upon developing planning and management capabilities to make conscious decisions based upon an evaluation of alternatives, impacts and opportunity costs.

The water law systems in the United States are in a dynamic and evolutionary process brought about by changing conditions, and can constantly benefit by an awareness of experiences in any nation.

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THE ASIAN REGION

by

Sandford D. Clark*

SYNOPSIS

Water legislation in Asia has been profoundly influenced by Common Law, Civilian and Roman-Dutch models. There is thus great diversity in the theoretical bases for water administration, but a common pattern of relying on administrative bodies to allocate and adjust private rights to use water. In this sense, systems of judicial apportionment of rights, through litigation, are most uncommon.

There is remarkable similarity in the techniques used for granting and controlling rights to water, although the primary emphasis of the legislative schemes naturally differs with the hydrological problems encountered. There is increasing reliance on techniques of multi-objective planning, but care must be taken in adapting systems of environmental planning to the different economic and social goals of developing countries.

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LA REGION ASIATICA

por Dr. Sanford Clark*

RESUMEN

El Derecho de Aguas de Asia ha sido profundamente influenciado por el Dreecho Inglés, por los modelos continentalistas de Derecho Civil y por el sistema Romano - Holandés.

Existe una grandiversidad de bases teoréticas para administración de aguas, pero hay una norma general de asignar y acomodar derechos privados al uso de las aguas, a través de cuerpos administrativos. Los sistemas judiciales de asignación de derechos de aguas a través de litigación son poco comunes.

Existe una marcada similitud en los sistemas para otorgar y controlar derechos de agua, aún cuando el énfasis primario de los sistemas de administración varía con los problemas hidrológicos que se encuentran. Existe un uso creciente de técnicas de planeamiento multiobjetivo, pero debe tormarse cuidado de adaptar los sistemas de planeamiento ambiental a los diferentes objetivos económicos y sociales de los países en desarrollo.

Las limitaciones al uso racional de las aguas provienen frecuentemente, no de la legislación hídrica, pero de otras leyes, a veces previsiones constitucionales con consecuencias imprevistas.

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HINDU WATER LAW AND ADMINISTRATION IN BALI

by Bernard J. Wolwend*

ABSTRACT

FOREWARD

A study of water law and administration in Bali presents several interesting features. Formerly a part of the Hindu Empire, this island of South-east Asia remains the only human settlement outside the Indian sub-continent where the immemorial Hindu tradition still constitutes for its people the essential, and only norm of life. As a result, her water management and practices, as all other activities, proceed directly from an established doctrine which these can, to the extent of their own practical limits, be said to reflect adequately.

Whereas India has been the arbour of one among the greatest hydraulic civilizations of the present world, the geophysical configuration of Bali has not required the development of large waterworks or structures. Her irrigated agriculture is however carefully organized within well defined hydrological units, called Subak, which still operate today almost unaltered after more than seventeen centuries. It is thus the structure and functioning of the Subak which constitutes the limited objective of this study which does not purport to investigate Hindu water law and administration in its entirety although such an ambitious task would certainly prove most enlightening.

The Subak "system", as it will be called for the purpose of the present study, should however not be looked upon in isolation since it has in fact constituted the traditional water management technique in all major islands of the Indonesian archipelago, and in particular in Java, even after Buddhism had become the established doctrine in the Javanese Empire.

Whereas Buddhism was not to modify the conceptual nor the operational framework of the Subak system, the subsequent Islamization of Indonesia produced considerable modifications in existing government administration structures and caused the Subak system to be abandoned, except in Bali, in favour of an administrative irrigation unit at the village level. It should however be emphasized in this connection that such a change originated almost essentially from government administration imperatives and not from a new conceptual approach towards water management which, in the Moslem tradition, is not fundamentally different from corresponding Hindu concepts.

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As in the cases of Buddhism and Islam, neither did Christianism brought along with the Dutch colonization of Indonesia penetrate Bali. Western legal concepts became however established elsewhere and in Java in particular. As a result, the existing conceptual and administrative framework of water management was replaced by a west-European system implemented through written laws. It is to be recognized, though, that the water legislation of the Netherland Indies did institutionalize a number of existing local institutions and left a large place to local customary law.

Following World War II, the Subak system of Bali was progressively revived in Java where it later became institutionalized under Indonesian law into two types of irrigation units with a varying degree of government integration. Finally, the Bali Subak itself has now become administratively integrated as well into the Indonesian water law system, although its conceptual framework has remained essentially the same.

Whatever interest the student of water law may find in the Subak water management system of Bali, it nevertheless appears that its integration into the legal framework of Moslem Indonesia, itself based exclusively on Hukum adat, or Indonesian customary law, deserves no less attention. It would indeed prove of considerable interest to consider how a nation composed of over 13,000 islands located between South-east Asia and Australia, stretching from the Malayan Peninsula to New Guinea, and made of an aggregate of people of different creed and traditions may be able to conciliate unity with such a diversity and technological development with the respect of her traditional heritage.

The answer to the first question is provided by the Indonesian national motto "Unity in Diversity", itself finding its fundamental root in the Constitution which, although the people of the Republic of Indonesia are of a large Moslem majority, has not established an Islamic State but the principle of the belief in one, Supreme God,[1] or one expression of a fundamental principle present in all traditional doctrines, be they Hindu, Buddhist, Christian, Moslem or else. As to the second question, suffice it to quote the statement made by Prime Minister Malik before the 1974 Conference of Islamic Foreign Ministers at Kuala Lumpur: "Religion without development is static; but development without religion is aimless".

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[1] Constitution of the Republic of Indonesia, art. 29(1)

WATER LAW AND WATER ADMINISTRATION

IN LATIN AMERICA

by Dr. Joaquin Lopez*

RESUME

INTRODUCTION

The countries of America which were colonized by Spain and Portugal have a system of water law with particular features. The juridical regulations of these countries have similarity of principles, norms, institutions, origins and customary uses respect waters. The system was influenced by the colonial legislation, the metropolitan legislation, the Civil Code of France and the Constitution of the United States. The Laws for Indias, the Laws of the "Siete Partidas" and the Spanish water law of 1866 were also influential. In Brazil the metropolitan legislation was constituted of several ordinances; the Alfonsinas of 1447; the Manoelinas of 1521; and the Philipinas of 1603.

The different legal criterias between the Spanish and Brazilian legislations determinated the existence of marked differences between the system of the water law of Brazil and the system of the water law of the other Iberoamerican countries.

In the former colonies of Spain prevailed the principle by virtue of which the waters were common to all the people, modified in some degree by the principles of the French Civil Code; in Brazil, instead, the Riparian system, of French and Angolsaxon ascendancy was followed.

Regarding their constitutional organization some countries adopted a federal regime, while others adopted unitarian systems of government. Among the former, despite their federal systems, there are some countries in which the domain of the waters and the jurisdiction to regulate their use appertains to the Federal Government; and ther are other countries in which these attrivutions correspond to the provinces.

The Administration, in the unitariam countries, is carried out by decentralized national organisms, by antarchical entities, or by the central government. In the federal countries there are some which maintain centralized systems of legislation and administration of the waters; while in others the provinces are attributed broad faculities regarding water.

REPUBLIC OF ARGENTINA

Basic Federal Legislation

The Argentinian Constitution establishes a form of government which

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is representative, republican and federal. The provinces keep all the power not delegated to the federal government; the powers delegated to the federal government are to control the navigation and the interprovincial commerce, to determine the goods of public and private domain, and to enact the Civil, Criminal, Commerce, Mines and Labor codes. There are also powers shared by the Nation and the Provinces.

The federal basic legislation, regarding waters, is contained in the Constitution; the Civil, Criminal, and Mines codes; the Law 6546, on construction of water works; the Law 15.336 on energy; the Law 13.577 amended by law 20.324 on " Obras Sanitarias de la Nacion" (Sanitary Works of the Nation); and the Law 20.094, on navigation.

The determination of the legal condition of the waters corresponds to the Civil Code. Almost all the waters are within the public domain of the State. These waters are: the seas, the rivers and their riverbeds; all the natural watercourses; the lakes; the waters having or acquiring qualities apt to satisfy uses of general interest; the spring waters forming natural watercourses; the waters of "vertientes"* beginning and ending in different properties and the underground waters, without prejudice of the regular right of the landowner to abstract them, in the measure of his needs and subject to the regulations. The rain waters fallen in private lands, the spring waters not forming natural watercourses, and the vertientes beginning and ending in the same private proterty are all private waters. There are discrepancies on the legal condition of the non navigable lakes, and of the rain waters fallen in public lands.

The regulation of the use of public waters corresponds to the provinces. The preferences are subject to different treatment by each different water law. The protection of the rights on private waters is carried out before the Courts of Justice, while the questions on the use of the public waters are decided by the administrative authorities.

The rational use of the waters and the operativity of the rules are limited by the lack of clarity of the substantive legislation, the abscence of coordination between the legislation on waters and the legislation on the other natural resources and the lack of an organic policy to assure the quality of the waters and the preservation of the environment.

Argentina has signed conventions, regarding international waters, with the neighboring countries. Argentina signed the Resolution 72, of the VII International American Conference of Montevideo of 1933, which established the obligation to use international waters, within the territory of a country, without prejudice of the rights of other sharing

* "Vertientes" are the waters flowing in natural waterbeds, which do not come from the underground, but from the fusion of snow, or from the collection of pluvial waters. See: Alberto Q. Spota , Tratado the Derecho de Aguas T. II, p. 509, Jesus Menendez Editores, Buenos Aires 1941. This definition is added due to the impossibility of finding an English equivalent for the particular meaning that "Vertiente" has in the Argentinian water law.

countries. Argentina has signed the treaty of La Plata River Basin.

Water Administration at the Federal Level

The are, in Argentina, three administrative levels, federal, provincial and interjurisdictional. The administration of the national waters and the exercise of the shared powers are mainly in the hands of the Federal Executive and the autarchical entities created by law. The Ministry of Economy, through the Sub-Secretary of Water Resources, performs a predominant role in water matters. There are numerous federal entities among which the most important are Agua y Energia Electrica (Water and Electrical Energy), Obras sanitarias de la Nacion (Sanitary Works of the Nation) and the Instituto Nacional de Ciencia y Tecnica Hidrica, (National Institute of Water's Science and Technology.)

The scheme of the Administration shows that the competence to administer the waters is distributed among several entities which do not have coordination among them. Regarding users participation in water management the Civil Code ordains to the users of the same sewage system to associate to carry out the tasks of maintenance, and the Rural Code for the national territories - of limited operativity- establishes water judges, to be elected by the water users.

Provincial Legislation and Administration in Argentina

Buenos Aires

The basic structure is given by the irrigation Law 5262, there also are laws regulating fishing, infection of the waters, and collective dikes, the law of irrigation regulates only one use and it is therefore, incomplete, the Administration of the waters is carried out by the Direction of Hydraulics and, in its area, by a foment corporation, named "Corfo Rio Colorado".

Catamarca

The legal system is contained in the law of servitudes, No. 594, and in the law of waters, No. 655. This legislation is obsolete and in many respects it contradicts the Civil Code and is therefore non-constitutional.

Cordoba

The basic legislation is contained in the Water Code, law 5589, which defines general principles of water policy, structures the permit and the concessions, the restrictions and limitations to the private domain in interest of the best use of the waters and regulates the underground waters, as well as the atmospheric waters and the regime for water works. The Provincial Direction of Waters is charged with the application of the Water Code and is the administrative entity with most of the attributions in the matter.

Corrientes

The Water Code of Corrientes contains a complete regulation of the use of the waters, defense works, underground waters, register of waters and of the authority charged with their government and administration. The Provincial Direction of Waters has not been structured and the competence in the matter corresponds to the Sub-Secretariat of Agrarian Affairs.

The Constitution contains norms on the domain of the sources of energy and of the waters, the water code has not been enacted yet and the Direction of Waters, of recent creation, is charged with all the subjects referred to water use.

Chubut

The Constitution contains basic norms in water matters, but the Water Code has not been enacted yet. The Foment Corporation of Chubut is an autarchical entity whose objectives are the programming of the integral development of the area under its jurisdiction and to carry out a survey of the natural resources of the region within its competence.

Entre Rios

The most important norms are contained in the law 2493 and in the decree 4390/44, both on irrigation. The Rural Code also contains some rules on irrigation. The Direction of Sanitary Works and Hydraulic is competent in most of the water uses.

Formosa

The Constitution of Formosa contains general norms on water matters, but the Water Code has not been enacted yet. The authority charged with water management is the Direction of Hydraulic, depending from the Ministry of Works and Public Services.

Jujuy

The Water Code of Jujuy, law 161 of 1950, covers practically all the problems of water use, regulating the permit, the concession, the servitudes, the water works, the procedures, and the sanctions. The administration of the waters is predominantly carried out by the Direction of Waters and Electric Energy.

La Pampa

The Constitution contains only one norm on waters, and this one is referred to interprovincial rivers, the basic legislation is contained in the decree law 2518 based on the Code of Jujuy. The administration of the waters is carried out by the Direction of Waters and Electric Energy.

La Rioja

The basic structure in water matters is determined by the law 3336 of 1974, based on the Water Codes of Cordoba and Jujuy, and constitutes a

modern legal system. The Subsecretarial of Water Resources of the province centralizes the Water Administration of La Rioja.

Mendoza

The Constitution of Mendoza devotes its sixth section to the regime of the waters establishing the basic principles in the matter of water uses. The basic legislation is the water law of 1884 based on the Spanish water law of 1879, complemented and amended by numerous posterior laws. The main administrative organism is the General Depatment of Irrigation, autarchical entity of constitutional creation. It prepares its own budget and collects autonomically its financial resources.

Misiones

The Constitution of Misiones contains basic principles of water legislation. The Province has not enacted yet a Water Code and there is no office charged with the management of the water resources.

Neuquen

The Constitution of Neuquen contains norms referred to water legislation, but the Province has not yet enacted a Water Law, even when there is a project of water laws based on the Code of Jujuy. The organism charged with the management of the waters is the Direction of Waters and Electric Energy of Neuquen, acting under the hierachical dependency of the Ministry of Agrarian Affairs.

Rio Negro

The Constitution contains basic norms on water matters, based on the Constitution of Mendoza. The legislation of Rio Negro is constituted of the law 285, which is a modern body of law in water matters. There are in Rio Negro a Functional-Territorial entity named Institute for the Development of the Lower Valley of Rio Negro (IDEVI) and a Provincial Department of Waters, whose function are regulated by the law 285.

Salta

The main legal body is the Water Code, enacted by law 785/46, which inaugurated the era of modern water codes in the Republic and was the base of the Water Code of Jujuy. The General Administration of Waters, created by the Water Code, has been dismembered and its attributions are at present carried out by the Secretariat of Public Works and by the Direction of Colonization and Irrigation depending from the Subsecretarial of State of Production.

San Juan

The law, even when named irrigation law, is an actual water law, which bases many of its norms on the water law of Mendoza. The Department of Hydraulics, autarchical entity created by law 886, regulates the administration of the public waters.

San Luis

The most important law is the law 2576 which regulates all the uses of the waters. It is based in the laws for Salta and Jujuy, whose structure it follows. The Provincial Direction of Waters depends from the Ministry of Economy and Public Works and is the authority of application of the law.

Santa Cruz

The Provincial Constitution contains some basic norms on waters, but a water code has not been enacted yet.

Santa Fe

The Provincial Constitution does not have water norms, the water norms are contained in the Rural Code and in the decree 1925. The main organism in water matters is the Direction of Hydraulics depending from the Ministry of Public Works.

Santiago del Estero

The Constitution does not have norms on water matters but the Water Code, which follows the Code of Salta, establishes fundamental principles in the matter. The entities of administration are the Direction of Hydraulics, the General Direction of Irrigation and the Direction of Energy.

Tucuman

The water law 731 is similar to the water law of Mendoza, in which it is based. The organism charged with water management is the General Department of Irrigation, entity which is also charged with the other uses of the waters. The Provincial Direction of Waters and Energy, and the Provincial Direction of Fishing also intervene in the administration of the waters.

Interprovincial Questions

Some interprovincial questions have been solved by treaties between the interested provinces, the most important compacts are the ones signed by Cordoba, Santiago del Estero and Tucuman, on the use of the Sali or Dulce River and Buenos Aires, La Pampa, Mendoza, Neuquen and Rio Negro on the use of the Colorado river.

Bolivia

The constitution of Bolivia contains basic norms on water, among which the Art. 136 must be pointed out because it defines the goods of national domain. It establishes that the land; the subsoil; the lacustrine, fluvial and medicinal waters; and the elements and physical forces that can be harnessed; are of original domain of the State.

The Civil Code of Bolivia, based in the French Civil Code; and the Water Law of Bolivia, of 1879, based in the Spanish water law, but adapted to the Riparian principles, are the main legal bodies in the matter.

By Constitution all the waters are within the public domain of the State, but the Civil Code declares private waters the rain waters fallen in private land; the underground waters; the spring waters and the waters of the rivers which cannot be navigated or used for flotation transport.

The law of January 1945, regulatory of the law creating the Irrigation System of Cochobamba and La Angostura, contains a complete regulation of the use of the waters, the same as the Regulation of Waters for Irrigation of the Ministry of Agriculture.

The main constraint for the adequate use of the waters is posed by the Riparian System established in the Civil Code and in the Water Law, in opposition to the principles of the Constitution.

Regarding international waters Bolivia has signed the treaty of La Plata River Basin and the declaration of Montevideo of 1933. Bolivia has also signed treaties with the neighboring countries for the use of waters.

Bolivia is a unitarian country and the administration of the waters corresponds to the national government and by delegation to the provinces, municipiums, and the autarchical entities depending from it.

There are numerous centralized entities charged with water government; within the decentralized administration the main entities of water government are the Service of Drinkable Water and Sewages and the General Direction of Hydraulics.

The analysis of the system of water administration of Bolivia shows that it is focused in the uses of the water and in the defense against its harmful effects, but not in the water as a resource. This system produces interferences in the action of the different organisms, lack of global approach to water problems, inconvenience and overlapping efforts.

Brazil

Brazil is a federal country, as established in the Constitution of 1969. The Constitution declares of national domain the lakes, the watercourses flowing in national lands, the water courses shared by more than one of the States of Brazil, the watercourses bounding states, or bounding Brazil and a foreign country, the continental platform and the territorial sea. The States own, by Constitution, the lakes located in State's lands, the rivers within the state not crossing the boundary lines, and the islands placed on rivers of state domain.

The Water Code, decree 24.643 of July 10, 1934, and its amendments, legislate on public and private waters, waterbeds, water uses, hunting and fishing, defense against the harmful effects of the waters, spring waters, underground waters, rain waters, pollution, servitudes, aqueducts, electrical use of the waters and establish the riparian system.

Regarding international waters Brazil has signed the Resolution 72, on industrial and agricultural uses of international rivers; the treaty of La Plata River Basin; and has also signed treaties with Argentina, Para-

guay, Uruguay, Peru, England, Ecuador, Colombia, Venezuela and Netherlands.

The bulk of the water administration corresponds to the federal entities. The autarchical organisms are charged with activities of entrepreneurial type. There are several supertendencies of development, which are entities of global planning and project execution for particular regions of Brazil. The Executive Group of Irrigation for the Agricultural Development, which function in the area of the Ministry of Interior, is an interministerial entity charged with the promotion of this use of the waters.

Colombia

The Constitution of Colombia establishes the unitarian form of government. The basic legislation in the matter is the decree 2811 "National Code for Renewable Natural Resources and Protection of the Environment". It regulates the management of all the natural resources, the atmosphere, the aerial space, the waters in any of their states, the land, the soil, the subsoil, the flora, the fauna, the primary sources of energy, the topographical slopes, the geothermical resources, the biological resources, and the landscape. The Code declares all the waters within the public domain of the State. They are inalienable and imprescriptible goods of the State. The Code is one of the most modern legal bodies on water in the world.

Regarding international waters, Colombia is a signer of the resolution 72 of the VII International American Conference of Montevideo of 1933 and she has also signed water related conventions with Ecuador, Venezuela, and the countries of the Ilhea Amazonica.

The Administration of the water resources of Colombia is mostly in the hands of decentralized institutions with functions determined in their structures. The National Institute of Natural Resources, and the Colombian Institute of Agrarian Reform act in decentralized fashion, through districts or regional corporations. There also exist entities of basin administration of the type of the T.V.A.

The scheme of the system of administration shows that the competence for the management of the resource in distributed among the many entities governing the waters, even when the presidency of the Colombian Institute for the Agrarian Reform and of the Institute of Natural Resources by the Minister of Agriculture, gives to these entities some unity of direction.

Costa Rica

The Constitution of Costa Rica establishes the unitarian system of government. The basic text of water law is the law 276 which regulates the waters of public and private domain, the special uses of the public waters, the reserves of drinkable waters for towns and villages, alluvium, avulsio, alveus derelictus, defense water works, lands dessecation, restrictions to the private property and servitudes, user associations, emergency measures to be taken by the State, connection among water and other natural resources, and punishments and sanctions.

The Water Law declares most of the waters property of the State, with

the exception of the rain waters fallen in private lands, the ponds and lagoons formed in private lands, the underground waters abstracted by the landowner from his private lands, and the thermal waters.

Costa Rica has signes treaties with Panama, and Nicaragua. In a conflict on the use of the San Juan river, Costa Rica and Nicaragua submitted the problem to the Centro-American Court of Justice. The Administration of the waters is charged to decentralized entities, having important functions of planning and government of the different uses of the resource and also to centralized entities with similar functions,which also carry out research activities. The most important of the decentralized entities is the National Service of Electricity, authority of application.

Cuba

It has been possible to analyze the Constitution of 1940, and its amendment of February 7, 1959. It is known that important amendments of the Constitution were made after that date, but their texts were not available. It is also known that a new Constitutional text has been prepared. The Executive functions are exercised by a President and a Prime Minister. The Council of Ministers exercise the legislative functions. Cuba is an unitarian republic, administratively divided in six provinces.

The enactment and regulation of the laws in competence of the Council of Ministers and of the President. The Constitution, in the cited text, foments the cooperatives, declares the subsoil a national property, subjects the waters,the transports and the public services to state exploitation, proscribes the latifundio, and foments the consortiums.

The law of agrarian reform of 1959, amended in 1973, establishes the maximum area that a person can own, nationalizing the farms exceeding such area.

The waters are regulated by the Spanish water law of 1879, and it is expected that in brief a new water law will be enacted.

We can assume that there are no private waters in Cuba, and that the classification of the water law has only an academic value.

The uses of the waters are special and common, the former can be carried out only through concession. The law establishes priorities, norms or servitudes, defense against pollution in the cases of industrial uses, and norms on competence of administration of the tribunals of justice.

Cuba does not share international, non maritime waters with any country.

The National Institute of Hydraulic Resources is the organism which attends to the government and administration of the waters. It has decisory, regulatory and applicatory powers. The regulation of the law can be made through general and particular resolutions. The Institute is subject to the general planning defined by the executive and legislative branches of the government.

Chile

The Constitution of Chile establishes the unitary system of government. The basic structure of the system of water law is defined by the law 9909,(Water Code), amended by the law 16.640, on Agrarian Reform.

The Water Code classifies the waters in pluvial, maritime and terrestrial waters, expressly declaring that its dispositions do not apply to maritime waters. By their legal condition the waters are movables, but they become immovables when they are assigned to the use or cultivation of an immovable. The Code proclaims all the waters of the national territory to be within the public domain of the nation. All the waters of private property, at the time of the enactment of the law No. 16.640, were declared of public interest, and subject to expropiation. The Water Code is complemented by other laws on distribution of waters, use of waters for motive power, industrial concessions, pollution of the waters, etc. The disposition of the Code are adequate, and the Code can be considered amongst the most modern of the world, even when a more detailed regulation of the underground waters would be desirable.

Chile shares domain and jurisdiction of non martime, international waters with Argentina,Bolivia and Peru. Doctrinarily, Chile adhered to the principles of the VII American International Conference of Montevideo of 1933, signed with Argentina the declaration of Santiago on the use of non maritimeinternational waters, and is signatory of several other treaties on waters with Argentina, Bolivia, and Peru.

The water administration of Chile is charged to four entities which are: the Direction of Sanitary Works, the General Direction of Waters,the National Enterprise of Irrigation and the Foment Corporation. The most importantinstitution is the Direction of Waters, depending from the Ministry of Public Works.

The irrigation and the generation of hydroelectrical energy are charged to public enterprises. Several organisms with functions of research, or of control of the use of the waters in a special sector, are given responsibilities with respect to the managment, use, investigation and conservation of the waters, as well as defense against their harmful effects. The Institute of Engineers of Chile proposes the creation of the Institute of Water Resources as coordinator of all the functions related with water, and the granting of greater autonomy to the National Enterprise of Irrigation.

The participation of the water users in the management of the waters is one of the remarkable features of the system. Even when the dispositions of the law of Agrarian Reform have reduced the attributions of these institutions and their privatistic character, the structure (now as public entities) of the communities of users, the canalists associations, and the boards of vigilance, is basically the same. The canalists associations are constituted of all the persons using the waters of the same artificial canal. The water communities have "de facto" existence, when two or more persons use the waters of the same canal. The boards of vigilance are formed of the canal associations and the communities of uses using in any

form the waters of the same basin. Their objects are to distribute and administrate the waters of the basin. The canal associations and the Boards of Vigilance are constituted, voluntary or coactively on petition of the Direction of Waters or of any interested person before the competent judge. The tradition of user participation that exists in the Chilean legislation makes the performance of the canal associations and of the Boards of Vigilance adequate and effective.

Ecuador

Ecuador is, by Constitution, a unitarian country. The legislation regulating use, harnessing, and domain, of the waters is the law No. 369 of May 17, 1972 which also regulates the defense against the harmful effects of the waters. The law contains dispositions on water use, pollution, concessions for water use, different water uses, hydraulic works and servitudes. There are also norms on infractions, penalties, jurisdiction, common uses and directories of waters. The law has been adequately regulated.

The water law declares all the water to be of public domain; the code contains all the provisions to achieve a rational and efficient use of the waters, but it would have been desirable a more detailed regulation of the underground waters.

Ecuador is a signatory of the resolution of the VII American International Conference of Montevideo of 1933, and has also signed treaties with Colombia, Brazil and Peru.

The bulk of the decentralized administration is carried out by the Ecuatorian Institute of Hydraulic Resources, without prejudice of activities sectorally charged to other entities. There is a territorial commission of development, acting under the control of the Ecuatorian Institute of Hydraulic Resources, when dealing with water resources The Institute performs its functions through agencies or districts which are territorially decentralized.

El Salvador

El Salvador is a unitarian country, as prescribed by the Constitution of 1952. The basic legislation regarding waters is contained in the Civil Code, which, following the project of Bello, considers of public use all the rivers and brooks flowing in natural stream beds, with the exception of those water courses which end in the property in which they have their origins. The navigable lakes are also declared of public property.

The Riparians have a preference for the use of the public waters, which constitutes a sensible limitation to their public condition. The Constitution declares the underground waters to be of public domain but the Civil Code, in its Art. 69, declares that the domain of the land is extended through lines vertical to the land surface.

The Law of Irrigation and Drainage contains norms or concessions and permits for the use of surface and underground waters, easements and

appropiation of waters for the public use. There also are many legal bodies whose dispositions are sometimes contradictory and other times incomplete.

The non riparians need concession for the use of the public waters, and concession is also necessary for the use of underground water, by virtue of a constitutional disposition.

The scatterment of legal norms; the riparian system and the contradictions among norms, like the ones on underground waters, are constraints to the rational use of the waters.

El Salvador has signed treaties on international waters with Guatemala, but there are no treaties with Honduras.

There are centralized and decentralized entities carrying out the administration of the waters. The most important organisms are the National Administration of Aqueducts and Sewage, supplying waters for domestic consumption for towns and villages; and the Executive Comission for the Lempa river, which is charged with hydroelectrical generation, and also with the construction of water works. There is no entity dealing with the water as a resource. The creation of the National Administration of Irrigation and Drainage, in 1961, was unsuccessful because the entity is not operating effectively. There are two districts of irrigation depending from the General Direction of Irrigation and Drainage, which depends from the Ministry of Agriculture. These districts carry out soil conservation tasks.

Guatemala

The Constitution of Guatemala, dating form 1966, establishes the unitarian form of government and contains dispositions on the national domain of the waters and the waterfalls. It compels the State to take measures of harnessing, defense and conservation of the natural resources. There are also important dispositions on water matters in the Civil Code and in the Regulations for Irrigation of 1972/

The Consititution declares of national domain the navigable or non navigable rivers and lakes, their riversides, the rivers, springs, and brooks forming international boundaries, the waterfalls and water sources located in public lands and the pluvial waters flowing in ravines of national property. Despite the Constitution, the Civil Code establishes that the riparians of neither navigable nor floatable watercourses and the riparians of public watercourses of non continous volume can use the waters for irrigation. They can use pumps, or other water works to abstract waters as long as they do not prejudice the navigation. According to the Civil Code the domain of the waters can be acquired by concession, permit, or riparianism.

The scatterment of the norms on domain and use of the waters and defense against their harmful effects; the Riparian System; the establishment of diverse hierarchies and priority orders in diverse laws; the lack of a systematic legislation on underground waters and of norms containing a policy of defense against the noxious effects of the waters are con-

straints to the rational use of the waters.

Guatemala has not signed multilateral conventions on the use of international maritime waters. There is a water comission to attend water conflicts between Mexico and Guatemala. The country has signed treaties with El Salvador and Honduras.

The Administration of the waters is charged to centralized and decentralized entities. The Ministeries and the decentralized enterprises and organisms are charged with the sectoral control of the uses of the waters. The predominant role corresponds to the Ministry of Agriculture. There is a regional institution among whose multiple objectives there is the multiple, harmonic and coordinated use of the natural resources, water included. There is a lack of coordination among the several sectoral administrations, a lack of planning authority, and there is no water policy at the national level.

Honduras

The Constitution establishes the unitarian system of government. It contains the basic norms for the use and conservation of the natural resources of the country. The Water Law declares to be public the waters of the lakes, lagoons, inlets, estuaries, rivers and brooks of constant flowing and the underground and pluvial waters located or flowing in national lands. These waters are inalienable and imprescriptible property of the State. The waters of vertientes* beginning and ending in the same property, the pluvial waters flowing in private waterbeds, the underground waters abstracted by the landowner, and the waters flowing in artificial canals are private property of their particular owners. Water rights can be acquired by prescription or by concession. There is no register for the concessions.

The contraints to the rational use of the waters are the lack of adequated regulations, the deficient legislation on underground waters, and the disintegration of legislative texts.

Regarding international waters there is a treaty with Guatemala and an arbitral award of the King of Spain respect waters shared with Nicaragua.

Like in the Mexican system the administration is centralized in a Secretariat of Natural Resources, with broader competence than the Mexican- which encompasses only waters- which controls the exploitation of the natural resources. Irrigation is carried out by districts. Urban supply, recreational uses and hydroelectric generation are charged to autarchical entities.

Mexico

The Constitution of the United States of Mexico adopts the form of government democratic, representative and federal. The art. 27 defines which waters are original and public property of the Federal State.

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* See the definition of vertiente given for Argentina.

They are the territorial seas, the maritime inlets, the lagoons and estuaries connected with the sea, the interior lakes directly connected to constant streams, the rivers and their direct or indirect tributaries, the constant intermitent currents, the lakes, lagoons and estuaries crossed by the lines dividing states within Mexico or Mexico and another country, the spring waters located in the shores, in the maritime zones, in the riverbeds and in the riversides, the waters abstracted from the mines and those waters corresponding to the nation by international treaties. The underground waters were declared public by the Federal Water Law. The waters not included in the Aet. 27 of the Constitution are property of the States or of the particulars. In addition to the Constitution the fundamental norms are the Water Law and the law on pollution.. The private waters are regulated by the Civil Codes of each state. The Federal Water Law is a modern and complex legal body which regulates the domain of the waters, the forms to grant water rights, the stimulus for the efficient use of the waters and procedures and penalties.

The Mexican delegation to the VII International American Conference of Meontevideo of 1933, formulated reserves to the declarations; there are treaties with Guatemala on non maritime international waters and numerous treaties with United States.

Mexico is a federal country in which there are waters of federal and state domain. The water regulation is competence of the Nation and also of each state, but most of the attributions are exercised by the Federal government.

The Secretariat of Water Resources centralizes most of the administrative attributions, (these attributions can be proper, delegated and of coordination) establishes the national water policy, directs the activity of the state and orientates the activity of the particulars. These centralization and unity of the fundamental basis for the use of the waters do not impair the decentralization of the concrete and particular activities, which are carried out through Work Commissions, Study Commissions and Irrigation Districts. There are other Secretariats of State and autarchical entities which have speicific functions respect some uses, but they all adjust their activities to the general policy defined by the Secretariat of Water Resources.

Nicaragua

The Constitution of Nicaragua adopts the unitarian system of government and establishes the public property of all the waters. There is no water law in Nicaragua. The Civil Code establishes the public condition of the sea waters and of the navigable waters and declares of common property (not private property) the waters which are not navigable.

There are isolated laws on hydroelectrical energy, urban supply, police regulations, etc., which contains allusive norms, but there is no organic body of legislation.

Nicaragua shares the domain and jurisdiction of international, non maritime waters, with Costa Rica and Honduras. The conflicts with these

countries have been settled through decisions of international courts or arbitral awards. There is a sectoralized administration of the waters, which is carried out through autarchical and ministerial entities, no ministery is prevalent. There is no entity charged with the administration of the water as a resource.

Panama

The Constitution adopts the unitarian form of government and declares the public property of the State on the territorial seas, the lacustrine and fluvial waters, the shores and riversides, the navigable rivers, the harbors, the estuaries, the lands and the waters assigned to public services of any kind and to irrigation, the hydroelectrical generation, the sewages and the aqueducts. The basic policies are established in the Constitution and in the Water Law (decree 135 of September 22, 1966), which regulates the exploitation of the waters by the State, in conformity to the public interest, and which considers public all the waters, including the atmospheric ones. The Law of Panama is a brief, but complete code of waters.

There are treaties on limits, with Costa Rica and Colombia, which include the waters. There are treaties with the United States on the Panama Canal. Most of the administrative functions of water government are carried out through the centralized administration. The most important Ministery regarding waters is Agriculture which carries out its tasks through the Water Commission; the ministry of the Presidency is in charge of the general planning and of the use of the waters for agriculture (Commission for Agrarian Reform). The other ministeries are charged with the construction of water works, data collection, and uses of the waters. There are also autarchical entities charged with observations, studies and construction of works.

Paraguay

The Paraguayan Constitution establishes the unitarian system of government. The Civil Code classifies the waters using the same system than the Argentinian Civil Code. The Rural Code of 1931 regulates the fishing activities, the concession of public waters and cattle watering. The dispersion of the water norms in several legislative bodies, the contradictions among them, and the lack of regulation of the underground waters are the main constraints of the system.

Paraguay shares non maritime international waters with Argentina, Bolivia, Brazil and Uruguay (*non bounding country*). Paraguay adhered the VII International Conference of Montevideo of 1933, is also a signatory of the multilateral treaty of La Plata River Basin and has signed bilateral agreements with Argentina, Bolivia and Brazil.

The administrative regime is decentralized, but the decentralization is sometimes structured for uses, and other for the entities financing a particular kind of water work. The most important of the water use, is navigation, which is charged to an autarchical entity and to the National Council of Public Waters. Planning is concentrated in the Presidency of the Republic.

Peru

The Peruvian Constitution establishes the unitarian system of government and the public condition of all the waters. The legal norms on water are concentrated in the Water Law No. 17.752 and its regulation. The law is a modern one, whcih considers all the waters to be of public property, establishes a system of priorities, the means to obtain water rights, easements, special norms on underground waters and environmental protection. The Peruvian legislation is one of the most advanced of the world and it contains adequate instruments for the efficient use of the waters.

Peru is a signatory of the VII International American Conference of Montevideo of 1933. Peru has signed treaties on non maritime international waters with Bolivia, Brazil, Chile, Ecuador and Colombia.

Most of the attributions on water affairs are charged to the General Direction of Waters and Irrigation, which, even when dealing sectoraly with one use of the waters, also deals with waters as a resource. Its activities are decentralized through irrigation districts; other ministeries and autarchical entities have limited functions respect specific uses. Planning in concentrated in the Presidency of the Republic. The Superior Council of Waters is the entity responsible for the planning and coordination at interministerial level.

Dominican Republic

The Constitution of the Dominican Republic establishes the unitarian system of government. The basic legislation is structured by the water law 5852 of 1962, based on the Spanish water law of 1879 and by the law 487 on underground waters. The Civil Code does also have norms on waters, which are frequently in contradiction with the Water Law. Respect the manners of granting water rights, riparianism is enough to use the waters for irrigation and cattle watering. The law on underground waters, on the contrary, contains an adequate mechanism for the regulation of underground waters.

The Dominican Republic shares non maritime, international waters with Haiti and has signed treaties on waters with this country. The government of the waters is mostly in charge of decentralized entities, the most relevant is the National Institute of Hydraulic Resources, but the are other entities charged with agricultural uses, even when in a partial manner. There is a regional corporation for the development of the resources of a region.

Uruguay

Uruguay is an unitarian country, as declared by its Constitution. Even when the Civil Code contains norms for waters, which are based in the riparian system, the main water rules are in the Rural Code, based on the Spanish water law of 1866, but adapted to the riparian system of the Water Code. The waters are classified in public waters, which can be of municipal or of national propterty; private waters of the riparian or landowner and appropiable waters. The harbors, inlets and rivercoasts; the rivers and the brooks when naturally or artificially navigable or floatable; the current waters-needed for basic needs of the persons, if there is public way of access; the public water works constructed by the Nation; the waters of rivers and brooks used in public works for irrigation and energy gener-

ation; the hydraulic forces; the private waters not used until the enactment of the law 10.582; the pluvial waters flowing in rambles of public domain; the spring waters feeded by abundant rain; the underground waters located in lands of public domain; the lakes located in public lands and feeded by public waters and the streambeds of the rivers when navigable or floatable; are within the public domain of the State.

The attribution of water domain to several public entities, and in addition to particulars, and the scatterment of the legislation in several laws and regulations are the basic constraints posed by the water legislation of Uruguay.

Uruguay is a signatory of the agreements of the VII International American Conference of Montevideo of 1933, is a participant on the treaty for the harnessing of la Plata River Basin, and a signer of treaties with Argentina and Brazil on the use of non martime international waters.

Planning corresponds to the National Council of Waters, but only as an advisory entity. The state activity is mostly carried out through the Ministeries of Public Works, Transportations, Agriculture and Communications and Tourism. There also are autarchical entities with intervention in the use of the resource. There is no entity or ministry having more attributes than other organisms in water related matters. This is a difference with other South American countries, in which there are entities concentrating most of the tasks related with the use and government of the waters.

Venezuela

The present Constitution of Venezuela adopts the federal system of government. It declares that all the waters are within the public domain of the State. The Civil Code declares public waters the waters of the rivers, when navigable or floatable; the lakes; and the pluvial waters fallen in public lands. The waters of the non navigable neither floatable rivers are public waters for the non-riparians, but private waters for the riparians. Are private waters the waters of the brooks, the springs, the vertientes*, the pluvial waters fallen in private lands and the underground waters. Water rights can be obtained by the fact to be a riparian or by concession.

The main constraints of the legislation of Venezuela are the riparian system and the dispersion of the legislation in several legal bodies.

Venezuela shares international waters with Brazil, Colombia and Guyana; she formulated reserves to the declarations of the VII International American Conference of Montevideo of 1933. The country has signed conventions on non maritime waters with Brazil and Colombia. Waters are mostly administed by the central government. The administrative organization of Venezuela is based in the attribution of the planning responsibilities to the President of Venezuela, who carries out this task through an interministerial organism, from which depend several specialized entities. The operation, on the contrary, is attributed to several minis-

* See definiton of vertientes for Argentina

teries and autarchical entities, the Ministries of Agriculture and of Public Works are the ones with the greater responsibilities on water use. There are several developmental corporations based on the unitarian government of all the resources of areas geogrpahically determined.

SOCIO-CULTURAL ASPECTS OF WATER MANAGEMENT

by Evan Vlachos*

The paper attempts to relate through a comparative analysis, major socio-cultural charachteristics of water management, especially in irrigated agriculture. The basic premise of the presentation is based on the notion that water has meaning and importance where socially used for the achievement of certain objectives.

The exposition of the argument is also based on a systems analysis framework relating social to other critical variables in water management and providing a common vocabulary for understanding effective water schemes. By assuming that optimum water development is directed towards the greatest common good, of the largest number of people, for the largest time issues of planning are also brought forward. Thus, some general sociological remarks are made also on the current concerns with environmental impact assessment and social forecasting. By utilizing the historical experience of the past, we may be able to understand better our present predicament and relate with higher sensitivity norms and cultural values to the demanding legal imperatives.

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ASPECTOS SOCIO-CULTURALES DE LA AGRICULTURA IRRIGADO

por Dr. Evan Vlachos*

RESUMEN

Este informe intenta relacionar, mediante análisis comparativo, las mayores características culturales de manejo de aguas, especialmente en agricultura irrigada. La premisa básica es que el agua tiene significado e importancia donde es socialmente usada para determinados objetivos.

La exposición del argumento esta basada en análisis de sistemas, relacionando lo social con otras variables críticas de manejo de aguas y proveyendo un vocabulario común para el entendimiento de esquemas de agua efectivos. Asumiendo que el óptimo desarrollo de los recursos hídricos es dirigido al major bien común, de la mayor cantidad de gente, durante el período más largo de tiempo, surgen problemas de planeamiento. De este modo, algunos comentarios sociológicos generales son hechos acerca de la preocupación corriente sobre evaluación de impactos en el medio ambiente y pronóstico social. Usando nuestra experiencia historica pasada podremos entender mejor nuestros predicados presentes, relacionando a través de más altas normas de sensibilidad los valores culturales con los demandantes imperativos legales.

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THE IMPORTANCE OF WATER LAW IN THE DESIGN AND OPERATION OF IRRIGATION SYSTEMS FOR IMPROVED ON-FARM WATER MANAGEMENT

by

Gaylord V. Skogerboe

ABSTRACT

Much emphasis will be given in the future towards improved irrigation water management to reduce downstream water quality degradation and minimize diversions in order to provide water supplies for new demands; but more importantly, to alleviate waterlogging and salinity problems in order to increase crop production on existing irrigated lands. In many cases, the key will be improved on-farm water management. However, technology alone will not usually bring about the necessary improvements. A combination of technological changes and institutional modifications will usually be required to effectively alleviate water management problems resulting from irrigated agriculture. The combination of water use regulations and flow measurement devices are the necessary prerequisites to accomplish desired water management goals.

LA IMPORTANCIA DEL DERECHO DE AGUAS EN EL DISEÑO Y OPERACION DE SISTEMAS DE IRRIGACION PARA MANEJO MEJORADO DEL AGUA EN LOS PREDIOS

por Ing. Gaylord Skogerboe*

RESUMEN

Mucho enfásis será dado en el futuro al manejo mejorado del agua en irrigación, para reducir la degradación de la calidad de las aguas más alla del punto de retorno y minimizar tomas de agua, a fin de proveer abastecimiento de aguas para nuevas de mandas; y aún más importante, para aliviar problemas de exceso de aguas y salinidad, a efectos de incrementar la producción en tierras irrigadas. En muchos casos la clave será el manejo mejorado de las aguas en los predios. Normalmente la tecnología, solamente, no aparejará los cambios. Una combinación de cambios tecnológicos y modificaciones institucionales será usualmente requerida para aliviar, efectivamente, los problemas de manejo de aguas resultantes de agricultura irrigada la combinación los regulaciones de uso de aguas e implementos para medir caudales son los prerequisitos necesarios para lograr los objetivo propuestos en administración de aguas.

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Design And Operation Of Urban And Rural Hydraulic Water Systems

by Stavros Triantafillides*

ABSTRACT

Water is a natural good necessary for the existence and life of man. For the civilized man it has become a basic element required for water supply, industry, rural economy, fire-extinguishing, production of energy, entertainment and other applications. It is only normal that besides the many technical problems and applications such a broadly applied element also creates social and legal problems referring to its possession as well as its use and operation.

We, technologists, resort to the assistance of the legal people for the solution of many problems and complications of this nature so that you, the legal people, should study further the incomplete, permit me to say, water law as regards the urban water supply operation as well as the rural and energy operation of water.

Moreover, and mainly in the narrow space occupied by Europe, even more complicated legal problems arise about international rivers and lakes and this requires that an international water law be founded soon in order to avoid disputes of every nature, quite unpleasant very often.

Greece, owing to its good will and that of its neighbors, has settled many questions pertaining to common rivers running across the land of its neighbors and its own by means of bilateral agreements. It is possible that these agreements may constitute the basis of an international water law, indispensable in today's technological progress where water is a basic element.

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DISEÑO Y OPERACION DE SISTEMAS HIDRAULICOS URBANOS Y RURALES

por Profesor Stavros Triantafillides*

RESUMEN

El agua es un elemento natural necesario para la vida humana. Es un elemento básico para el hombre moderno, requerido para obastecimiento de aguas, industrias, economía rural, extinción de incendios producción de energía, entretenimientos y otros usos. Es normal que en adición a problemas técnicos el uso de este elemento, universalmente demandado, cree también problemas legales y sociales, en lo referido a su posesión, uso y operación.

Nosotros los técnicos, apelamos a la asistencia de los juristas para la solución de muchos problemas y complicaciones, que demandan que ustedes, los legistas, deban estudiar más completamente el incompleto, permítaseme decir, derecho de aguas, respecto de la operación de sistemas hídricos urbanos, rurales y energeticos.

Más aún, y principalmente en el angosto espacio ocupado por Europa, surgen, problemas aún más complicados sobre ríos y lagos internacionales que demandan la pronta creación de un derecho de aguas internacional para evitar disputas de toda índole, generalmente poco placenteras.

Grecia, debido a su buena voluntad, y a la de sus vecinos, ha solucionado muchos conflictos sobre los ríos comunes que cruzan su tierra y la de los países aledaños, a través de acuerdos multilaterales. Es posible que esos acuerdos puedan constituir las bases de un derecho de aguas internacional, indispensable para el progreso tecnológico contemporáneo, del cual el agua es un elemento básico.

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SURFACE AND UNDERGROUND WATERS IN SPAIN

by Carlos C. Arrieta*

ABSTRACT

Chapter I of the study contains a description of the country's hydrographic characteristics, and the surface and underground hydraulic balance of same, emphasizing the considerable difference between these, as the underground water available is far less than the surface water availabilities.

Chapter 2 studies the joint surface and underground hydraulic planning, and through a historic, juridical analysis, it outlines the successive phases through which it has passed, taking advantage of the waters, from an unconnected, individual or concessional use, to the planned use made between basins, transferring the waters. The chapter ends discussing the future plans which will require new resources to be incorporated.

Chapter 3 discusses the surface waters, and based on the current legislation, Civil Code and Law on Waters it discusses the general principles that the water ordinance is based on, as contemplated in Spain's historic law, discussing the reasons for the Law on Water, jurisprudence and Spain's juridical doctrine.

The Civil Code, Law on Waters and complementary legislation is analyzed in full detail, establishing the classification of the spring and private waters and carefully studying the running waters, springs and currents, dead and backwaters, and rain waters.

A careful examination is made of the various methods which the legislation sets out to make use of the surface waters, making a distinction between the common uses, the special ones, and analyzing uses made for domestic, farming and industrial consumption, for fishing, navigation, floation, for the surface waters, common uses. Regarding the special uses, town supplies, railways, irrigation, shipping canals, industrial and hydro-electric uses, bridges and passage ships, fish breeding grounds are all subject to a detailed examination.

The ways of acquiring uses established by legislation regarding the administrative concession and usucapion are studied and discussed in detail. The juridical features of the concession from its legal point of view, and its transmission, revision and extinction are examined in detail. The usucapion, way and form of acquiring same, comparison and legal treatment identified with the administrative concession is subject to a special discussion.

The problem of hydraulic planning considered from a written law perspective and the practical application of same is analyzed in detail. The transfer method of basins is analyzed as a genuine work of current

planning, within the institutional framework of the Law on Public Works and Waters, as these are differentiated but deeply related problems. The claims made by the riverside inhabitants towards the river bank landed property, insisting on their preferent rights to the water, the reserves of discharges, as an institutionalized juridical figure in favour of the State organisms, as compared with the sought after concession, along with the problems and jurisdictionality of the Administration in its planning task, is studied in detail and analyzed in this Work.

Chapter 4 discusses the underground waters, setting out the doctrinal concepts inspired on historical background and current legislation. The concept of natural currents as a public good, and the problems raised by the current juridical ordinance, in the face of technological progress, and the modern prospection means, is examined, in an attempt at applying a legislation that was passed and in force last century. The use of the waters, the limitations imposed by Law in benefit of the proexisting uses and the protection measures of the aquifers, as a result of the Administration's policy, is remarked upon in detail.

The Administration's work through its various departments dealing with underground waters, considered from a perspective of different competences inciding on one and the same asset, are also analyzed in this Study. The attributions which lesser important by-laws have offered on the question, to the various Ministerial Departments of the Ministry of Public Works, Agriculture and Industry, and the problematics which this presents, are analyzed and sutdied. The coordinating norms of a territorial nature ruled by the Government Presidency are examined and commented upon. Likewise, the Mines legislation, qualifying a certain group of waters as minerals, has met with an opportune comment.

Lastly, Chapter 4 discusses the problems of making a legal revision of the underground waters, based on the fundamental physical and juridical principle of the functional unity of the water, as a premise to permit a maximum good development and use of the waters, with no distinction as to surface or underground waters.

Two revision methods are proposed in the Study. One is on a reglamentary level, making one sole Ministry hold full competence, which would be in charge of qualifying the natural currents, and arranging the uses to be made of same, protecting them from third parties. The other method is on a legal level, declaring all the waters public, although granting the owner of the landed property an ex lege concession, and establishing an institutional and functional ordinance of the uses of this nature.

HYDROGRAPHIC TRANSFERS IN SPAIN

SUMMARY

by José María Mendiluce*

The Spanish hydraulic problematics are first of all described, illustrated with a long term balance of assets-demands, which clearly shows the conditions of its hydraulic policy; control of discharges to overcome the temporal irregularity and hydrographic transfers to correct the geographic unequal distribution of the resources.

The problems of the most deficitary basins are then described (Mediterranean coast) and the transfers proposed from the basins of the Tajo and Ebro to overcome these problems, describing in detail these and their location. The specific problems of the basins in the Cantabrian coast are also analysed. These are the richest ones hydraulically speaking in the Peninsula but they need proportioned, complementary regulation from other basins. The future forecasts are described which exist to increase the nation's assets of resources by transfers in two directions from the Cantabrian side to the Meseta of Castile.

The peculiar, technical feature of the Spanish transfers is emphasized. This essentially resides in planning the reversibility for peak energy production in the schemes recently proposed, which again couples development of the hydraulic resources with the energy sector, by means of these modern multiple use developments.

The difficulties found up until now in planning the transfers, are analysed. These basically reside in the economic planning argument of State investments rather than in a hydraulic planning to allot resources.

Finally the legal aspects are analysed, reaching the conclusion that the present Spanish legislation does not need any modifications to make the transfers possible.

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LOS TRASVASES HIDROGRAFICOS EN ESPAÑA

RESUMEN

por José M^{a} Martin Mendiluce*

Se describe en primer lugar la problemática hirdáulica española, ilustrada con el balance a largo plazo de disponibilidades-demandas, que pone de manifiesto los condicionamientos de su política hidráulica; regulación de caudales para combatir la irregularidad temporal y trasvases hidrográficos para corregir la desigual distribución geográfica de los recursos.

A continuación se describen los problemas de las cuencas más deficitarias (litoral mediterraneo) y low trasvases propuestos desde las cuencas del Tajo y del Ebro para resolver los problemas, con descripción detallada de los mismos y su situación. Se analizan también los problemas específicos que plantean las cuencas del litoral cantábrico, las más ricas hidráulicamente de la peninsula, pero que precisan de regulación complementaria proporcionada desde otras cuencas y las previsiones futuras que existen para incrementar la disponibilidad nacional de recursos mediante trasvases en dos direcciones desde la vertiente cantábrica a la meseta castellana.

Se resalta la característica técnica peculiar de los trasvases españoles que en definitiva reside en el plantaeamiento de la reversibilidad para la producción de energía de puntas en los esquemas propuestos recientemente, que viene de nuevo a hermanar el desarrollo de los recursos hidráulicos con el sector energético, mediante estos modernos approvecha mientos de uso múltiple.

Se analizan las dificultades encontradas hasta ahora en el planteamiento de los trasvases que fundamentalmente residen en el debate de la planificación económica de las inversiones estatales mas que en la planificación hidráulica de asignación de recursos.

Finalmente se analizan los aspectos legales llegándose a la conclusión de que la actual legislación española no precisa de modificación alguna para hacer posibles los trasvases.

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WATER RESOURCE ECONOMICS, EXTERNALITIES, AND INSTITUTIONS IN THE UNITED STATES

by S. Lee Gray and Kenneth C. Nobe*

Abstract

The nature of the water problem in the United States is essentially a problem of economic scarcity and conflicts among competing water users. Because of the characteristics of water--its mobile flowing nature, uncertainty of supply, and the physical interdependencies in use--efficient allocation and development decisions under a single institutional framework are rendered difficult, if not impossible. There is, thus, a crucial interface between law and economics in assuring an allocation of the resource which is truly in society's best interest. Economic theory offers a set of conditions which are necessary to an efficient allocation of water in its alternative uses. There are a number of real-world situations, however, in which these theoretical conditions are violated. One of these, termed externalities, poses particular difficulties through the imposition of uncompensated costs or benefits on society. As a result, some rather complex institutional arrangements in dealing with water have emerged in the United States. Among the most important is the concept of property and the attendant system of water rights. The paper examines, briefly, the interrelated roles of economics and law, as viewed from the economics perspective, in providing a socially desirable allocation of water. It proposes that this be accomplished through sound economic analyses and legislation which promotes flexibility and which minimizes uncertainty in the use of scarce water resources.

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ECONOMIA DE RECURSOS HIDRICOS, EXTERNALIDADES E INSTITUCIONES EN LOS ESTADOS UNIDOS

RESUMEN

by S. Lee Gray y Kenneth C. Nobe*

La naturaleza del problema hídrico en Estados Unidos es básicamente uno de escacez económica y de conflictos entre usuarios compitiendo por la misma agua. Debido a las características del agua - móbil, fluída, incertidumbre sobre su disponibilidad, interdependencias físicas en su uso - decisiones eficientes en cuanto su asignación y desarrollo, llevadas a cabo en un solo sistema institucional, son díficiles, sino imposibles. Existe así una interconexión crucial entre economía y derecho para asegurar una asignación del recurso que sea verdaderamente en el mejor interés de la sociedad. La teoría económica requiere un conjunto de condiciones necesarias para el eficiente empleo de las aguas en sus usos alternativos. Sin embargo en el mundo real estas condiciones teoricas son vroladas. Una de ellas, llamada externalidad, ofrece particulares problemas, pues impone costos y beneficios no compensados sobre la sociedad. Como resultado sistemas institucionales bastante complejos han sido desarrollados en Estados Unidos para lidiar con problemas hídricos. Entre los más importantes estan el concepto de propiedad y el sistema de derecho de aguas resultante. El reporte analiza, brevemente, los papeles relacionados de la economía y el derecho, vistas desde la perspectiva económica, proveyendo una asignación de aguas socialmente deseable. Se propone que esto sea cumplido a través de un análisis económico sano y legislación que promueva flexibilidad, al mismo tiempo que minimice la incertidumbre, en el uso de los escasos recursos hídricos.

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The Role of New Technologies For Improved Water Management And Related Effects On Water Law Systems

by Lucien Duckstein*

ABSTRACT

Water resources development has seen a recent evolution of the goals. Both traditional and new technologies are needed to solve the fundamental problems of flood control, irrigation, effects of urbanization, and water quality. General research needs include planning methodologies and administration, water pollution and water qu ity management, flood and drought prevention, development of new supply sources and new technologies, and resolution of international water problems. Recent trends have been to understand the role of human beings and institutions in the management process. Physical research needs include better data collection methods, establishment of bases for standards, reuse schemes for wastewater, and public health considerations. In addition, the relationship between water and energy is receiving considerable attention at present. The problem of allocating water between competing sources, especially energy production and agriculture, is quite acute in certain regions, such as near the coal reserves of western U.S.A.

Next, technological developments are classified according to their expected effect on future water supplies and demands. As a result of new technologies, water requirements may increase or decrease with various degrees of certainty. Two water treatment technologies, namely desalination and wastewater treatment, are given special consideration. Desalination may be used as a supplementary fresh water source in conjunction with natural supplies. Several wastewater treatment schemes may be used to increase insufficient water supply. In examining technologies that may be applied to developing countries, it is found that a problem-oriented approach facilitates the choice of such a technology. In fact, such an approach tends to erase the distinction between developed and developing countries. Finally, systems analysis techniques themselves should be considered as new technologies.

Legal systems are briefly reviewed from the viewpoint of their role in the overall water resources system and in the decision-making process. Public engineering decisions are contrasted with legal decisions which lean on common law or statutory law. Legal factors may act as either constraints or facilitators for the introduction of new technologies. Besides legal problems, difficulties in the decision-making process include various kinds of uncertainties compounded by the multi-objective nature of decisions and the difficulty

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in pinpointing constraints involving human factors. These difficulties may be overcome by using a proper kind of systems analysis methodology such as the systems design methodology of Wymore (1975). The problem definition phase of this methodology places the various elements of the problem into proper context and enables decision-makers to study long-range forecasting. One of the main outcomes of using such a systems approach is that the legal system can and perhaps should be considered as a decision variable. Such a viewpoint is of special importance in countries where structural changes introduced by a water resources project may change the preference ordering of individuals.

REPORTS

HISTORICAL AND GEOGRAPHICAL EVOLUTION OF WATER LAW AND ITS ROLE IN THE MANAGEMENT AND DEVELOPMENT OF WATER RESOURCES

by

Guillermo J. Cano*

1. PURPOSE OF THIS DOCUMENT. EXPECTED CONTRIBUTIONS FROM THE CONFERENCES OF VALENCIA (1975) AND CARACAS (1976) TO THE UNITED NATIONS WORLD CONFERENCE (1977).

I have been requested to introduce to the subject of this Conference - in order to explain the value of discussing that which has caused its convocation - a comparison of the different legal systems that, throughout the world and history, have ruled the ownership, use and management of waters in the various parts of the world. This comparison is expected to provide legislators and politicians with helpful ideas for their future actions.

I am president of the International Association for Water Laws (Asociación Internacional de Derecho de Aguas - A.I.D.A.),[1] the aim of which is to promote the progress of national water legislations and administrations and, surely for that reason, have I been elected to speak about said subject on occasion of this meeting.

This is a good opportunity to highlight the fact that the conclusions of this Conference of Valencia shall constitute the first contribution and, therefore, the first subject in the Agenda of our Second International Conference on Water Law and Administration (A.I.D.A. II) that we have convened with the sponsorship of the Venezuelan Government and the participation of the United Nations and FAO, to be held in Caracas next February 8-14. The Rapporteur on this subject, in Caracas, will be professor George Radosevich.

The United Nations General Secretariat, which supports and will participate in our Conference, has announced it will prepare a document on its results, that will supply the grounds for one of the reports it will present at the Water World Conference that the United Nations has convened to take place in Mar del Plata, Argentina, in March, 1977. So both conferences - this one of Valencia and the Caracas one - will provide important contributions to the 1977 World Conference. It is due to the contribution of this Conference of Valencia involved for ours of Caracas, that the A.I.D.A. Executive Committee has decided to co-sponsor it and to entrust its representation to the distinguished Spanish Water Law expert, Professor Sebastián Martín-Retortillo, representation which the author of these lines has the honour to share with him. From the twenty-four speakers in this Conference of Valencia, twelve are also members of A.I.D.A.

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2. WHAT DOES THE TERM WATER LAW[2] INVOLVE. TOWARDS ITS UNIFICATION

2.1 Water Law and Maritime Law

The Water Law that will be dealt with both in Valencia and Caracas and, later, in Mar del Plata, rules the use of non-maritime[3] waters. Traditionally, maritime and non-maritime waters have received a separate legislative and academic treatment. Most surely, this has been due to the different uses and technical means necessary to exploit them.

Originally, maritime waters were mainly used for navigation and incidentally, for fishing, recreation and war. They constitute the subject matter of "maritime law". Today, other uses have appeared for maritime waters and beds: exploitation of petroleum and mining resources contained in them or in their beds and in their subsoil; the employment of the sea as a place to dump rubbish, refuses or wastes; the use of tidal electric power and the extraction of algae and other vegetable species.

Traditional Maritime Law, in turn, comprises two different subjects: (a) the ownership of maritime waters and their shores and beds, and (b) their use, mainly navigation, and others mentioned above. Navigation, as long as its main destination is maritime carriage, encloses the legal régime of vessels, their cargoes and crews and is part of two larger branches of law, called "Commercial Law" and "International Public Law". This, by reason of the juridical nature of extraterritorial maritime waters and their eventual utilization, applies both to peaceful and war purposes.

Instead, Water Law, referred to non-maritime waters, encompases several themes.[4]

2.1.1 With respect to the physical location of waters, it comprises: (i) Continental surface waters, including edaphic ones; (ii) groundwater; (iii) atmospheric or meteoric waters, all of which are or may be the object of juridical and legal treatment, either in liquid, solid (snow or ice) or gaseous states. Lately, a fourth category has been added: (iv) endogenous or geothermic water and vapours, produced by the combination of water with natural endogenous caloric sources from the Earth.[5]

2.1.2 With respect to the ownership and uses of water and the defensive action against its harmful effects, it includes the legal régime of ownership of waters and their beds (public, common, private and "res nullius") and that of the following uses: (i) human, domestic and municipal consumption; (ii) irrigation for agriculture, forestry and cattle-breeding; (iii) generation of electric and motive power; (iv) industries; (v) mining and petroleum exploitation; (vi) transportation: river and lake navigation and floatation; (vii) recreation; (viii) fish culture and fishery; (ix) medicinal and thermal uses; (x) warlike uses; (xi) sometimes, river- and lake - beds and waters can also be the object of mining exploitation; (xii) rivers, lakes and underground aquifers are also used to dump rubbish, refuses and wastes.

Among the noxious effects of water, against which Water Law provides, we can mention: floods, pollution, salinization, rising of the water table, alluvium, droughts, eutrophication, hail, frosts, transmission of diseases, etc. Such multiple uses, and their correlative techniques, have justified the classic differentiation between "Water Law" and "Maritime Law".

2.1.3 With respect to the current political milieu it comprises (i) national or local water law; (ii) international rivers law.

However, the hydrologic cycle of Nature is only one, and through it evaporating maritime waters may become atmospheric, then continental and underground and viceversa. Therefore, the division between Water Law and Maritime Law contradicts a law of Nature.

Besides, there is a category of coastal and estuarine waters, where it is difficult to set the limit separating those which must be ruled by Water Law and by Maritime Law, whereas both maritime and continental waters are mutually influenced through them. Maybe this will lead, further on, to the inclusion of all these waters - saline or not - and their beds, into a single branch of the juridical sciences and the exclusion from Water Law, instead, of the legal regime of certain facilities or techniques that use water, such as vessels, the legal regime of cargoes carried by water, generation of power, river fishing, etc.

2.2 "Normative" and "Institution-organizing" Legal Rules in Water Law

Having defined Water Law, it is also convenient to notice that it includes two large categories of subject: (a) Rules which govern relations among individuals, between the latter and water, or between individuals and the Government, in connection with the ownership and use of the waters. They are of a preceptive nature. (b) Organization and operation of Governmental (public administration), semi-public or private institutions to administrate and manage waters and their beds. Such as the associations of canal-users in Chile, irrigators' communities in Spain, water juries, the irrigation syndicates and the Water Court of the Valencia Lowlands (Spain), the irrigation canals in Mendoza (Argentina), the irrigation districts of the USA, the polders of the Netherlands, etc. This category of provisions does not govern individual rights and duties, but organizes and regulates the action of institutions, either public, semi-public or private, established to administrate or manage waters.

The above distinction has juridical significance and it is undertaken by the Agenda of this Conference (Valencia 1975), dealing with both subjects separately. While some of the institutions included in the second of the above categories are purely public or governmental, they come into the sphere of law which rules public administration and may even be included into the category of international public organizations, that is, into the sphere of international public law (the Danube Commission, the Canada-USA joint International Commission, etc.). Some of the early political institutions of human history (e.g. the nomes in prepharaonic Egypt, the Greek amphictyonies) were born, precisely, to manage waters.[6]

3. THE GEOGRAPHY OF WATER LAW

The World is divided into or - rather optimistically - composed of various juridical areas, each of them including several nations, which are not always adjacent. The demarcation of territorial boundaries in these areas depends on historical and cultural or even religious and philosophical factors. The principal aim of this Conference is to define said areas and to explain the main characteristics of Water Law in each of them. It would be too lengthy if I did it here, especially where it has been previously done, brilliantly and wisely, by many writers.[7]

Even the brochure which describes this Conference[8] enumerates some of said areas (Roman, modern Italian, Spanish, Moslem, Chinese, English common-law, French Continental, Soviet, American, Israeli, Hindu-Bali, Latin American, Hispanic, Asiatic), and illustrates graphically, on a map, the flow of cultural currents which took water law systems originating in certain countries, to others.

In a gross generalization, I would say that to define said areas, eight periods may be distinguished: (i) In Europe, the diversification process of Roman Water Law, its absorption or mixing with that of the Ancient peoples that migrated from North to South and from West to East, its decantation and transformation caused by local actions, such as the privileges obtained by cities and towns in a period of struggle between feudal lords and the rising monarchies, led to define areas still existing like the Anglo Saxon common-law, the Germanic, the French, with Napoleon's codes, the Spanish, the Italian, the Scandinavian; (ii) contemporarily with the above mentioned period, in the Islamic countries, it is the formulation of a Moslem Water Law, which develops the Holy truths revealed in a Koran through the prophet Mohammed. Moslem law was taken to non-Arabic countries conquered or occupied by the Arabs - chronologically, the first "imperialists", on both Mediterranean Coasts (European and African), as well as in African and Asiatic nations;[9] (iii) during the colonization process (16th to 20th century) of America, Africa and Asia by the Great European powers, the latter "export" their water law and institutional systems to the colonized countries, as it is graphically represented - with some "arrows" that may be the object of discussion in the map of the op.cit. note 8. The juridical systems of the "metropolis" mentioned in (i) also undergo an adaptation process, receiving and assimilating the influence of indigenous legal régimes and transformations added by local governments after their independence. I have had the opportunity of describing this process with respect to South America, in general, and the water law of Mendoza, Argentina.[10] Also Caponera has studied it for Africa, highlighting the influence of customary law.[11] (iv) The Soviet Revolution and the establishment of socialist régimes in Central and Eastern Europe, after the 1920's and especially after World War II, have defined and spread in the area of USSR political influence, a water law which manifests its conception of a centrally planned economy.[12] (v) In Asia and the Orient, save for the European influence in some countries, the various local juridical systems have maintained their individuality. The Chinese régime, founded much more on a philosophical conception and behavioural patterns derived therefrom than on written laws, had a major influence on neighbouring countries.[13] (vi) Technical assistance, international or bilateral, provided by international organizations or certain Western governments from the 1950's onwards (recently including the USSR) is producing a new transfusion of legal systems

from certain juridical areas to others. This operates by reason of the experience and individual activities of the experts and consultants assigned to that task and not as a government-inspired[14] political action. (vii) A new, purely modern juridical area, is the Israeli water law, born only a few decades ago, with the State of Israel (1959), whose "exportation" is also being attempted. (viii) The advent of super-national organizations, such as the European Economic Community or the Andean Pact, has engendered a tendency to harmonize national legislations, i.e., to gradually blot the boundaries of different juridical areas even as regards water. Mr. Charles Campet, during the A.I.D.A. Inaugural Session (Valencia, Spain, March 25-28, 1968) produced an interesting speech, regretably unpublished, referring to the harmonization of legislation on water pollution in the E.E.C. With respect to water legislation of the Andean Pact or the Cartagena Agreement countries (Bolivia, Colombia, Chile, Ecuador, Perú) a comparative study has been produced recently, which also pursues a design of legislative integration.[15]

As stated by Robert E. Clark as foreword to his work[16] "Condiciones rompen leyes" ("the conditions break the laws", in Spanish in the original). This thought translates the fact that, some times, the transplanting of legal systems from countries with certain physical or cultural conditions to others where different conditions prevail, has now and then produced unsatisfactory results. That is what happened with the riparian rights system, when it was transferred from its country of origin (Great Britain, humid) to the arid Southern and Western states of the United States of America, which finally ended in the adoption of another régime, through the "Reclamation Act" of 1902.[17] And this is also the case when attempt is made to transplant the system of "First appropriation" - justified when applied to vast extensions of lands owned by the State or that have no owners, to promote their development - to regions where lands already have owners or where concessions for private use of public waters, due to water shortage, need detailed conditioning and regulations, to avoid the primacy of the Far West Law, that is, the supremacy of guns to impose the law.

On the other hand, as regards water legislation it is interesting to notice that, notwithstanding the various "juridical areas", when some of the influencing factors are similar in configuration, analogous solutions are repeated for similar problems, although not copied and even without previous knowledge. The irrigators' consortiums of the Po Valley, in the 11th century, Italy,[18] are, for instance, remarkably similar to the "associations of canal-users" (Chile),[19] or the 20th century irrigation districts of the USA.[20] The system of "mitas" (work in common) of the Peruvian Incas, for opening or cleaning of irrigation canals, is applied still today in Mendoza (Argentina), as well as in other continents.

The discovery of these affinities will be the true issue of the Conference of Valencia. For it will allow to take advantage of the experience of some juridical areas in others, if due precautions are taken in their adaptation. Said experiences are valuable both when they succeed and when they fail. Failures cost money. But the subsequent analysis of their causes can save it elsewhere.

4. HISTORICAL EVOLUTION OF WATER LAW

In the foregoing Chapter I have tried to outline the reasons that determined the configuration of different juridical areas throughout the world, and how the process of their delimitation occurred. Here I should try to define the historic evolution of water law, a process which takes place within each of said geographic areas, although not simultaneously in all of them, this depending on the particular local circumstances.

4.1 Changes Related with Water Demand and Availability. Influence of the Degree of Development

In this paper, which is merely introductory to the Conference subject, I can only present a bird's eye view of each theme. I cannot go into details or overwhelm the reader with quotations from legislation of different countries, adequate for a treatise. Having made this point clear, I can say that the historic evolution of water legislation of the many countries I have studied, shows three stages that appear generally and successively: (i) Where water availability exceeds its demand, in the early stages of the nations' development: in such situations, laws have intended to promote the wider use of water, offering all sorts of encouragement - e.g., the guarantee of acquired rights according to the chronological order of their acquisition (without prejudice to third parties clause) - even permitting to strike water in other people's lands[21] or use water without concession (riparian rights system). These laws have only been concerned about the uses of water, not the conservation of the water resource. (ii) Where water demand exceeds availability, particularly due to demographic growth, the solution has been reverted and laws have become restrictive of consumption and regulatory of its use,[22] adopting priorities régimes and even revising existing ones. This is also the case of Israel, where it is compulsory to use rainwater, surface water, groundwater and recovered sewage all combined, the law allowing - as in Peru - to replace the source with which any water right is supplied.[23] (iii) Increased water consumption arising from technological progress, also restricts water availability, forcing legislators to adopt solutions like the recycling or reuse of water or the reloading of underground aquifers.[24]

The above considerations should move legislators to find out in which of said stages fits the case he intends to solve, since they do not appear simultaneously in all countries - and sometimes, not even in the various regions of one country - they are closely linked with the variant celerity in the economic and social development process of each nation and with the rate of its demographic growth. The solutions to be applied in a country where the average annual income per capita is of US$5,000 can never be the same as those to be applied in another where it only amounts to US$50. One must be advised against the risk of oversophisticated law-making. A person living in New York will demand 500 litres of first rate water per day. One in Sahel, will be satisfied if he receives only 50, regardless of its quality!

4.2 Changes Resulting From Modifications of the Social and Political Structure

In many countries, water rights were originally established as implicit privileges. In general, this was done initially to stimulate the growth of said countries. Thus, in Peru, for example, the first users of irrigation waters settled on the higher slopes of valleys, constituting the so-called "derechos de cabecera" (headwater rights), privileged with respect to those situated downstream. Together with that, also the best lands were there. Changes in the social structure and distribution of wealth drove to the elimination, not of the water rights themselves, but of their privileges.[25] Water law-making, specially for agricultural colonization purposes, has been often and recently used as an instrument of economic and social policy.[26] In arid regions, the "water reform" has been a pre-requisite to the "agrarian reform", where the latter was deemed convenient. Thus, for instance, the deficient agricultural use of water in Chile, pointed out in a United Nations study,[27] led to a substantial water legislation reform[28] related to the start-up of the agrarian reform. This is also the case of all communist countries.

However, it should be pointed out that in countries where users have not received previous technical education with respect to irrigation, or where they have lacked managerial spirit, both water and agrarian reform have failed, which induces to approach the subject cautiously.

4.3 The Influence of Technology on Law-making Evolution

In all countries, the early utilization of water was single-purposed, i.e., one water source served for one use: domestic supply or irrigation or navigation, etc. The improvement of engineering technology led, some decades ago, to the construction of works which admit multiple uses, that is, several uses of the same water work. This has created the necessity of significant changes in legislation, to remedy problems in the management of said works, in priorities of their uses and in the allotment of costs to the different sectors of users.[29] Gilbert White[30] has also preached the technique of multiple means-employment (water included), either structural or not, to achieve a common objective, that is, the integration and coordination of water use with that of other resources and with institutional measures, as done by the recent Colombian Environment Code (1974).

Other modern technologies, like desalting, re-utilization of waters, re-loading of underground aquifers, sprinklers and dripping irrigation, vertical drainage, induction of rain and hail, purification of sewage waters, etc., have accosted water legislations, causing the latest stages of its evolution.

The newest and most advanced one - still in the field of futurology - is that of water grids, through which the development of water resources in very vast geographical areas (e.g., the Hindu sub-continent) must be adjusted to very long-term and long-range plans, which lead to an obligated integration in the absorption and distribution of water resources between points as distant as 3000 kilometers and more, from each other.

4.4 Integration of Water Law in Natural Resources Law and Human Environment Law

Other natural resources and environmental elements have begun to influence the enjoyment of waters and viceversa, indirectly restricting or conditioning the availability of the former and making their shortage critical or their management more expensive. The management of forests, for instance, has started to play on the flow and volume of rivers and the quality of soils. Or river-waters pollution by urban sewage or industrial waste effluents has restricted the availability of drinking water or irrigation water. This fact has driven legislators to dictate joint rules for waters and other natural resources (e.g., Forestry, Soils and Waters Law of Venezuela;[31] or to include waters in the global comprehensive legislative treatment of the entire milieu (human environment), including natural resources, as it was done in the Environment and Natural Resources Code of Colombia.[32] The idea of giving a joint and integrated legal treatment to all natural resources (including water), I had anticipated fifteen years ago, in a draft I prepared in 1959[33] and in some publications,[34] has now materialized with the enactment of the Colombian Code. It comprises, in the same body of law, natural resources plus other environmental factors and elements not related therewith. However, it should be noticed that Water Law and Environment Law coincide or overlap only in part, for there are subjects covered by Water Law that have no environmental implications.

4.5 Substantive Expansion of the Contents of Water Law

Originally, water law referred only to man-to-man relations. It just governed disputes among individuals, generally neighbours, hardly regarding the object itself (water). Such are the rules contained in civil codes on relations among neighbours with respect to water (permitted distance form dividing walls to build wells, obligation to receive waters naturally leaking from higher properties, etc.). Later on, rules appeared that regulated Government-men relations. This happened when conflicts between individuals extended beyond the neighbourhood and disputes arose on water interests that had a vaster geographical repercussion (claims from different persons to use the same water source or to use it to mutually conflicting purposes). So the public administration was forced to a more active intervention, setting aside the simple position of laissez-faire, introducing rules that established individual rights and duties related to water, but referred to the Government (e.g., concession to use public water). In a more recent stage, man-object relations were regulated. They are the conservationist laws which prescribe the forms of using water, regardless of what other individuals may do. Finally, there appear Government-water relations, at the time when laws start to shape a water policy, establishing duties and behaviour rules, not so much for users but for the public administration itself.

These steps in Water Law evolution are no more than the reflection of gradual expansion of the State's functions and duties which is a prevalent trend even in countries with a non-socialist political structure. Of course, said expansion is usually resisted in liberal countries. But Adam

Smith's pure thought does no longer exist, anywhere. Demographic growth and technological progress - and the consequent critical water shortage - have determined the sharp expansion of government responsibilities and therewith, an evolution of the substantive contents of Water Law.

Parallel with the evolution analyzed in the foregoing paragraph is the development undergone by Water Law as regards the ultimate purpose of the legal rules it contains, which can be summarized in the following modalities that appear in the legislative history of different countries, in the sequence described below:[35]

(a) Risk-oriented legislation and referred to neighbourhood relations or to specific risks: the above mentioned case of urban wells or drainage of rainwater.

(b) Water use-oriented legislation, which only refers to certain uses, separately: urban supply, irrigation, river navigation, fishers, etc.

(c) Water resource-oriented legislation is that in which the law is first concerned with the conservation of the water resource or with its optimum use and only then with its uses. We are confronted already with the "Water Codes", adopted by some countries, which are quite more than mere compilations.

(d) Legislations oriented towards all natural resources, water included, taking into account the interdependence of water with the other natural resources.[36]

(e) Human environment-oriented legislation, dealing with water, globally, together with other natural resources and environmental elements other than the latter. This is what the Colombian Code of 1974 has done.[37]

5. THE ROLE OF WATER LAW IN THE MANAGEMENT AND DEVELOPMENT OF WATER RESOURCES

5.1 Factors and Elements Leading to the Optimum Utilization of Water

A sound water law is, in no way, the universal remedy which leads to the optimum utilization of waters. But it certainly does help to accomplish it. Contrarywise, on occasions, an obsolete water legislation is the bottleneck that hinders it.

Thus, for instance, Japan is one of the countries where water is best used. But it lacks an organic water legislation and water legal rules are scattered over more than sixteen bodies of laws.[38]

Instead, there are places - like the provinces of La Pampa, Jujuy and Salta, in Argentina - where water laws appear to be perfect but their enforcement fails.

As a matter of act, besides legislation, there are other factors affecting the problem, viz:

(a) The efficiency of public administration agencies in charge of enforcing the law. The Province of Buenos Aires, Argentina, has an

excellent law for water pollution control. But its enforcement has been entrusted to municipal authorities, over 110 in number. They compete among themselves in being as lenient as possible in said activity, because the less demanding Mayor is the one who obtains the settlement of more (polluting) industries in his area, which means collecting more taxes and employing a larger number of workers. This phenomenon is repeated, in the international sphere, in the European Economic Community. The efficiency of water authorities may be lessened not only by their unwillingness to enforce the law - as in the cases mentioned - but also by reasons inherent in their organic structure, or by the lack of properly trained personnel.

(b) The inter-jurisdictional problems and dissensions occurring in the international milieu, but also within countries, even non-federal ones. This is more of a political problem than a juridical one, for jurisdictional conflicts arise from the geographical viewpoint as well as from the functional-sectoral viewpoint. With respect to the former, the problem derives from the fact that water basins do not recognize the political boundaries designed by Man.[39] As regards the latter, even in non-federal countries, the organization of Government in independent departments or ministries creates conflicts among them, where more than one has responsibilities on water affairs. A typical case is found in Bureau of Reclamation vs. Corp. of Engineers, in the United States. The creation of the Water Ministries (Mexico, Argentina, India, Iran) and basin-development agencies (TVA, Cauca, etc.) tend to solve this problem.

(c) The availability of financial resources to attend to the development of water resources and the public utilities based thereon, against which inflation conspires.

(d) The availability of management and technical staff, properly trained on the specific subject, as well as multidisciplinary, for the administration and management of water resources, from government positions, the private sector or semi-public offices.

(e) The education of users, specially farmers, but also industrialists and domestic consumers, for the better utilization of water.

(f) Scientific and technological research on water, in the field of natural and exact sciences, as well as in that of social sciences, to improve the sciences and technology concerning the utilization and conservation of water.

(g) The availability of equipment, materials and manpower to build and manage water works.

(h) The clear definition of a water policy, understood as the enunciation of national objectives on the matter and its coincidence and coordination with the policies of other sectors of the same country. A list of water works to be built does in no way represent the definition of a water policy, but merely one of its forms of execution. A Water Law which is not based on a prior definition of the policy it is to enforce is quite useless.

(i) The action of a quick water courts system, which allows to solve efficiently individual disputes and protect rights of the same nature, a good example of which is had in the Water Court of the Valencia Lowlands, Spain.

5.2 The Role of Water Law and Administration in the Development of a Country

It has been said that water law and administration play separate roles, for there are cases where the former is good and fails because the latter is bad, and others where the latter is efficient, despite the absence of a sound legislation. However, both put together do not only influence the development of the water sector, but also all other sectors which make up the global development of a country.

Of course, an inter-sectoral coordination on water is essential within each Government. When the agencies in charge of one single problem (or sub-sector), e.g.: drinking water, hydroelectric power, or irrigation, are just concerned with that, they may sometimes have a negative incidence on general development, delaying it, for they tend to disregard national objectives.[40]

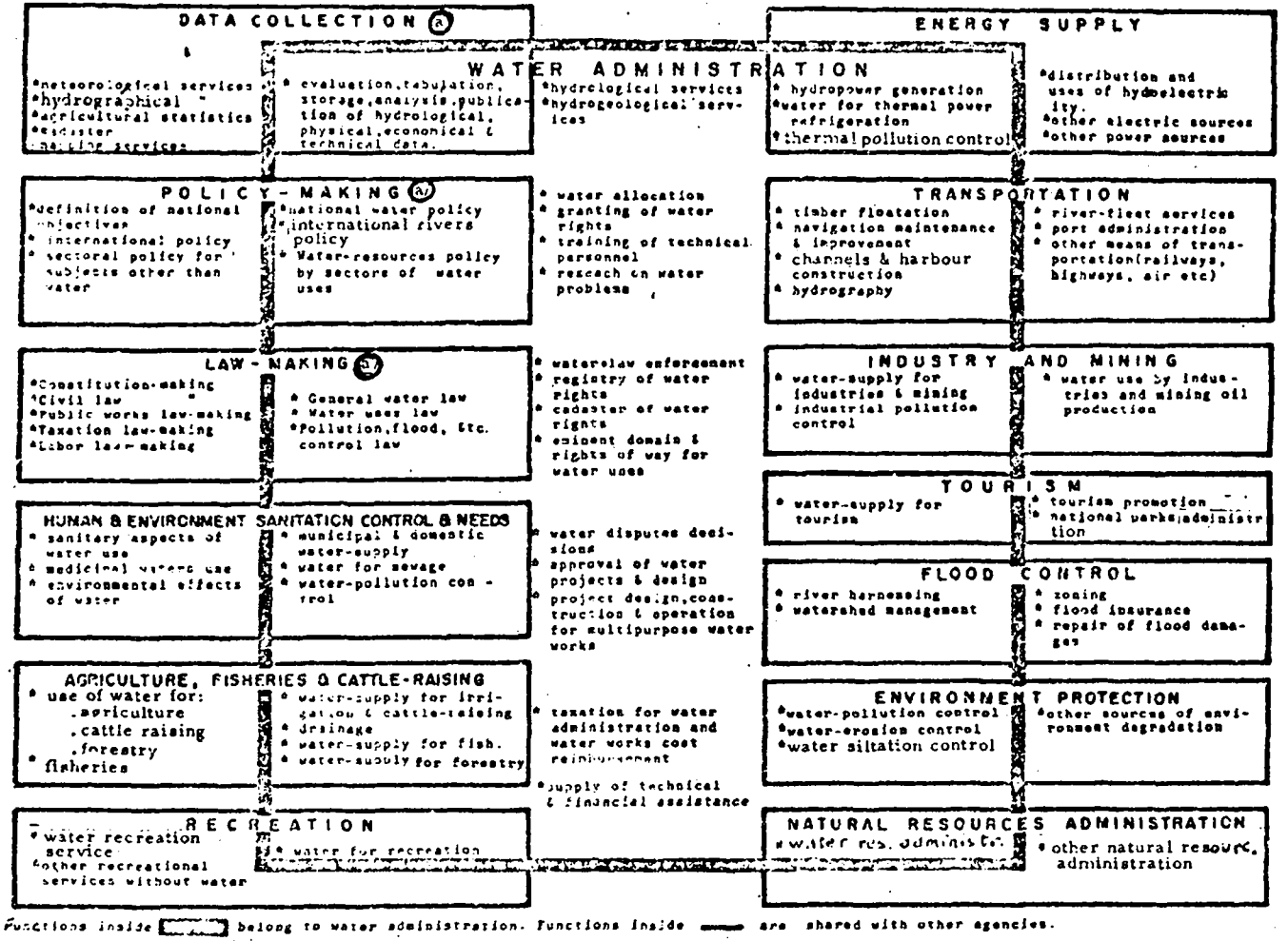
Water Law and Administration in countries that share international water basins, may also be a significant factor in international policy,[41] in accordance with the relative importance attributed to the use of the water resource by the respective country.

On the subject referring to the local national milieu of each country, it should be recalled that the activity of public administration is divided into sectors, while over and above there are general policy aspects which concern them all. One of them is water, but other sectors also include activities relating to water resources. For instance: agencies in charge of river transportation, electric power generation and distribution, public health, agriculture, mining and oil activities, have to use water resources, although their management is not their main responsibility or even no responsibility at all. Thus, the problem of organizing the water administration appears particularly delicate, in order to avoid the collision of inter-sectoral bureaucratic interests.[42]

It is at the farm level - the use of water in agriculture (including forestry, fish culture and cattle-raising), in manufactures and mining exploitation - where the influence of a good or bad water legislation becomes more apparent. Farmers, in particular, are naturally conservative and resist technological as well as legislative changes. In their case, the task of agricultural extension (including knowledge of water legislation) should be a previous and explanatory step to every legislation amendment, for there is the risk of failure. Credit facilities and tax exemptions constitute ancillary means more effective than the repressive law enforcement, to obtain its compliance.

A water world crisis has already been forestalled[43] for the second decade of the 21st century and maybe the most important result of the

fig.1 INTERRELATIONSHIP BETWEEN WATER ADMINISTRATION AND OTHER SECTORS OF PUBLIC ADMINISTRATION



Note: Functions inside [ ] belong to water administration. Functions inside —— are shared with other agencies.

(a) Field of activity common to all sectors of public administration.

Source: reproduced from: United Nations "Proceedings of the Interregional Seminar on Water Resources Administration, New Delhi 1973", quoted in note 36, p.85

World Conference convened by the United Nations for 1977 will be the taking of measures, even legal ones, in time to control it. This crisis involves, directly although not solely, food production. In the world-wide scene, both of them have already attracted the attention of governments, international organizations and individuals. It must be the Governments' first concern to keep up a food production level that permits each government to meet the needs of its own - ever growing - population.[44] And maintaining exportable surpluses of food and vegetable fibers - in the countries with possibilities to produce them - involves an ethic responsibility with Mankind. This is all related directly with the water policy, for water is an essential factor for said production and both water legislation and administration are one of the most important weapons to achieve such policies.

Often water, within one country, is not equally distributed. India has an excessively generous region in the North, whereas the Southwest suffers acute and critical want. In Argentina, 90 percent of water resources are found in one-fourth of its territory, the rest being of extreme dryiness. The same happens with Australia. This turns water into the necessary instrument for territorial political integration in those countries, when the transfer of water from certain regions to others is possible. Water legislation is to play a significant role in this respect.

The exaggerated growth of great urban areas, a phenomenon that takes place throughout the world, can also be controlled, among other means, by a water legislation restricting the use of water where the settlement or growth of urban populations is undesirable.

5.3 Water Resources Legislation as Related with the Legislation on other Natural Resources and Environmental Elements

I have mentioned this subject before. (See 4.4 and 4.5 above.) If, for reasons of method, I come to it again here, it is to assert that not only is it necessary to codify water legislation in each country, but that it is convenient to integrate it with the legislation on other natural resources and the human environment.

Codification of water legislation does not encompass the mere compilation of rules usually scattered in numerous bodies of laws, but their systematized collection that must be preceded by the enunciation of policy principles.

To integrate it with legislation relative to other natural resources is the proper action to take, including in a single body of laws, waters together with the atmosphere and the air space, earth and soil, slopes, ore and oil deposits, flora and fauna, electric power, geothermic, recreational resources, and those of the sea and its bed. They all interdepend and interact mutually and the law must take said interrelations into account.[45] That is what I proposed in my draft Code quoted in note 33 and what has been partially achieved in the Code of Colombia (see note 32) (which, through express parliamentary order, only excludes from its

provisions non-renewable natural resources, although it sets regulations for the environmental effects of their exploitation).

Of the various kinds of natural resources listed in the foregoing paragraph, there are two (waters and the atmosphere) that, because of their quantity, fluidity and mobility, are indivisible and uncontainable. Such qualities make them the most frequent vehicles of said interactions. In the Report for the International Law Association quoted in note 36 ("Relationship among waters and other natural resources"), I have examined the physical aspects of these interrelations. It is on account of all that that, at this stage of the legislation evolutionary process, I consider it timely to have water legislation integrated to that referring to other natural resources and environmental elements.

Water and environment have already become inseparable concepts. Water pollution is one of the most serious environmental problems, but not the only one, affecting the former. Among others we can mention:

(a) alteration of the natural water flow caused by damming, which may damage navigation, aggravate pollution (through decrease of the self-purification capacity) or, inversely, to produce noxious "strokes";

(b) siltation of rivers and canal beds, due to excessive accumulation of solid bed load (e.g., produced by erosion). This makes floods worse and navigation more difficult;

(c) salinization of waters;

(d) floods and alluviums worsened or induced by the mismanagement of fauna and flora (goat-raising in foot-hill areas);

(e) eutrophication of lakes, through accumulation of fertilizers;

(f) depletion of underground aquifers due to excessive extraction and their salinization due to intrusion of brackish waters.

(g) artificial rain induction in places where they are harmful;

(h) waterlogging due to lack of appropriate drainage;

(i) decrease or loss of water flora and fauna engendered by pollution or autrophication;

(j) increased disease transmission through water, caused by their damming in infected zones;

(k) other ecological effects of large artificial lakes, such as seismic phenomena from geological alterations, increased evaporation, recession of deltas, etc.

Water, as well as environment legislation, may and must take into account all these possibilities.

5.4 The User

This personage is always left for the end, both in water legislation academic studies and, generally, in the action of governments. However, he is the "last but not least", for he is the very reason and the ultimate recipient of every law. And, indirectly, he also is the maker, except of Holy laws.

The user requires a double guarantee: juridical security and physical safety.

Juridical security does not mean laws that are lenient, but that will not be changed arbitrarily, when changes harm individual rights or interests. Such security is the strongest motive-power of individual action and initiative because he who is protected thereby knows that he and his issue will enjoy the results of his work. For that reason, the Water Law of Mendoza (Argentina) of 1884,[46] for instance, defines water concessions for irrigation as "intuitu rei", adhered to the land and not to the person of the concessionaire, to prevent that the farmer who owns the land may be deprived of the water that irrigates it, in a place where water is more valuable than land.

This necessity of juridical security creates complex problems when legislation must be up-dated. Iran has faced them bravely (see its above-mentioned law in note 9). As for myself, I have prosed concrete solutions in the water bills for Bolivia,[47] Argentina and Venezuela.[48] Solutions that intend to preserve such security, without enervating the progress of water legislation.

The physical safety the user requires refers to two fields: (a) that he will be supplied in due time; and (b) that he will be protected against the excess of water by its prevention or elimination, when noxious (floods, drainage, waterlogged lands). Water legislation can and certainly must try to provide such safety, through preventive as well as corrective measures. The surety of a timely supply is also linked with the proper organization of water courts. Because wherever water is concerned, slow court procedures are tantamount to total unprotection. Harvests wither much before lawsuits end, when they are too long.

5.5 Final Considerations

Many a time have I repeated one of G. Bernard Shaw's expressions: "the golden rule is that there is no golden rule". This assertion is particularly valid in the subject we are considering. Some jurists are inclined to surrender to the temptation of seeking to unify legislation, not only at the world level, but at the national level. Some of them maybe want this for their convenience (for a practicing lawyer, it is much easier to handle one legal text than many).

In federal countries, where federalism is determined by physical, historical and cultural factors, such undertaking does not only seem impossible, but undesirable.

In non-federal countries, although governed by a framework of general juridical principles, water legislation and administration (using the expression in a wide sense to include regulation), require local variations, adaptable to the problems and needs of the places where they are to operate. The legislation of Valencia (Spain) makes good evidence for this assertion. Alvin Toffler[49] has recently pointed out that the institutional trend for the survival of Mankind lies in the need to accentuate the local and popular participation in government decisions, i.e., the strengthening of local governments. Henry Caulfield[50] did a "mea culpa", and regards local administrations rather sympathetically.

My above assertion could be deemed to contradict the objectives of this Conference. But not at all: the experience gained in some places may be used in others, with the essential adaptation imposed by the due consideration of local circumstances, physical, economical and cultural. Its employment is useful, and the objective of this Conference is to facilitate it.

The United Nations Economic Commission for Asia and Far East has made a valuable exercise: it has prepared a manual for drafting Water Codes,[51] which, as explained in its first pages, is a guideline to the subjects that must be included in a Water Code, with methodological indications. It is not "a book written by lawyers for lawyers" and it does not seek uniformity in legislation. Dale Carnegie has not yet interfered in Water Law. And he had better not.

If, as some forestall, the World is heading towards "continentalization", in the first place, and then to "universalization", due to the interdependence among nations and continents,[52] this involves, within a worldwide and continental planning, together with a lessened power of national governments, a parallel expansion of local laws and governments. Exactly what is recommended for environmental problems.[53] In the field of water resources, this would imply no more than going back to the sources. Thus it was insinuated at the beginning (page A-3, third paragraph), when I pointed out that the earliest forms of political organizations in the history of Mankind were born for the management of water resources at the local level.

FOOTNOTES

1. Non-governmental international institution with headquarters in Vía Montevideo 5, 0198 Rome, Italy, which holds consultive status with the United Nations, liaison status with FAO and category "C" status (mutual information) with UNESCO.

2. As this document will be printed in English, it is essential to make a linguistic and juridical distinction. In Spanish the term "derecho" includes three different things; (a) the law or written statutory rule; (b) the doctrine of jurists; and (c) the jurisprudence set by courts, which in the countries with a Roman Law tradition only interprets, but does not create - save in few exceptions - legal rules. Instead in English, due to the common law system, a single term (law) includes and defines all three categories mentioned, wherefore in that language "Ley" and "derecho" are synonyms, whereas in Spanish "ley" (the literal translation of which is Law) and "derecho", are not. The same considerations are valid for the French language: the Spanish words "derecho" and "ley" being synonyms of the French "droit" and "loi".

3. We prefer this term to "fresh water" because our Water Law comprises all waters not included in the sea (atmospheric, continental and underground waters) and some of them are saline or brackish.

4. See my "Concepto y Fuentes del Derecho Argentino de Aguas", in Jurisprudencia Argentina magazine (Buenos Aires, Doctrina 1974), p. 512.

5. See "Codigo de los Recursos Naturales y del Ambiente de Colombia", decree 2811, dated December 18, 1974, articles 172-177.

6. See Karl Wittfagel, Oriental Despotism, Yale University Press, 1957. See also F. Laurent, Historia de la Humanidad (Madrid, 1875), volume 11, page 91; Alejandro Moret, Historia de Oriente, (Bs.As. 1928, second edition) page 61; and my "Estudios de Derecho de Aguas" (Mendoza, 1943), Abeledo Edit., page 37.

7. See, among many others: Alberto G. Spota, "Tratado de Derecho de Aguas", (Buenos Aires, 1941) ed., J. Menendez, 2 vols.; M. Championnière, "Des Eaux Courantes" (Paris, 1846), ed. Hingray.

8. International Conference on Global Water Law Systems, Valencia, Spain, 1975, pages 3 and 9.

9. See Dante A. Caponera, Water Law in Moslem Countries (FAO, Rome 1973). However, Iran, with its Water Law and about the nationalization of waters (September 1968), has exceeded the Muslim juridical Area.

10. See my "Régimen Jurídico-Económico de las Aguas en Mendoza durante el Período Intermedio" (1810-1884) (Mendoza 1941, ed. Libreria de la Universidad); and my "Las Leyes de Aguas en Sudamérica (FAO, Rome, 1956).

11. See U.N. Economic Commission for Africa, Water policy, administration, and legislation in Africa, doc. WRD/CONF.4 Addis Abeba, 1970) by Dante A. Caponera.

12. See Water Resources Law and Policy in the Soviet Union, edited by Irving K. Fox, Madison, 1971, the University of Wisconsin Press, with contribution of Oleg Kolbasob, et al.).

13. United Nations (Economic Commission for Asia and Far East) Water Legislation in Asia and the Far East (2 vols., 1966 and 1968) doc. sales Nr.66 II.F. 11 and E,69 IIF.6, contributions by Dante Caponera, Yoshio Kanazawa, Lydia Vendiola, Ivan Shearer, Sandford Clark et.al.

14. Some of these experts believe that the system in force in its place of origin (e.g., that of "first appropriation), is the "best in the world" and intend to transplant it "urbi et orbi", never stopping to think that historical, cultural and physical factors which made it a success in its origin may not be repeated in elsewhere.

15. David R. Daines and Gonzalo Falconi H., Legislación de Aguas en los Países del Grupo Andino, Minutes of the Water Laws Seminar of the Andean Group (Quito 1974).

16. Robert Emmet Clark, Water and water rights (Indianapolis, 1967) published by The Allen Smith Co., vol. 1, p. iii.

17. Clark, op.cit. vol. 1, page 29. Here we should repeat what was said in note 14 above.

18. Spota, op. cit. vol. 1, page 221.

19. Pedro Lira Urquieta and Lorenzo de la Maza, Regimen Legal de las Aguas en Chile (Santiago 1940), ed. Nascimiento, p. 102.

20. Wells, A. Hutchins, Irrigation districts, their organization, operation and financing (Washington 1931). U.S. Dept. of Agricultural Technical Bulletin Nr. 254.

21. U.N. Economic Commission for Latin America and Federal Council of Investments, "Los recursos hidraulicos de Argentina" (Buenos Aires, 1969), vol. 6, page 70.

22. Op. cit., in note above, vol. 6, page 26.

23. On Israel's legislation see: United Nations "Captación y Aprovechamiento del Agua: Estudio Comparado de los Regímenes Jurídicos", by Ludwik Teclaff (N. York, 1974) doc. sales Nr.S. 72.II.A.10, page 55; similar rules may be seen in the Peruvian Law quoted in note 25, art. 7, f.

24. See rules in force in Valencia (Venezuela) in G. J. Cano, Estudio sobre los Recursos Hidráulicos de Venezuela - Aspectos Institucionales y Legales (Santiago de Chile, 1960, ed. Mimeo. of ECLA), p. 130.

25. Perú, Ley General de Aguas (Decree-Law 19952, dated July 24, 1969).

26. See G. Cano Las Leyes de Aguas en Sudamérica, quoted, chapter 3; FAO, Groundwater's Role in Social and Economic Development: An Example Based on FAO's Near East Regional Activities on Groundwater Development and Use, by David Burdon, Dante Caponera and J. P. Hrabovsky (doc. AGL:Misc.7.8. April, 1971).

27. United Nations - Los Recursos Hidráulicos de Chile (México 1960), doc. sales Nr. 60.II.G.4, pages 53, 67 and 113.

28. Chile, Código de Aguas (Decree-law 162, dated January 15, 1969). Santiago, 1970, Editorial Jurídica de Chile.

29. United Nations, Integrated River Basin Development (New York 1970, second Edition) doc. sales Nr. E.70.II.A.4, pages 2 and 18.

30. Gilbert White, Strategies of American Water Management (Ann Arbor, 1964), The University of Michigan Press, p. 46.

31. Law of Venezuela, dated August 31st, 1955.

32. Decree of Colombia, Nr. 2811, dated December 18, 1974. See also my Introducción al Derecho Ambiental Argentino, in La Ley magazine, (Buenos Aires), vol. 154, p. 914.

33. See my Anteproyecto de Código de los Recursos Naturales para la Provincia de Jujuy (Argentina), (Mendoza, 1959).

34. See United Nations doc. E/4636 add. 1 (1969), articles titled Law, Institutions and Natural Resources, reproduced in Spanish in "Recursos Hídricos" magazine, (Buenos Aires, July 1970). Nr. 3, p. 41.

35. See my op. cit. in note 32; and Peter H. Sand, Legal Systems for Environment Protection-Japan, Sweden, United States (Rome, 1972) FAO Legislative Studies Nr. 4. See also: Asociación para la Protección del Ambienta (Argentina): First Argentine Meeting for Environment Law and Administration - Working Papers (Buenos Aires, 1974) p. 24.

36. Jack Kratchman, The Rise and Fall of Natural Resources Systems, in "Land and Water Law Review", vol. VIII, nr. 2 (1973). p. 429, ed. University of Wyoming College of Law. See also International Law Association, Report on the 53rd Conference Buenos Aires, 1968 (London, 1969), p. 531; and my works: New approaches to water resources administration in developing countries, in United Nations, Proceedings of the "Interregional Seminar on Water Resources Administration, New Delhi, 1973", (New York, 1975), doc. DP/UN/INT-70-371) p. 84 and The Legal Basis of Integrated Utilization and Conservation of Water Resources (Ferganá, USSR, 1966), document of the UN Interregional Seminar, and my op. cit. in note 33.

37. See above note 32.

38. In my work, Aspectos Legales del Uso y Conservación Integrales de los Recursos Hídricos, quoted in note 36, page 33, I individualize the laws in force in Japan with respect to water.

39. See my National Water Laws and Administrations as Elements of Water Development in "Water for Peace Conference", Washington, 1967, vol. 5, p. 5.

40. See Alberto Wagner de Reyna, El Problema Mundial del Agua (Lima, 1972), ed. Academia Diplomatica del Perú, p. 83.

41. See my Argentina, Brazil and the "de la Plata" River Basin, A Summary Review of their Legal Relationship, in "Natural Resources Journal" (Albuquerque, New Mexico), in print at the date of this paper; and in Spanish, in La Ley magazine (Buenos Aires, May 26, 1975), vol. 161.

42. In my paper, New Approaches to Water Resources Administration in Developing Countries, quoted in note 36, I have analyzed this problem more at length. Figure 1, taken therefrom, is its graphic representation.

43. Lawrence Rocks and Richard P. Runyon, La Crisis Energética Mundial (Buenos Aires, 1974) Emecé edit. p. 457.

44. Jaro Mayda, The Legal and Institutional Framework for Environmental Resources Management (Ecomanagement), (Mexico, 1974).

45. See my A Legal and Institutional Framework for Natural Resources Management (Rome, 1975, FAO Legislative Study), where I list and classify into categories all kinds of natural resources.

46. See my Reseña Crítica de la legislación y Administración de Aguas de Mendoza (Mendoza, 1967), pp. 19 and 28.

47. See Instituto Nacional de Economía, Legislación y Administración de Aguas (Argentina), Anteproyecto de la Ley General de Aguas y de Ley de Autoridades de Aguas de Bolivia (Mendoza, 1972), articles 169 and 170.

48. See my Anteproyecto de Ley de Aguas de la República de Venezuela (Caracas, 1963), articles 225-233 and my Anteproyecto de Legislación Nacional de Aguas (Argentina) (Buenos Aires, 1972), p. 11, articles 13-17.

49. Alfin Toffler, The Ecospasm Report (New York 1975) ed. Bantam. See also his thought on this respect in Diego Uribe Vargas and Noracio H. Godoy Política Mundial Siglo XXI (Bogotá 1974, Fundación para la Nueva Democracia).

50. Henry Caulfield The Apostasy of a Longstanding Water Development Federalist (paper delivered to the National Conference on Water, Washington, U.S.A., April 1975).

51. United Nations, Guidelines for the Drafting of Water Codes (New York, 1973) doc. sales Nr. E.74.II.F.2, by Sandford Clark.

52. Mihajlo Mesarovic and Eduard Pestel, Stratégie pour Démain-2e Rapport au Club de Rome (Paris 1974). ed. Seuil.

53. World Health Organization, Report on the Planning, Organization and Administration of National Environmental Health Programmes (Geneva, 1970); Peter Sand, op. cit., p. 36.

Mr B.

is een apart boekje (Tribunal des Aguas) in Spaans met Engels en Frans summary.

EARLIEST WATER LAW SYSTEMS

by

Dante A. Caponera*

1. INTRODUCTION

The purpose of this note is to describe, as concisely as possible, the earliest water law systems as developed by the most known early civilizations in the world. Many of these civilizations are referred to by the name of the river around which they developed. Thus, the Egyptian civilization is the civilization of the Nile, the Assyro-Babylonian or Mesopotamian (literally, between two rivers) as the Tigris and Euphrates civilization, the Hindu as the civilization of the Indus, the Chinese as the civilization of the Huang-Ho. Other civilizations which developed during different historical periods also grew around important water points; such as the case of the pre-Columbian, Peruvian, and Meso-American civilizations, the Khmer civilization around the Mekong River, the Hilmand civilization between present Afghanistan and Iran, the Elam and Suziana civilizations around the Dez River, etc.

It may be said that all human migrations and the birth of towns and communities have been closely correlated with the search for and settlement around naturally-watered areas. This does not need to be demonstrated, as the importance of water in all aspects of human activity is well known; one basic condition for human life is the availability of water for drinking, watering of animals, plant growth and transportation, the first utilizations of earliest human settlements.

As soon as human groups settled around a water point or a river valley the need arose for minimum water control in order to satisfy increasing water demands and to ensure an equitable water distribution between different users and uses. It is from this need that the earliest water law systems developed. Their growth, persistence and character varied and were dependent upon many factors, such as local geo-physical, climatic conditions, socio-economic and managerial situations, and the religious-philosophical beliefs of the populations concerned.[1]

It may also be said that the development and growth of early hydraulic civilizations, as they are sometimes called, were closely related to the degree of effectiveness of the administrative-managerial, religious and legal controls imposed on water use; on the other hand diminished social concern over the management of water has been one of the main causes for

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the subsequent decay and sometimes disappearance of early hydraulic civilizations. A typical example is the disappearance of the Mesopotamian civilization as a consequence of decreased administrative control over the canals, which became burdened with silt. Likewise, throughout history, the intervention of external invaders with the destruction of waterworks and disruption of existing water management also made certain hydraulic civilizations disappear.[2]

2. DIFFICULTY OF STUDYING EARLY WATER REGULATIONS

The sources for the study of primitive law in general are many; for the analysis of ancient water law in particular, three sources seem to be more relevant. The first is the skilled observation of past and present authors of the life and laws of primitive people, the second consists of the written ancient texts and compilations commonly referred to as codes and which continue the historical development of primitive law, the third consists of the legal or other relevant documents which have come to us from the past, especially those embodying legal transactions and administrative or managerial instructions.

However, this study is extremely difficult as it involves the interpretation and analysis of scattered passages of ancient texts. It is even more difficult to abstract basic principles from them. A thorough knowledge of the works in their entirety would be necessary, not only from translated, deciphered or transliterated texts but from direct sources. This task presupposes the knowledge of ancient languages, and those who know these languages are seldom lawyers. To these difficulties may be added the need to put the legal and institutional aspects of water ownership, utilization and administration within an historical framework, including political, religious and geo-hydrographical background of the period, and the regions and civilizations within which they originated, developed and eventually disappeared. Therefore, a thorough and scientific legal analysis of ancient texts to ascertain or abstract irrefutable legal principles on water laws of early times would require the cooperation not only of lawyers but also of anthropologists, linguists, philosophers, theologists, historians, political scientists, sociologists, economists and water technicians; qualities very seldom found in one person.

On the other hand, the importance of considering the values of primitive water regulations and institutions within the overall framework of the society in which they developed cannot be overlooked. A general background of the historic and socio-economic situations of primitive hydraulic civilizations is therefore a prerequisite for undertaking these studies. Finally, in the eyes of a modern writer the administrative and legal concepts of ancient civilizations may appear somewhat different and have diverse meanings if considered in the light of our current institutions within which our scientific, technological and legal preparation was developed.

3. DEVELOPMENT OF EARLIEST WATER LAW PRINCIPLES[3]

The very nature of water presented two precisely opposite challenges to the evolving early hydraulic civilizations: how to convey it to the land for irrigation where it is needed, and how to control it where it threatens men with damage. In the first instance, hydraulic civilizations developed where natural and recurring floods brought water and alluvial soil to the lands; at a later stage man-made aqueducts and irrigation canals provided for such need. In order to fight against harmful effects of water, dikes, dams and artificial hydraulic structures were built. In the second aspect, the harmful effects of recurring floods obliged populations to pool their efforts and organize themselves.

These two physical aspects of water brought about the first quest and development of water law principles.

The incalculable amount of labour obliged a whole community to work for a common end, and, as a consequence of the union of efforts in water activities, a decisive step took place toward the elevation of a community to the level of a state. Defense and devine worship constituted the basis of combined action for progression from community to state. Hydraulic civilizations necessitated an authority which planned the works, supervised their execution and brought them by coercion to successful termination. Such coercion must have taken place by means of water regulations under an appropriate water administrative authority. Government control over agriculture and commerce was subsequent to the construction of canals and navigation structures.

In the primitive development of the law, the chief valuable is land, including water, cattle and slaves (for which water is needed), ships or boats (utilizing water) and the rest of movable articles (food, household furniture, equipment), etc. However, unlike movables, land and the availability of water is the essential source of livelihood in all phases of human society. Land is fixed in extent, and all members of the community must have access to it in appropriate quantities. This is how the rights-duties relationship of land and waters developed. Public interest of the community in land and water gave rise to their becoming public property. Individuals within hydraulic civilizations practiced a certain mode of conduct towards the use of communal land and water for drawing water, transit, hunting, fishing, etc., and this behaviour came to be considered the right of any member of the community. Such public rights varied according to the character of the land and water and the socio-economic structure of the community; in most places it so developed as to give rise to the notion that all lands and waters belonged to the community and that the rights of individuals or groups were either dependent or partial. In those communities where there was no land property, what vague notion existed with respect to land ownership went probably in the direction of communal property under various forms: tribal, property of groups intermediate between the tribe and the family, cases where land and water were vested in the hands of the chief, or a combination of all of these.

4. ANCIENT EGYPTIAN WATER REGULATION AND CONTROL[4]

Very little is known of the water regulations of ancient Egypt, although Egyptian records relate that they existed. The most important codifications referred to are those of Horemheb at Karnak. None of these regulations seem to have survived.

However, reliable records describe in detail the hydraulic structures constructed and the water administration through different periods, from which it may be assumed that a whole body of water regulations must have existed.

In the pyramid texts, the God Osiris is identified with the Nile waters. According to tradition, Menes, the legendary first of the Pharaohs, dammed the Nile to control floods. As early as the period of the first two dynasties[5] there was a "constructor of the king" (Medeh Nisout) providing public works. Since that time the Nile was measured and recorded on the Palerm Stone.[6] During the third dynasty[7] the water administration under the "constructor of the king" developed into two departments, at the head of which were a Master of Canals and a Master of Lakes. While no changes occurred during the fourth dynasty,[8] under the fifth dynasty[9] a "Master of water castles" was added to the water administration, and the State organization developed even further. The civil status of the population, the cadastre of lands, the registrar of all deeds, the water administration, the public works department were coordinated by the Central Chancery. Branch offices of these services were scattered all over the country and the officers recorded everything on papyrus conserved in the State archives. Through this organization and records, the State could assess and collect taxes through its financial services. Under the fifth and sixth dynasties a larger degree of decentralization of services developed, together with a diminished concern for waterworks construction and maintenance. It is during this last period that the civilization decayed; the deltaic towns became for a while small autonomous states governed by an oligarchy.

During the twelfth dynasty centralization of water administration was renewed. The district governors of the Old Kingdom had as their chief title "Digger of Canals" and were responsible for the upkeep of canals and dikes, for patrolling and inspecting the banks when water reached its height, and for organizing aid when disasters threatened. In the case of floods, a state of emergency was declared, obligatory corvees organized to fight against water invasion. A larger network for measuring the height of the Nile (Nilometers) developed, the records of which were used to compare with past records and forecast possible floods downstream. The deterioration of dikes and canals was regarded as an offence punishable by death, and this principle continued to be maintained up to and after the Romans.

In ancient Egypt the land and water belonged to the Pharaoh who, as a living god on earth, granted its temporary use practically to whom he liked. Every community had to provide the king with the produce of the soil through its "Xerp" or public officer in charge of a district. The

waterworks were carried out by groups of 1,000, 100, 10 or 5 men organized under a farm leader, in working units to whom a plot of land was granted for cultivation. The income derived from cultivated lands was controlled and assessed for taxation by public treasury officers who were themselves under secret control by the king. The Scribes recorded everything.

It is unfortunate that, so far, no written water regulations have come to light, probably, as some authors have suggested, because the Pharaoh needed no law other than his own.[10]

5. ANCIENT MESOPOTAMIAN WATER REGULATIONS AND CONTROL[11]

A series of records in the form of inscriptions were available concerning water regulations in the Babylonian, Assyrian, Hittite and related civilizations.

The Sumerians worshipped the God of inundation, and the Sumerian King Gudea (2492 B.C.) is reported to have "constructed a new canal and maintained in an excellent state of repair the irrigation system of smaller canals." The Babylonian God "Nun" personified the idea that water is the source of life, and of all blessing, and the element of creation. During this period there also developed a codified law by Shulgi, the second king of the third dynasty, which laid down the basis of the Hammurabi Code. This code and the royal letters to local governors giving instructions for the upkeep of waterworks and canals, constitute the basis for most of the water legislation in Mesopotamia, even when issued subsequently under new forms of codification.

In the introduction of this code, King Hammurabi describes himself as "the gracious arbiter who has allotted.....watering places to Lagash and Girsu..." and, "the giver of the water abundance to.....drink."

Water is considered as possessing a divine character, and as means of punishment for various offences.[12] But articles 53 to 56 are those dealing specifically with water control. Thus, Art. 53 states that if a man has been slack in maintaining the bank of his fields and has not strengthened them and a breach has occurred whereby the waters carry away the harvest on the land, the man in whose land such breach has occurred shall replace the corn which he has caused to be lost. If he is not able to replace the corn, he and his goods shall be sold and the tenants of the water-land whose sesame the waters have carried away shall divide the proceeds from the sale (Art. 54). A similar punishment is provided for in Art. 55 in the case in which "a man has opened his trench for irrigation and has been slack and has let the waters carry away the soil on his neighbour's land, he shall pay corn corresponding to his neighbour's loss." Art. 56 provides that if a man has released the waters and in so doing has caused the waters to carry away the works on his neighbour's field, he shall pay 10 gur of corn for every bur of land.

Finally, this code ends with a supplication to various divinities for punishing anyone who would not comply with the regulations set forth in the code. King Hammurabi exclaims: "May Ea, the great prince.....stop his

river at the source, and cause bread-corn, the life of the people, fail to grow on his soil...." and, "...may Adad, the lord of ever-flowing wealth, the controller of heaven and earth, my helper, deprive him of the rains from heaven and the flood water from the source, may he bring his land to ruin by famine and hunger, may the thunder in rage against his city turn his land into a heap left by the flood..."[13]

After the Hammurabi Code, some of the subsequent codifications of later civilizations in the area also contain similar provisions on water control.

Article 3 of the New Babylonian Laws enacted about one thousand years later states that a man who has dug his cistern for irrigation but has not strengthened it, and by not doing so causes a flood in his neighbour's land, shall pay in flour the damage caused by him.[14] This article may be compared with Arts. 53-56 of the Hammurabi Code.

The Assyrian fragments in our possession containing legal provisions are not a complete code. One tablet deals with land law, and Clauses 7 to 15 specifically with wrongs committed against a person with respect to his land.[15]

The Hittite Laws, dating back to the 13th Century B.C., also contain important articles relating to water. Special provisions for those who irrigated their land are set up (Art. 48), and while Articles 146-147 provide for an indemnity for those wounded in digging a well to be paid by the owner of the well, Art. 162 contemplates payment of fines in money for those diverting waters unlawfully.[16]

In the same region, the inscription of Kudurru of Nebuchednezzer I (V Century B.C.) contains malediction for those having let mud fill the canals. This provision denotes lesser concern for the upkeep of canals and other waterworks, which caused the decay of the ancient Mesopotamian hydrualic civilization.

The remains of the impressive hydraulic works carried in the Mesopotamian region[17] indicate that specialized water engineers and a strong water administration had to exist. Hammurabi's letters to local governors show that each district was responsible for the upkeep of its own waterworks; thus to the Governor of Larsa the King writes: "Summon the people who hold fields on this side of the Damanu Canal that they may scour it... within this present month and let them finish it." In another letter he complains that the bed of a canal has been imperfectly cleared so that boats cannot enter the city of Erech; the Governor must have the necessary work done within three days.....[18]

In the earliest periods, the direction of water administrations to construct, maintain and distribute waters for irrigation seems to have been under the authority of priests, creating thus a theocratic state. Subsequently a dynastic authority developed which slowly took the place of the priesthood.

The Mesopotamian State was born and grew as a consequence of organizing water distribution "...the State was in the water and came forth out of

it, no less than the earth itself according to the cosmology of the people."[19]

More recent inscriptions found in the area refer to water rights owned and administered by bankers, and to sanctions for the owners of water rights for selling, renting or otherwise alienating them. It would appear that private water rights and localized water administration came about in later periods and substituted previous communal rights over water and, consequently, the centralized water bureaucratic organization of earlier periods.

6. ANCIENT HINDU WATER REGULATIONS AND CONTROL[20]

The hydraulic civilization which developed in the Indus Valley[21] has many features similar to those of the Nile and Tigris-Euphrates civilizations: recurring annual floods, strong bureaucratic water administration to control the water, large amounts of waterworks and divine character of the waters.

The most important documents relating to water laws are those contained in the Manava-Dharma-Shastra or Laws of Manu, the ancient origin of which has been subsequently recorded in later texts.

For the Hindu, the Law of Manu represents the expression of the divine will or principle of universal order, as the necessary norm of correspondence between the essential nature of man (Dharma) and his deeds (Karma).[22]

According to Rig-Veda belief, the Goddess Sarasvati gave birth to the rivers; she was the peacock-riding wife of the four-headed Brahma, creator of all things.

The Code of Manu, after Brahamism arose, was set within a body of rules prescribing the various duties of the King, who was also law-giver and judge. The mythical Manu is besought by the sages to tell the sacred laws. He informs them how he was born from Brahma, how the world was created, and how he received the Code from Brahma and communicated its contents to the Ten Sages. He asks Bhrigu, one of the Ten, to repeat it to the other nine, after which the content of the Code follows, recited by Bhrigu.[23]

Chapter III, Section 151 of the Code states, "Let him not entertain at a sradda (dinner)...., he who diverts watercourses and he who delights in obstructing them...."[24] In Chapter IV, Article 226 reads, "...a rich man must always without avoiding it and with faith, do charitable works as constructing a reservoir or a well or building a public fountain..." and Art. 229: "He who gives water obtains satisfaction." This provision is similar to the "Waqf" or religious endowment developed in Islamic law.

In these regulations is found the concept of public waters: "....water" along with other things "they declare to be indivisible."

(Chapter IX, Section 219).[25] In the same order of idea we find that kings used to collect rights or way for crossing rivers (Chapter VIII, Section 404) and that the law imposed upon the king special obligations with respect to public water such as to "organize vigilance and guards, both stationary and patrolling, and spies..." on waters and on "houses where water is distributed" (Chapter IX, Section 264-266).

The emphasis of economic and social concern placed on water in this code may be seen by checking the rigorous punitive system by which the common utilization of public waters was insured. We find thus a moral sanction to consider "as a matter for exclusion from the society of the good people the sale of a consecrated reservoir" (Chapter VIII, Section 61 and 69); then, the obligation to punish with death "he who breaks the dam of a reservoir and causes loss of water by drowning him in the water or have his head cut off." The offender "may repair the damage but he shall have to pay the highest fine" (Chapter IX, Sect. 279). But he "who shall take away the water of a tank made in ancient times, or shall cut the supply of water, must be made to pay the first (or lowest) fine" (Chapter IX, Sect. 281). Furthermore, "the fine of a gold Masha and the obligation to restore everything to its original state" shall be imposed upon anyone who "destroys a public fountain" (Chapter VIII, Sect. 309).

Finally, the unlawful appropriation of the water of a well or cistern shall be punished by a "lunar penance" (a minor one) (Chapter XI, Sect. 164).

Waters are also considered an element of purification, as well as a means to ascertain the culpability of a person for certain crimes. Special ceremonials had to be performed in this latter case.[26]

The control over water utilization and distribution was under the responsibility of a powerful water administration headed by a water superintendent; this high official was vested with full and undisputed powers on all questions relating to water.

7. ANCIENT CHINESE WATER REGULATIONS AND CONTROL[27]

The water regulations of the Chinese hydraulic civilization evolved together with the peculiar legal, administrative, philosophic and political framework of China.

Chinese legal thought was based on the belief in a close interconnection between the human social order and the natural cosmic order. This concept is particularly relevant with respect to water ownership, distribution, utilization and administration. Harmony and unity, prevailing throughout creation, were believed to be reflected in human behaviour towards oneself, the neighbours, the family, the group, the society and the emperor. As a consequence, the foundation of social order was not necessarily the law (fa), but the li, a term variously translated as rules of propriety, rituals or customs, prescribing to everyone a behaviour in harmony with the natural order. These are the views of the Confucian theory, out of which Chinese legal thought developed.

Around 200 B.C., these doctrines, based on moral and ethical influence as opposed to law enforcement, were for a time opposed by the so-called school of legalists who held that the law (written and known) to which everyone was subject, governed the relationships between human beings.

It is the combination of the Confucianist and Legalist theories or, as it has been said, the Confucianization of the law (fa) that gave birth to the Chinese legal system.

The development of water regulations closely follows the evolution of this legal history and philosophy.

The first reliable records on Chinese water law are to be found in the Li-Chi,[28] or treatise on ceremonial rules, in which interesting and suggestive passages refer to the behaviour of the ruler in the administration and regulation of water resources, in harmony with the natural behaviour of nature and recurring seasons. As an example we may quote, "....in spring, all life starts and rains of heaven fall on earth, and therefore, let the waters run and irrigate the fields..."; in the summer months, "build dams and dikes and store the waters for later consumption..."; in the winter months, life ceases and therefore hardship arrives..." let inspection of works and collection of water rates and taxes be undertaken...punish offenders," etc. From these regulations it appears that no private ownership existed, and the government administration was responsible for the construction, repair and maintenance of hydraulic works, including bridges, navigation and fishing. Local officials derived their authority from the will of the emperor, and could issue orders and regulations in compliance with the behaviour of natural order. Labour was provided by the people concerned under a system of corvees as part of their yearly obligations towards the State.

Under Shih-Huang-Ti, the first emperor of the Ch'in Dynasty (249-207 B.C.), the influence of the legalists was at its peak; the centralized administration enacted a uniform and publicized system of codification.

The subsequent Han Dynasty (200 B.C.-618 A.D.) codified the previous Ch'in system of laws, but again introduced the Confucian li (rules of propriety, custom) in the fa (law - punishment), or, as it has been said, humanization of law occurred. An ordinance on waters was enacted in 111 B.C., and a new principle of "water equalization" appeared in this text. Land and water resources were under the control of a director of agriculture, and a court architect was responsible for water control. "The mountains and the seas, including lakes, streams, rivers, swamps.... are storehouses of heaven on earth... and... their control ought to belong to the office of Shu-Fu.." (Secretary of the Treasury).

It is interesting to note that the basic principles of water ownership, use and administration as related in detail in the original Li-Chi and pre-Han periods, reproducing the earliest concepts of water law, continued to persist in the water ordinances of subsequent major codifications of the T'ang, (618 - 1644 A.D.), Manchu or Ch'ing (1644 - 1911)

Dynasties and, with obvious modifications for improved and enlarged water administration, up to modern times.

Under Chinese water law principles private water ownership never appeared; the individual's duties in water matters would eventually lead to and enhance public welfare. Under the "water equalization principle," the upper riparians could utilize the water but without monopolizing the resource. The water administration was always in charge of all water activities, including navigation, flood control, floating, waterworks construction and upkeep, bridge control and water policing, while individual irrigation and fishing could be performed provided they fit into a collective pattern. The obligations with respect to opening and closing ditches and canals, cleaning and upkeep of waterways, and "turns of duty conscription," or corvees, had to follow the natural seasonal variations and requirements according to the natural order. Punishment was provided for in the case of offences under the water codes, ordinances and regulations.

8. HEBREW WATER REGULATIONS AND CONTROL[29]

The Hebrews, one comprising a loose federation of tribes of mixed origin, have left us an invaluable code of early law, partly influenced later (400 B.C.) by contact with Babylon. The basic principles of this code are contained in the Bible, which today serves both Jews and Christians. But in the matter of water law the Christians have adapted themselves and accepted first the rules enacted by the Romans and subsequently those of the countries where they live. The Jews evolved their own legal doctrines and opinions from the Bible. These are contained in the Talmud, a consolidated and unified digest of Jewish law, written between the IVth and IIIrd Centuries B.C. With respect to water regulation the Talmud includes a few references which are the development of the basic principles contained in the Torah, or revelation of Biblical texts.

The attribution to waters of an economic value of stability, exchange and prosperity stems from the context of the following passages of the Bible: "And ye shall serve the Lord thy God and He shall bless... thy water."[30] The fact that the habits, customs and social organization of men have been influenced more by their association with water than with land is indicated by these passages: "For the Lord thy God bringeth thee into a good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills..."[31]; "I did know thee in the wilderness, in the land of great drought..."[32]

Water is a divine gift for the subsistence of human, animal and plant life: "He sendeth the springs into the valleys, which run among the hills. They give drink to every beast of the field: the wild asses quench their thirst. By them shall the fowls of the heavens have their habitation, which sing among the branches. He watered the hills from his chambers... He causeth the grass to grow for the cattle and the herb for the service of men..."[33]

As a consequence of the benefits that water provides to all living creatures water resources seem to be substracted from private ownership.

Thus, under Talmudic law: "Rivers and streams forming springs, these belong to every man."[34] The existence of wells belonging to the public domain and the right for every traveller to use them is also recognized.[35]

Servitudes and rights of way limited the use of water on privately owned lands, and the principle of compensation for the use of water also existed: "And the children of Israel said unto Him, "We will go by the highway, and if I and my cattle drink of thy water, then I will pay for it only, without doing anything else, go through on my feet.'"[36]

Restrictions on land ownership rights also appearing in Talmudic law prohibited riparian landowners from planting anything in a strip four cubits wide along an irrigation canal, and along the two banks of a navigable waterway for the purpose of both protecting the waterworks and facilitating water transport and navigation; in this manner, "The haulers of barges can work along shore leaning inlandward as they pull their barges, unhampered by trees or vegetation;" public interest overcame private ones as "... the barge haulers may freely cut down any plant growing within the four cubit passageway, without warning the owner."[37] It is possible that such rules for protected areas also applied to wells or other water points.

Water utilized for domestic and irrigation purposes was subject to a certain order of preference. In the case of several irrigators receiving water from a common well, the one closest to the well conduit filled his cistern first, and the other irrigators did so in descending order.[38] In the case of irrigation water coming from a stream, including the right of upstream riparians to divert the flow, Talmudic law does not seem to provide a definite principle. One authority gives priority to downstream users, another to upstream riparians.[39] Maimonides, a famous Jewish author, rules with the latter but adds that "The stronger one's right is superior" in any dispute between riparians.[40] In another instance, a distinction is made between the law in Palestine, where the upper riparian has priority, and the laws of Babylon, which consider as the criterion the ease with which the respective owner may use the water.[41]

As for the use of a spring owned and utilized by a town for domestic purposes such as drinking, watering of animals, laundering, etc., the order of priorities is established as follows: "A spring owned by the people of the city, their lives and the lives of others: their lives take precedence over those of others; their beasts and the beasts of others: their beasts take precedence over the beasts of others; their laundering and the laundering of others: their laundering takes precedence over the laundering of others; the lives of others and their laundering: the lives of others takes precedence over their laundering."[42]

For the maintenance of a well or of an irrigation ditch, all riparians shall assist those closer to the source of water; thus "The most downstream owner repairs with all other riparians but repairs his own portion by himself." In the case of drainage operations it is the most downstream riparian who benefits from the help of all; the most upstream riparian, being the sole beneficiary of the most upstream segment of the drainage conduit is alone responsible for its maintenance.[43]

It is interesting to note that many legal principles set forth in the Talmudic law are similar to those developed under Moslem water law later, particularly with regard to the order of priorities in the uses of water, to the maintenance of waterworks and their protected area.[44] This is understandable, as these legal obligations reflect the needs of a land where life is centered around water.

The early Jews, in their legal relationship with other Jews and with non-Jewish cultivators, were presumably subject to local water laws and customs, which on the other hand did not differ much from the principles contained in the Talmudic law. However, incapacities were sometimes imposed upon them by local rulers. Under the Sassanids they were barred from holding the office of waterworks warden;[45] according to one rabbi, however, this officer is a heavenly appointed official.[46] On the other hand the importance of such function is evidenced by the fact that Maimonides would appoint only Jews to this capacity in any restored Jewish theocracy.[47]

Talmudic law unified and consolidated Jewish doctrines and eliminated organized "heresies." It constitutes primary law, encompassing the whole life, written "as a fence around the Torah." Although Jewish agriculture diminished as time went by Talmudic doctrines influenced subsequent Moslem legislation and, after the XIth Century, also European law. It served as a guide to Jews and some non-Jews up to the industrial revolution.

9. PRE-COLUMBIAN WATER REGULATIONS AND CONTROL[48]

Although no written records of water regulation have come down to us under the civilizations existing in the Americas before the arrival of Columbus, the network of irrigation canals and other waterwork structures show that flourishing hydraulic civilizations existed.

On the southern coast of Peru, agricultural practices started around 1,500 B.C.,[49] and in 1,200 - 800 B.C. flood irrigation seems to have been practiced under priest leadership.[50] From 800 B.C. to 200 A.D. agriculture, based on canal irrigation, fully developed. The expansion of irrigation systems created the need for centralized water administration, always under the leadership of priests. From 200 to 1000 A.D. trans-valley irrigation systems and intensive agriculture took place. As a consequence of enorous population growth, the Mochica kingdom expanded into a multi-valley state.[51] From 100 to 1532 A.D. the organization of a new kind of society under military rule took place.

The Inca conquest of the coast left the old administrative system, managed through the local hereditary nobility, largely undisturbed. Land and water were under state control; taxation was in the form of labor on state agricultural lands, public works, army, and service to the Emperor and nobility. Water engineers and other specialists were government civil servants.

In pre-Columbian Meso-America, extensive irrigation took place in Tecomaltepec, the practices of which have survived up to modern times.

Water was diverted through a dam and a large network of canals from the Calderon River. Maintenance was continuous. Only those who had contributed to the construction of waterworks could benefit from irrigation water. Special arrangements were made for water allocation among the users whose lands were crossed by canals and those using the Calderon River directly.

A centralized water administration existed in Tecomaltepec, responsible for allocating irrigation water, upkeep of waterworks, and the organization of water on a rotation basis. The system of sanctions for water offenses ranged from the temporary suspension of water supply for a specified period, to complete prohibition from using water. More than 382 villages where irrigation was practiced have been indicated.[52] Irrigation works and practices were used in the early civilizations of the Tepanec Empire, the Toltec,[53] and the Teotinuacan. Disputes among users and water transport are also recorded.

10. CONCLUSION

The main purpose of this note has been to focus attention on the important aspects of early water law systems. Other future studies concerning ancient hydraulic civilizations could include a comparative study of common patterns of parallel development, another on the persistence of early basic concepts up to modern codifications either deriving from or expounded in the areas concerned, and on the influence of early water law principles on modern systems of water codification.

As other ancient records are discovered and deciphered further elements for the study of early water law systems will emerge. Archeologists and water engineers are continually discovering remains of ancient waterworks, canals and hydraulic structures, which undoubtedly will bring to light other hydraulic civilizations still little known or unknown altogether.

In general, with the probable exception of China, most early water regulations have been closely associated with religious beliefs; water constituted a gift of God, or possessed a divine nature, serving as an element of purification, a reward for a state of grace, or an instrument of punishment.

Parallelly to the development of hydraulic civilizations, water regulations and administrative water control occurred. Some form of water regulation with legal obligations, on which the bureaucratic water machinery could either justify its actions or impose its decisions, were a necessary part of any organized hydraulic state.

Often the decay or disappearance of early hydraulic civilizations is reported as a consequence of decreased concern for the maintenance of waterworks, canals and other hydraulic structures. I venture to say that these consequences could have been avoided if the water administration had continued, as in earlier periods, to maintain its concern over the

safeguard of the hydraulic structures and water distribution. In turn, this obviously means that for one reason or another, the people and the users of a water community did not feel obliged to follow the instruction received for undertaking the necessary works. As a consequence, the softening or lack of respect for existing water regulations caused later decay and eventual disappearance of an hydraulic civilization. The only exception to this pattern is when factors foreign to a water community abruptly destroyed the existing structures and disrupted the existing administration and law, as in the case of invasions by less water-concerned populations. Thus, the study of early systems of water law and control may serve as an interesting lesson for enlightening all those responsible for water resources management, ...including water lawyers.

ROMAN WATER LAW SYSTEM

by

Dante A. Caponera*

1. INTRODUCTION

The Roman system of laws has profoundly influenced the legal systems following it, both in Europe and in many other parts of the world, right up to modern times, and this is why the study of Roman water law and institutions is important and relevant.

In order to better understand Roman water laws and the general principles to which these laws conformed, some knowledge of Roman legal history and legislative process is necessary.

As in any other system of law, Roman water law forms part of the whole Roman legal system, which evolved during a time period of almost 1,500 years. Many changes in the social, economic and political conditions occurred during that time, which in turn influenced the legal-institutional framework.

On the basis of Roman political and constitutional developments, Roman legal history may be divided into the following four main periods:

(a) The early period (about 500 years), which starts from the origins, first millennium B.C., includes the legendary foundation of Rome in 753 B.C., and ends with the Regal period and the beginning of the Republic in 509 B.C.;

(b) The Republican period (about 500 years), which includes the period of the Republic (509 B.C.) up to the introduction of the Principate in 27 B.C.; the last century of this period constitutes, together with the next period of the Principate, the "Classical Period" of Roman Law;

(c) The period of the Principate (about 300 years), which starts when Caesar Octavianus received the title of Augustus in 27 B.C. and ends in 286 A.D. with the accession of Emperor Diocletian;

(d) The period of the Absolute Monarchy (about 250 years), which goes from the division of the Empire between the two Augusti (Diocletian and Maximian, 286-305 A.D.), includes the period of Western and Eastern Empires, and ends with the fall of the Western Empire (476 A.D.) and the Justinian Codification in 565 A.D.

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Within each one of these periods the legal regime of water is analyzed here under the following headings: (i) classification and ownership of water; (ii) right to use water; (iii) protection from harmful effects of water and control on waterworks and structures; and (iv) water administration.

2. ORIGINS AND REGAL PERIOD - EARLY PERIOD (1,000 - 500 B.C.)

The ancient writers report that the earliest Roman people were divided into three tribes, the Ramnes, the Tities and the Luceres and that they were made up of elements drawn from the Latins, the Sabines and the Etruscans. These earliest populations had a talent for military affairs and a genius for making law, both being instrumental for good organization.

During the subsequent Regal period, which goes from the legendary foundation of Rome (753 B.C.) to 509 B.C. when the Republic is said to have been established, the Roman State was an agricultural community settled in Latium, dedicated to cultivation and stock-breeding. Except perhaps for a small holding allotted to each family as an inalienable homestead (heredium) there seems to have been no individual land ownership as we understand it; areas under the name of ager privatus were apparently allocated to large groups or clans (gentes), consisting of a number of families descending from a common ancestor. Ager publicus, or public land, was divided into three classes: the largest one set aside for the king, the next large as range of common pasture on which the citizens under some system of registration (scriptura) had the right to graze their cattle, and the third was an area of arable land apportioned between the clans, who periodically parcelled it out in plots to individual families for cultivation.

As further territory was acquired by conquest, it ranked as ager publicus (public land) and was divided in a similar way, although tracts were often left for occupation by individuals who could cultivate them as they pleased, upon payment of a rent to the State. In rare instances some areas were cut up into plots which the citizens could not only possess but own.[54]

During this period, the sources of law were:

(a) Custom (ius non scriptum, mos maiorum), in which a distinction between ius (law) and fas (religious law) took place, parallelly with the existence of boni mores (morality or rules of conscience);

(b) The so-called "Leges Regiae" or "Ius Papirianum", of which no record remains.

Pomponius, a jurist contemporary with Gaius (150 A.D.), is quoted in the Digest[55] as saying that during this period everything was regulated by the direct control of the kinds through statutes eventually collected in a book of Sextus Papirius (contemporary with Superbus) called Ius Civile

Papirianum (or Leges Regiae); fragments of these Leges Regiae show that they were religious regulations not created by any popular assembly.[56]

No reliable water regulation has come to us from this period.

3. REPUBLICAN PERIOD - SECOND PERIOD (509 - 27 B.C.)

Although there is a good deal of uncertainty about Roman history before 390 B.C., date at which Rome was sacked by the Gauls, it is customary to regard the years following the Twelve Tables (cir. 499 B.C.) as the beginning of the historical era of Roman law.

The political institutions of the Republic consisted of three main groups: the Senate, the Comitia of the people and the Magistracy.

The Senate and the Comitia (Comitia Curiata, Centuriata, Tributa, Concilium Plebis) had judicial, legislative and electoral competence; the Senate also had competence in home and foreign affairs.

The Magistracies were the organ of execution (public officials), and included the dictatorship, an extraordinary magistracy; consulship (highest administrators); the censorship (census, public works, finance); aedileship (maintenance of public services); tribuneship (people's representatives); quaestorship (treasury and finance), and the praetorship (justice). Some of the functions attached to particular Magistracies varied with time. As a result of internal social development and external Roman conquests, the plebeians gradually attained equality with the patricians and could attain magistracies.

Roman economy evolved from agriculture to commerce, and the City's constitutional machinery and its system of law changed and expanded.

The sources of law were the following:[57]

(a) Mos: long-established custom;

(b) Leges: legislation de iure by the Comitia, forming the ius civile;

(c) Senatus consulta: legislation de facto by the Senate;

(d) Ediota: regulations enounced by magistrates in virtue of their imperium, forming the ius honorarium or ius novum; and

(e) Responsa prudentium as an indirect source of law: interpretation by those skilled in the law, pontiffs until about 300 B.C. and jurists thereafter.

As far as water legislation is concerned, we may quote:

(a) The law of the Twelve Tables, drawn up between 451-448 B.C., only fragments of which have survived through the works of ancient historians (Livy, Dionisius) and of jurists (Cicero, Pomponius). This was the very first written law code drawn by the Romans, a collection of public, private, criminal, religious and procedural customary rules which governed the relationships among the early inhabitants of Rome. It has a deep influence on the further development of Roman law until the rule of the Emperor Justinian (VIth Century A.D.).[58] There exist two references to water in the Twelve Tables, showing that even then it was a matter of concern; we have one fragment which dealt with what were probably the earliest rights which water users could claim with respect to private water (rivus, aqua);[59] another fragment provided a regulation for damages caused by the flush of torrential rains on downstream lands.[60]

(b) Lex (Baebia?) agraria (cir. 112 B.C.), containing useful information on the legal condition of land. The importance of this law stems from the fact that during this period the legal status of land directly influenced that of waters.[61]

(c) Lex Mamilia Roscia (Iulia agraria) (cir. 58 B.C.),[62] and

(d) Lex Coloniae Genetivae Iuliae (cir. 43 B.C.), both shedding some light on the condition of municipal waters.[63]

(e) Lex Sulpicia rivalicia (cir. 50 B.C.), probably governing private connections with public aqueducts for private water supply.[64]

The legal regime of waters during the Republican period is analyzed under the following headings:

(a) Classification and ownership of water.

(b) Right to use water.

(c) Protection from harmful effects of water and control on water works and structures.

(d) Water administration.

3.1 Classification and Ownership of Water

During the Republican period the legal status of water followed that of land.[65] Accordingly, where land was public (ager publicus) all water running, springing, lying or gathering thereon was deemed public;[66] all water which fell within private land, that is, within so many plots of ager publicus as had been allocated was deemed private.[67]

Ager publicus included all mountain land and such strips of land marking the borders between existing colonies (subseciva) or, within a colony, between allotted plots of land (space "inter centurias exceptus"), often corresponding to a perennial river (flumina) and, sometimes, to

streams (rivi). As a consequence all rivers (flumina)[68] and some streams (rivi),[69] the springs feeding urban aqueducts,[70] mountain lakes and such rain water as was collected by natural mountain pools or artificial tanks, were public.[71]

Springs, wells and pools located within private property were private;[72] in addition, torrents (technically flumina torrentia) were also considered private, as land surveyors did not regard their irregular beds as reliable borders for delimiting lands (subseciva or space inter centurias exceptus).

During this period all public water considered as "res publica" (public things) entailed the vesting of the ownership thereof in the Roman people or in the autonomous Italic burghs (civitates: municipia and coloniae).[73] Private waters were considered an appurtenance of private land ownership.[74]

Towards the end of the Republican period, the legal regime of water ownership was extended from Italy to the Provinces, following the increasing allocation (adsignationes) of newly-conquered lands (ager publicus).

3.2 Right to Use Water

Direct sources of information are available regarding the legal regime of urban water supply and the right to use private water.

Water was supplied to towns by means of public aqueducts directly emptying into public tanks and reservoirs (castella, lacunae) and thence into public baths, public fountains and public wash-houses. Throughout the Republican age, private connections with public aqueducts or reservoirs were strictly forbidden; only excess water (aqua caduca) could be diverted exceptionally from public mains, under a perpetual concession from the administrative authorities and subject to payment of a rent (vectigal).[75]

From early times in the Republican period, water-use rights could be purchased or otherwise acquired from the owner of a private water in the form of ad hoc servitudes, the most important of which being the water conduit (aquae ductus) and the water hauling (aquae haustus).[76] Aquae ductus conferred the right to divert water from a private water source and to convey it to one's own land by means of suitable water pipes and fittings; aquae haustus conferred only the right to draw water from a private source and the additional right of access thereto.

The distinction between the ductus and the haustus aquae, which constitutes a fundamental of classic Roman water law and which dates as far back as the law of the Twelve Tables (rivus = aquae ductus, aqua = aqua haustus),[77] was definitely fixed during the Principate.

3.3 Protection From Harmful Effects of Water, and Control on Waterworks and Structures

The earliest concern of Roman law-givers with regard to the harmful effects of water was for the damage caused by the flush of torrential rains.

The law of the Twelve Tables stated, in fact, that either rain water was to be retained upstream or, in default, compensation was to be paid for the damage occurring downstream.[78] Presumably the actio aquae pluviae arcendae (action for the protection against rain water) originated as a means of judicial redress of this principle.[79]

As to the legal aspects of overflow protection, a permissive regime probably governed the construction of waterworks by riparian landowners for protection purposes. The control by water authorities probably took place, either directly or following a complaint, only when navigation and/or community uses were impaired.

3.4 Water Administration[80]

In early Republican times water administration was probably part of the Consuls' financial and administrative competence in the matter of public waterworks.

Later, around the middle of the fifth century B.C., water administration duties passed on to the Censors. Censorship was an extraordinary five-year post, the creation of which tradition places in 443 B.C.; it was first reserved for patricians, later (from 351 B.C.) open to plebeians. Censors were appointed by the Comitia Centuriata, and numbered two. Censors had functions in matters of civil status, census, survey, finance and public works. They were responsible for financial aspects of water administration, with particular reference to the construction, maintenance and management of Rome's aqueducts and for policing the bed and banks of the Tiber and its tributaries. In addition to their judiciary powers for the settlement of water disputes, censors had responsibilities relating to public waterworks and inland navigation throughout continental Italy.

Towards the end of the Republican period, water administration became the responsibility of the Aediles; the control and inspection of urban aqueducts, fountains, public baths, allocation of surplus water and water concessions was taken over by the Quaestors.[81] Both Aediles and Quaestors were responsible to ensure an uninterrupted water supply.[82] Plebeian and Curule Aedileships, both sharing responsibilities in water administration, were ordinary annual magistracies, heading the great urban services: cleaning and upkeep of public buildings, fire brigade, police, food supply, public games. They were created about the middle of the Vth century B.C.

Quaestors were generally in charge of the treasury and finances. Censors, Aediles and Quaestors had administrative, judicial and religious

powers and functions in the civil domain, as a clear separation of powers was alien to Republican Rome.

Italic burghs (civitates: municipia and coloniae), autonomously owned and administered public waters existing within their territory. Local magistracies, which were modelled on Roman magistracies,[83] were responsible for local water resources with regard to irrigation, urban water supply and water-police.

Water administration in the territories outside Italy conquered by Republican Rome varied according to the particular legal status existing between Rome and those territories or burghs. When they were entirely subject to direct Roman rule (civitates vectigales), water administration was under the responsibility of the Roman governor (a magistrate or a pro-magistrate); where a treaty (foedus) governed the relationships between Rome and the conquered burghs (civitates libarae et foederatae), a large degree of autonomy was left to the local authorities, also in the field of water administration.

Finally, the Senate of Rome also took an indirect share in water administration all over the Roman world. In fact, besides supervising the conduct of all Roman magistrates and provincial governors, it had supreme control of State finances from the earliest stage of the Roman constitution, both with regard to expenditures (including public works) and revenues (including water rates - vectigalia).

4. THE PRINCIPATE - THIRD PERIOD (27 B.C. - 286 A.D.)

After the battle of Actium (31 B.C.) Caius Octavius stood alone as Consul; in 28 B.C. he resigned his command and immediately afterwards he was bestowed consulship with the proconsulare imperium for ten years, with the title of Augustus; he was also called Princeps. In 24 B.C., Augustus was bestowed tribuneship and, in 19 B.C., consulship for life.

Augustus retained the forms of the Republican constitution, but the duplication of his offices and the exercise of the proconsular military command and of the tribuneship's right to veto (tribunicia potestas) were grave breaches of the true principles of the former Republican constitution.

The new constitutional order which Augustus gradually shaped was a kind of diarchy, as all ultimate power shifted to the hands of the Emperor and the Senate. The diarchy further evolved, starting from the beginning of the IIIrd century A.D., toward absolute monarchy, as all powers ultimately concentrated in the hands of the Emperor alone.

As a result, during this period sovereignty passed from the people to the Emperor, and, with the decline of the old popular assemblies, the old Republican magistracies also declined. These were gradually deprived of all authority in favour of an entirely new internal administrative machine.

During this period the sources of law were:[84] a) custom; b) leges (statutes); c) edicts of the magistrates (until revision of the Praetor's edict by Salvius Iulianus, cir. 131 A.D.); d) Senatus Cunsulta; e) imperial constitutions (edicta, decreta, rescripta, mandata); f) responsa prudentium, which during this period became a direct source of law.

While C. Cassius Longinus (fl. 60 A.D.), was unanimously deemed by contemporaries to be the most skilled in water law, Sextus Iulius Frontinus (40-103 A.D.) wrote a comprehensive treatise on Roman aqueducts, including water law and administration.

The major legal enactments relevant to water law during this period are the following:

(a) a Senatus Consultum of 10 B.C;[85]

(b) the Lex Quinotia de aquaeductibus (8 B.C.);[86]

(c) the Edictum Augusti de Aquaeductu Venafrano (cir. 10 B.C.);

(d) a lex collegii fullonum (law of the college of laundrymen and dyers; Ist century A.D.),[87] and

(e) the Lex Nervae Agraria (96-98 A.D.),

all of which dealt with the connection of urban private dwellings with public aqueducts and reservoirs for domestic and/or industrial (mainly washing and dyeing industries) purposes. Furthermore, we have:

(f) a lex rivi which forbade bathing and the washing of clothes in a stream of Savoy;

(g) the Edictum Perpetuum (perpetual Praetor's Edict as revised by Salvius Iulianus cir. 131 A.D.), many sections of which expressly dealt with waters;

(h) a Rescriptum by Emperors Antoninus and Verus (cir. the end of the 2nd century A.D.) dealing with private diversions of water from public rivers.[88]

It is to be noted that the first two centuries of this period, together with the later part of the Republican era, constitute the period of Roman classical law.

4.1 Classification and Ownership of Water

During this period, the public or private nature of water continued to derive from the legal status of land. In addition, the concept of "public river" (flumen publicum) developed and included all perennial rivers.

Non-perennial watercourses such as torrents (flumina torrentia) were private; however, whenever the law under which an ager publicus had been allotted, or custom had considered such torrents as public, these continued to be regarded as public. It seems, therefore, that torrents could be either public or private.[89]

Classification of water as public or private continued to entail consequences with regard to their ownership and right of use. It is to be noted that the concept of res publicae as the people's property (res populi) gradually faded during this period, and, after the rule of the Severi Emperors (cir. the middle of the 3rd century A.D.) with the transfer of sovereignty from the people to the emperor, a new concept evolved whereby res publicae came to mean "people's right of use."[90]

Running water (aqua profluens) ranked as thing common to every one (res communes omnium), as any man was entitled to make use of it and no one could claim ownership thereof. This classification had, however, the value of a statement of principle, as the effectual usage of running water followed the public or private condition of the watercourse it belonged to.

4.2 Right to Use Water

During this period there developed a very permissive regime with respect to the right to use public watercourses, both for community (or public) and private purposes. Citizens (cives) and also aliens (peregrini), were entitled to community uses of public watercourses such as drinking and domestic needs, watering of cattle, fishing and transportation, without the requirement of any administrative concession or permit.[91] Similarly, administrative concessions were not needed for water diversions for irrigation or industrial purposes, provided that neither community uses nor existing diversions were impaired (sine iniuria alterius). In the case in which a water diversion impaired community uses or existing diversions, the water authority had the power to interfere and either terminate or modify such diversion.[92]

Starting from the period of the late Republic, private rights to divert water from public watercourses and also exclusive fishing rights could be secured through an administrative concessions which ensured water users against any subsequent intervention of the water authorities.[93]

With respect to the right to divert water from a perennial river for irrigation and/or industrial purposes without administrative permission or concession, Principate lawyers upheld that such rights could either relate to a given land (real rights) or to a given person (personal rights). The holder of a real water right was entitled to divert as much water as was needed for a particular use;[94] in the case of a personal water right, separate from land (ius aquae separatum a fundo), which was a perpetual and transmissible water right the holder was entitled to divert and utilize water wherever possible at his discretion (quocumque aquae duci possint).[95] In both cases a right of way was included for crossing other people's lands with pipes and for repairing them.

The legal regime of urban water supplies underwent a remarkable change: connecting private dwellings with public aqueducts and reservoirs became normal practice, subject to the terms and conditions of an administrative concession (epistulae caesaris). The right to divert water from a public water supply installation (ius aquae ducendae ex castello, ex rivo) could be granted for a given place or to a given person; such right could be either perpetual or temporary and was subject to the payment of an annual rate (vectigal pro aquae forma) and to the possibility of cancellation at any time.[96] Water concessions ended with the death of the concessionaire.[97]

With regard to the use of private waters, the owner could enjoy his own water, both surface and underground, up to its total depletion, irrespective of the damages which such conduct could cause to neighbouring landowners (jus utendi et abutendi).[98] Toward the end of the Republican period, however, this principle suffered restrictions with respect to the drainage of rain water. The upstream landowner was no longer entitled to interfere with such natural drainage, as he could be subject to the downstream landowner's civil action (aquae pluviae arcendae).

As a consequence of the extended use of private waters for irrigation, industrial and domestic purposes, this period witnesses a clearer definition and the increased use of water servitudes.

A right to use private water could be purchased or otherwise acquired[99] from the owner under the form of a servitude; this was either for a given usage, such as watering of animals (servitus pecoris ad aquam adpellendi, or appulsus[100]) or for a given amount of water. In the latter instance, in order to divert water from a private source of perennial running water and convey it to the user's land, a servitus aquae ductus (servitude for conveying water) could be acquired; this servitude included the right to lay water pipes and fittings through intermediate lands and maintenance rights (reficere, purgare).[101] A striking feature of the aquae ductus was that, in the opinion of Principate lawyers, the diversion could be made only at the source (caput aquae) of a perennial running water.[102] This limitation, which disappeared in the Late Empire,[103] entailed that any additional intake from a channel carrying water under an aquae ductus servitude could not take place under a similar aquae ductus servitude, but only under the form of a mutual obligation.[104]

In the case of a non-permanent water intake, such as drawing water from a private well, tank or pool, a servitus aquae haustus (servitude for drawing water) could be acquired; such servitude would entail the right of access to the water point.[105]

These water servitudes, under classical law, were considered real rights and appurtenances to a given land (iura aquarum).[106] In addition, private water use rights could also be acquired as personal rights by usufruct (usus fructus or usus).[107]

We will now briefly outline the legal system of protection of existing water rights, as developed in classical law.

Such system was largely based on the so-called interdicta (literally, an interdiction to do). Interdicta were the magistrat's (the Praetor,

in Rome) binding injunctions, under which, upon the mere claim of an alleged offended party or, in some instances, of any citizen (quivis de populo, popular action), the alleged offender was summoned to stop the nuisance and restore things to their former state. Investigation concerning the grounds for the injunction would only take place following any action which the claimant could bring against the alleged offender, on the offender's failure to comply with the interdictum.[108]

This speedy and effective means of judicial protection applied extensively to water rights. Water interdicta included a series of interdicta "de fluminibus" which protected common use rights of perennial rivers (for transportation, fishing, etc.);[109] the interdictum "de aqua castellaria", which protected existing rights to divert water from public aqueducts or reservoirs;[110] the interdictum "de aqua cottidiana et aestiva", which probably protected both rights to divert private water under a servitude and rights to divert water from a public watercourse.[111] Other specific interdicta could be issued for the protection of water servitudes and of other rights relating to water diversion from public and private waters (interdictum "de rivis", "de fonte", "de fonte reficiendo".[112]

Recourse to the procedures of the interdicta, from extraordinary, as it was under the late Republic, became, during the Principate, an ordinary means of judicial remedy for the protection of existing water rights against any nuisance.

In addition to the procedure of the interdicta, other ordinary judicial means protected the ownership and possession of things or of any servitude from nuisance,[113] and the individual's freedom to use public things.[114]

4.3 Protection From Harmful Effects of Water; Control on Waterworks and Structures

Principate lawyers gave extensive consideration to the legal aspects of the prevention of overflow, then considered the most harmful effect of water.

Riparian landowners were entitled to build reinforcement structures (munitio) on the banks of both perennial rivers, navigable and non, and torrents without the need of any administrative permission. However, in the case of a perennial river, navigability and/or suitability for public utilizations other than navigation had to be safeguarded.

The already-mentioned interdicta "de fluminibus" could be utilized as a means of redress for the restoration of a river back to its original state. In addition, a ten-year guarantee had to be given to the other riparian landowners against any possible damage arising from the construction of waterworks (satisdatio damni infecti nomine). The riparian landowners' right to build reinforcement structures was protected from interference by an ad hoc interdictum "de ripa munienda"; this

interdictum also applied to the right to build such structures on the shores of public lakes and pools.[115]

For the purpose of protecting his land from the rush of torrents, a landowner was entitled to undertake all necessary works on his own land; however, trespass to upstream or downstream lands had to be expressly permitted either by the local law of public land allotment (lex agri) or by custom (vestustas). As a consequence, the disadvantages or advantages or possible overflow were the landowner's burden.[116]

Thus, administrative control on waterworks and structures affecting banks of perennial rivers followed the issuance of an interdictum, and the restoration of a river to its former state would take place if the works under accusation had proved harmful.[117]

Legal attention was also given to the harmful effects of torrential rain. Under classical law, the "actio aquae pluviae arcendae" (action for protection against rainwater) was a judicial means whereby the downstream landowner could request the destruction of those upstream works which had changed the natural drainage of rain water.[118]

Provisions concerning the protection of waterworks and structures included, first of all, the possibility of expropriating lands for the construction of waterworks. Servitudes for crossing private lands with pipes had to be acquired from the landowner; this latter, sometimes, gave these servitudes free as a gesture of generosity. Public lands could not be crossed with pipes without a permit of the responsible municipal or governmental authority.[119]

For the protection of aqueducts, a strip of land on both sides was protected and had to be left free from any incumbrance (vacuum agrum), the total width of this protected area varied between 20 to 30 feet, including the width of the aqueduct itself. Within this area it was prohibited to build, plant, let vegetation grow, or to do anything which might have caused damage to the aqueduct.[120] A fine of 10.000 sesterces, of which half for rewarding the delator would be imposed on the offender.[121] Planting of trees in this area could be punished by confiscation of the offender's land.[122]

4.4 Water Administration [123]

As far as the city of Rome was concerned, in the early organization of the Imperial administrative system the Republican magistrates kept the whole of their urban attributions; only the censorship was abolished.

The Curule and Plebeian Aediles were maintained at the head of the great urban services which they ran in Republican times, such as the water-service (supply, upkeep and distribution).

But, although the magistrates of Rome kept the whole of their urban functions, they didn't exercise them alone, as they were now faced with the competition of the Emperor and his servants; with respect to water

administration two urban executive Commissions, one for Water, and another for the Bed and Banks of the Tiber and Drains were created.

The Water Commission (Cura or Statio Aquarum), which was instituted in 11 B.C., was headed by a Water Commissioner (Curator Aquarum) assisted by two Praetorians (adjustores), was in charge of everything connected with the water supply of Rome. The powers of the Water Commission reasserted by a Senatus Consultus[124] were gradually extended to the whole system of existing aqueducts and therefore to a large area outside the city.

The Water Commissioner was appointed for life by the Emperor, with the approval of the Senate; he was of senatorial rank. In addition to the two assistants, his office included one general inspector (procurator libertus Caesaris), one "tribunus aquarum", one or more water engineers (architecti), and a large number of specialized workers (familia aquaria publica and familia aquaria Caesaris), including one chief (prepositus aquariorum), one registrar of water sharing (tabularius rationis aquariorum), measurers (libratores), plumbers (vilici acquarii of serf class), castellarii (in charge of reservoirs), inspectors (circitores), stone and other workers (silicarii, tectores).[125]

The Water Commission maintained either one double entry or two water registers. One of them contained information on the permanent inventory and availability of water resources, with an indication of their origin, sources, springs, volume, water courses, reservoirs, water fountains and monuments. It also contained information on water distribution, which could be in favour of the Emperor (nomine Caesaris), in favour of public uses (usibus publicis) and in favour of individuals (nomine privatorum). The other part of the water register, or another register, contained information on the modifications of water rights, water users and water distribution. As soon as a concession came to an end it was noted in the register (in actis) and the water returned to the administration for re-allocation to a new concessionaire.[126]

It would appear that, particularly at the level of the plumbers of the Water Commission (vilici aquarii), there was a great deal of corruption; the purest water was sold privately and replaced by more ordinary water; during the interval between a terminated concession and a new one the water was sold private surplus water was sold, etc. As one author put it, "it is in the instinct of both ancient and modern water guards to commit such frauds...."[127]

Another Commission, created by Tiberius in 15 A.D. was that of the Bed and Banks of the Tiber (Cura alvei et riparum Tiberis); this Commission had to keep the channel of the river in good condition and take such steps as were possible against the danger of floods. It contained five members of Consular rank, one of whom was president. First chosen by lot, later they were appointed directly by the Emperor, like the members of other similar commissions. Trajan added the maintenance of the drains to its duties, and its name expanded accordingly (....et cloacarum urbis).[128]

In accordance with the general principles of Roman public law, the Water Commissioners had judicial powers within their own sphere, in

addition to their administrative competence. Water Commissioners were also made responsible for grain distribution (Curatores aquarum et Miniciae)[129] around 200 A.D.

Curule and Plebeian Aedileships, steadily drained of their real powers, became useless and superfluous organs and definitely disappeared before the middle of the IIIrd century A.D.[130]

Outside the city of Rome a gradual concentration of the water administration of Italy in the hands of the Emperor took place as the territorial jurisdiction of the Imperial executive water commissions extended. Italy was divided into administrative districts (regiones) each governed by an Imperial representative (the Consulars under Hadrian, the Juridici up to Diocletian, vested with administrative and judicial powers), which posed as intermediaries between the central government and the traditional autonomies enjoyed by Italic burghs.

As during the preceding Republican period, water administration in these Italic burghs (municipalities and colonies - municipia and coloniae) continued to be under the responsibility of the local magistracies (aediles or quinquennales).[131]

In the Provinces the surviving administrative autonomies of free provincial burghs (civitates liberae et foederatae) continued. In provinces which were subject to direct Imperial rule (civitates vectigales), the Imperial or Senatorial Governor's administration was in charge of major public works and of the licensing and control of private connections with public water supply installations.

Within the new administrative framework, the Senate was doomed to play a role of ever-decreasing importance; its competence confined more and more to the domain of urban administration. The Senate had supreme control over public property in the City; it directed and supervised the magistrates in the exercise of their annual functions; the Senatorial budget, with respect both to expenditure (public works, roads, food-supply, and of revenues (customs, water, various taxes), was largely a local budget. The evolution, which began in the reign of Augustus and continued for two centuries, accelerated under the military anarchy and culminated under Diocletian and Constantine. By the IIIrd century A.D., in spite of certain prerogatives, chiefly honorary, the Senate was little more than the town council of Rome, and even in that limited sphere it had to compete with the Emperor's authority as exercised through his agents.

5. THE ABSOLUTE MONARCHY OR LATE EMPIRE - FOURTH PERIOD, 286 A.D. - 565 A.D.

The period of the Absolute Monarchy begins with the accession of Diocletian in 286 A.D. and ends with the death of Justinian in 565 A.D. During this period all ultimate power (legislative, executive and judicial) was concentrated in the hands of the Emperor, regarded more as a dominus than as princeps. The main seat of government shifted from West

to East, with the consequent increasing reception of oriental notions in all departments of public life and in the evolution of the legal system.

The division of the whole Roman world, including its administration, into two parts, the Eastern and the Western, virtually amounted to a federal system. However, for legal purposes, this subdivision was regarded as two fractions of a single whole.

During this period the sources of law were:[132]

(a) custom;

(b) the Imperial Constitutions (edicta, rescripta, decreta, a few mandata) eventually known as Leges.

It became customary to cite former legal enactments not by reference to the original text (e.g. leges, Senatus Consulta, Praetor's edict) but by reference to the works of the commentators, particularly of the later Empire, since the quality of the living jurists deteriorated.

For practical purposes, the countless constitutions delivered by the Emperors in the exercise of their ius edicendi (legislative power) were collected and systematized first by private, later by official codifications.

The major codifications of this period were:

(a) the Codex Gregorianus, drawn up in 294 A.D., a private code which collected the Imperial constitutions from S. Severus to Diocletian (196 A.D. to 295 A.D.);

(b) the Codex Hermogenianus, drawn up in 334 A.D. was also a private code, collecting the Imperial Constitutions from Diocletian to Constantine (291 A.D. to 378 A.D.);

(c) the Codex Theodosianus, which was an official code promulgated in 438 A.D. by the Emperor Theodosius II in the East and accepted also in the West in the same year by the Emperor Valentinian III. This code collected the Imperial constitutions from Constantine onwards (312 A.D. to 436 A.D.).

During the Vth century A.D. the Western Roman Empire collapsed. Visigoths, Vandals, Ostrogoths and Burgundians adopted the policy of retaining the law of invaded territories for the use of conquered inhabitants. The system of law which they administered consisted of roughly selected extracts from early codes and from the work of some jurists. There were three of these official Roman-barbaric codes:

(a) Lex Romana Visigothorum (or Breviarium Alaricianum) promulgated in 506 A.D. by Alaric II for his Roman subjects but not applied to Visigoths;

(b) Edictum Theodorici (same period) for both Goths and Romans, which was a condensed outline of Roman legal principles with no reference to original texts;

(c) Lex Romana Burgundionum (or Papinus), issued a little later, applying only to Roman subjects; after the Franks conquest, it was replaced by the Breviarium Alaricianum and the Code of Theodoric.

About the middle of the VIth century A.D., the Eastern Roman Emperor Justinian (527 - 565 A.D.) conceived a consolidated system of law. This codification combined and systematized the large number of laws in force and the thousands of scientific law works which had been drawn up by the jurists of the past. The result of this huge work (Corpus Iuris Civilis) consists of four parts:

(a) the Code (Codex), containing the Gregorian, the Hermogenian and the Theodosian Codes combined, edited and modernized. It was promulgated in 529 A.D. and replaced five years later by an entirely new second edition (Codex repetitae praelectionis);

(b) the Digest (Digestum or Pandectae), which systematized Roman law contained in the writings of jurists of the past who had been vested with the right to deliver official responsa. The Digest was promulgated in 533 A.D.

(c) the Institutes (Institutiones), which was an official law-book (533 A.D.)

(d) the New Constitutions (Novellae Constitutiones), which was a new Code collecting the Imperial Constitutions from 535 to 565 A.D.

The compilation of Justinian constitutes by far the major available source of information for enlightening both the classical and the post-classical system of Roman water law.

We will follow the same outline adopted for the preceding periods.

5.1 Classification and Ownership of Water

The former distinction between public and private waters was maintained but extension of publicity to non-perennial rivers (flumina torrentia) seem to have taken place, thus increasing the category of waters ranking as public.[133]

Res publicae, which included public waters, no longer were the equivalent of the People's property (res inpatrimonio populi), but seems to have become the synonym of the people's right of use (res in publico usu).[134] The former "res in patrimonio populi" (people's property) came to be known as Caesar's or fiscal property (res in patrimonio Caesaris or res fiscales). Accordingly, public water seems to have maintained the qualification of State's public property, separate from the Emperor's own property (res fiscales or res in patrimonio Caesaris).

The further classification of running water (aqua profluens) as a thing common to everyone (res communes omnium) continued to keep its full significance as a statement of principle; res communes included those things which could not be the object of ownership in view of their nature.

5.2 Right to Use Water

The Corpus Iuris introduced some important innovations with respect to the legal regime of the right to use public and private water.

The general freedom of use of public watercourses remained unchanged, particularly with regard to drinking and domestic purposes, the watering of animals, transportation and fishing. However, the ever-increasing granting of concessions and leases, as well as the acknowledgement of water usurpations and privileges for fishing, fish-breeding and other purposes, tended to infringe upon this principle.

Justinian lawyers even stated that if any person had been fishing in a given stretch of a public river or lake for a long time, he would acquire an exclusive right to fish therein (ius praeoccupationis), on the grounds of prescription (longi temporis praescriptio).[135] This late Roman mode of acquisition of water rights continued throughout the Middle Ages and became a mode of acquiring water rights for the utilization of mills.[136]

From the Late Empire (IVth century A.D.), the traditional permissiveness of classical Roman law was superseded by an entirely different system, which made the administrative concession the only legitimate mode of acquisition of a right to divert water from public watercourses for irrigation and/or industrial purposes. A further blow to the ancient permissive system was brought about by a general prohibition to divert water from navigable watercourses and from effluents thereof, which seems to have been introduced under the law of Justinian.[137]

The system of administrative concessions to make private connections with public aqueducts and/or reservoirs for household or industrial purposes which existed ever since the age of the Republic continued.[138] These concessions were called "sacrum rescriptum" or "divini apices de sacrum epistolarum scrinio".[139] Administrative control was increased, however, because of ever-increasing usurpations (illegal connections to aqueducts). A pertinent interdictum (de aqua castellaria) could be issued only to the holders of a regular concession for connection to an aqueduct.[140] In addition, the central water authority exercised strict control over the existing connections and legalized only those of long-lasting usage (usus vetus).[141]

The practice of legalizing unlawful diversions of water from public aqueducts or reservoirs on the grounds of long-lasting usage had interesting developments in the Middle Ages. While under late Roman law (post-classical law) long-lasting usage served only as a presumption that an administrative concession had been issued, the same usus vetus later turned into a mode of acquisition of a right to use public water.[142]

As to the unlimited right to use private water, the law of Justinian introduced some restrictions: a water-right owner could no longer use his waters for the sole purpose of damaging his neighbour.[143]

Furthermore, the law of Justinian abolished the restriction whereby a right to divert water from someone else's private source of perennial running water (ductus aquae) could be acquired only from the source (caput aquae). As had been practiced during the late Empire, private running water which sprang from a perennial source could thenceforth be diverted from any point (ex quocumque loco) under a regular water right separate from land (ius aquae separatum a fundo), no longer necessarily a real right.[144] These water rights separate from land were those under which public and, thenceforth, private running waters were diverted and were the origin of the so-called "perpetual water rights", largely applying to irrigation, industrial and miscellaneous uses of water throughout the Middle Ages.[145]

5.3 Protection From Harmful Effects of Water; Control on Waterworks and Structures

Under the law of Justinian, legal action for defence against damages caused by rainwater (actio aquae pluvia arcendae) changed its meaning. Parallelly with the shifting of relevant concern, the former significance of "preventing harmful effects of rainwater downstream", evolved to that of ensuring the natural drainage of rain water for "protecting beneficial uses downstream".[146]

No other considerable change seems to have occurred with respect to this topic, as the regulation which had developed under classical law was incorporated into the Corpus Iuris.

5.4 Water Administration[147]

The bureaucracy which developed in the last period of the Republic and which extended during the Principate reached its height in the Late Empire. From Diocletian and Constantine onwards (IVth century A.D.), competence for the City of Rome's water supply, the Tiber and the drains continued to be handled by the specialized technical water service (Curatelae aquarum), which became a strictly graded department under a great Imperial dignitary, the Praefect of the City, with a staff composed entirely of Imperial officials (aquarii, at the lower grade). The name of those responsible for water administration changed from "Curator aquarum" to "Consulares aquarum".[148]

The organization of water administration continued as during the Principate without major changes. In Italy and in the Provinces water administration presumably passed entirely to the Emperor's vicars (Consulars, Praesides and Correctors both in Italy and in the Provinces, Proconsuls also in the Provinces) parallelly with the gradual suppression of the surviving local autonomies.

6. CONCLUSION

Roman law principles, and for our interest, Roman water law, have not died; on the contrary they have continued up to the present day. The laws which regulate water ownership, distribution and use of a multitude of people of different races and religions all over the world are based on principles deriving from Roman water law.

In the Eastern Roman Empire the Roman system of law continued to operate not only up to 1493, the date of the fall of Constantinople to the Turks, but, with minor modifications, right up to modern times. The Turks introduced Islamic Law;[149] however, the Justinian codifications were translated into Greek and other Greek compilations of Law were made,[150] and Roman-Byzantine law continued to govern the relations of the Christians within the Ottoman Empire until the Balkan states achieved their independence. Thus, the modern codifications of Greece,[151] Serbia,[152] Bulgaria, [153] Romania, [154] and Russia,[155] all had, until recently, basic principles of Roman-Byzantine water law.

In Western Europe after the fall of the Western Roman Empire, Roman-Byzantine law remained in force in southern Italy, while in central and northern Italy, Roman-Barbaric codes of law were promulgated, the study of Roman law flourished in Italian schools.[156]

During the European Middle Ages the basic principles of Roman Water Law continued to prevail, together with some German traditional law, and were adapted to the historical and political times. Thus the Constitution of Frederic I includes navigable waters, among public things which have become the property of the prince.[157]

In Germany, Holland and Austria, Roman law principles influenced the remodeled legislation adopted in the XVth and XVIth centuries, and together with local customs gave birth to the German Civil Code of 1900, the Austrian Civil Code of 1869.

In France a similar fusion of Roman and customary law gradually developed during the Middle Ages and served as the basis for the French Civil Code of 1804. French legislation influenced all those countries which came under Napoleonic rule and subsequently those countries under French cultural influence.

The Spanish legislation, based on Roman law principles with some influence of Moslem Law in southern Spain particularly concerning irrigation uses, was instrumental in shaping the laws of all Latin American countries; Pope Alexander VI, on May 4, 1493 issued a Papal Bull by which he gave to the Catholic kings all newly discovered lands, including waters. Water use became subject to a special King's permit (merced especial de los Reyes).[158] Roman water law principles can be seen in the modern codifications of Latin American countries.

The riparian doctrine of Anglo-Saxon Common Law is also a Roman law water principle. The Common Law of England was instrumental in shaping

the legislation of the eastern states of the U.S.A. and the western provinces of Canada, and of all countries in the world which came under British influence.

Finally, it is worthwhile noting that the Republic of Venice, as an exception to the classical Roman and subsequent Barbarian and Feudal principle of subdividing waters into public and private, declared, in 1556[159] all waters without exception, including springs and wells, as belonging to the Republic's public domain.

Venice, a town born "out of water" soon recognized the importance of water as a social commodity which the State had the duty to conserve for insuring its fullest and equitable utilization for the benefit of all.

THE ITALIAN WATER LAW SYSTEM

by

Dante A. Caponera and Stefano Burchi*

PART I - SUBSTANTIVE WATER LAW

1. INTRODUCTION: LEGAL FRAMEWORK AND POLICY

The present water law system in Italy, which developed between 1865 and the enactment of the Basic Law on Public Waters (Testo Unico sulle acque pubbliche) in 1933, appears to have been influenced partly by Roman water law, partly by post-Roman or Intermediate water law, and finally by original nineteenth-century doctrines.

The influence of Roman water law appears in the distinction made between the rights to use public and private waters, then introduced for the first time, and in the concept of public waters treated as a resource of primary social concern.

The influence of Intermediate water law can be seen in the introduction of an expanded system of administrative concessions, which still governs all major water uses today.

The ever-increasing controls imposed upon the use of private waters represent the contribution of late nineteenth-century, social-oriented doctrines.[160]

The Italian water law system thus developed from a more comprehensive, multi-purpose pattern, featured by the first law on waters of 1865, which embraced such aspects as centralized control over waterworks and structures, land reclamation, navigation and floating, water diversions, and water policing,[161] to a more fragmentary scheme whereby some of the above aspect have been given separate legal treatment.

The current system comprises, therefore, a basic Water Law, several Basic Laws (Testi Unici) governing other aspects of water management and control,[162] together with Civil Code provisions governing water ownership and the right to use private waters,[163] as well as numerous additional legal provisions scattered in other legal enactments dealing incidentally with particular aspects of water resources.

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As a result of the above-mentioned trends, the policy for water resources management and control seems to have shifted from that of protecting the water balance, as underlined by the first water law of 1865, to that of encouraging the maximum utilization of available water, as provided for in the present Basic Law on Public Waters of 1933.[164]

1.1 Classification of Waters

Two major categories of water resources are recognized with respect to the legal regime governing their ownership and apportionment: public waters and non-public (or private) waters. Additional classifications have recently been introduced through regional legislation concerning rivers used for waste disposal. Slight differences also exist in the legal regime governing surface and underground waters.

The law defines as "public water", springs, water courses and lakes, even if artificially constructed or increased, which have or acquire a tendency to be of public use, whether because of their length, width, flow, or their relationship to the hydraulic system of which they may be a part.[165]

The application of the above-mentioned legal criteria is entrusted to the administrative authority; public hearings are provided to ensure adequate protection of pre-existing legal rights.

Waters which, in the administrative authority's discretionary opinion came within the purview of the above-mentioned legal definition are listed in ad hoc provincial registers of public waters. The lists contained in these registers may be modified through additions or deletions at any time.[166]

Waters which do not fall within the purview of the above definition for their classification as public waters are considered private. It is, however, worth noting that the laws in force merely qualify such waters as "non-public" and regulate their right of use.[167]

1.2 Concept of Ownership

The ownership concept may refer to either public or non-public (or private) water resources, the two categories of water existing in Italy.

1.2.1 Public Waters

As a consequence of the introduction in Italy of regional autonomies after the Second World War, "public waters", once solely part of the State's public domain, today form part of the "public domain" not only of the State[168] but also of the autonomous Regions of Sardinia,[169] Sicily,[170] and Valley of Aosta,[171] and of the autonomous Provinces of Trento and Balzano.[172] The major element underlying the concept of "public domain"

is that of a patrimony necessarily vesting in the State (or in the autonomous regions or provinces), which includes those movable or immovable properties possessing, either naturally or if artifically induced, the requisites to serve general public uses.[173]

Accordingly, water forming part of the public domain constitutes a natural means for the fulfillment of those public-interest functions entrusted to the State and to the other authorities for the promotion of social and economic development.[174] Public waters cannot, therefore, be alienated, whereas water use rights may only be acquired through administrative procedures and subject to such legal restrictions as are provided by law.[175]

1.2.2 Non-public (or Private) Waters

Generally water is private when it springs, flows on or lies below lands under private ownership. As a consequence, the ownership of non-public (private) water constitutes an inherent feature of land ownership. By virtue of the relevant provisions of the Civil Code, the land owner has the right to use, for irrigation or for operating his industries, private water bordering his land, which flows naturally and upon which others, including the State, have no claim along its course, provided he returns the water without impeding or diverting its natural course. The owner's right to use freely those waters, including the right to place them at the disposal of others, is subject to a series of limitations concerning its flow (which cannot be impeded), the construction of works (likely to harm neighbouring lands) and the use of its springs (in a manner endangering human health, and the interests of agriculture and industry.[176]

In addition, disputed ownership rights in non-public waters may be restricted or even suppressed judicially, whenever, in the court's opinion, the development of local agriculture and/or industry is likely to benefit.[177]

When a non-public water acquires a character of common interest, however, it becomes public and may then be officially so declared.

1.3 Allocation and Control

Different rules apply to public and non-public water resources.

1.3.1 Public Waters

Public water resources may be allocated for use only by the competent administrative authority through the issuance of a permit or concession for the use of water. After an application has been filed, public proceedings of growing complexity take place, as the social and economic importance of the proposed use increases.

Such proceedings are intended to enable the administrative authority concerned to investigate the technical and economic feasibility of any proposed utilization, as well as the applicant's reliability. Proceedings

end either with the rejection of the application or with the issuance of an administrative deed of concession specifying the amount of water to be diverted, the purpose(s) and duration, as well as any other term or condition which may be imposed.[178] Perpetual concessions may no longer be issued for the use of public water resources; the maximum period of validity is fixed by law.[179]

Before allocating permits, authorizations or concessions for the use of public water resources, the competent authority may:

(a) reject those applications which are contrary to the good regime of waters;

(b) select, among competitive applications, those which by themselves or in connection with other applications, show the best utilization from the hydraulic point of view and satisfy other public interests;

(c) in the case of two applications concerning irrigation, give preference to the application of the owner of the land to be irrigated;

(d) for the purpose of ensuring a more rational use of water, make different applications more compatible and request the applicants to modify their projects or to form a consortium of users.

(e) disregard existing rights of use (previously granted) if deemed less important than, or technically inconsistent with a new allocation.[180]

There are two major exceptions to the legal regime governing the allocation of public water through a concession: small, customary individual water intakes intended for household consumption are free from administrative interference on the basis of customary law;[181] in addition, the abstraction and use of public groundwater resources for satisfying a landowner's own domestic needs is permitted and is free from any administrative interference.[182]

As regards non-consumptive uses of water, floating is subject to an administrative authorization[183] and fishing to an administrative licence;[184] navigation is, however, free.[185]

1.3.2 Non-public (Private) Waters

The right to use non-public (private) water is, first of all, acquired through inheritance, sale, acquisition or possession of a land on which or under which such water is located.

The allocation of these waters to third parties may also be permitted by the owner or by the holder of a (non-public water) use right. Frequently, the right to use non-public waters may also be enjoyed as a consequence of servitudes accruing according to the water's location. Thus, the proprietor of land receiving water flowing naturally from higher levels is forbidden to do anything whatsoever impeding the natural flow; it is likewise forbidden for the owner of upper lands to erect, even on his own property, works likely to harm lower lands; while water must run

its natural course, the owner of upper lands is allowed to make modifications provided these do not threaten any damage to neighbouring lands.

Judicial allocation of private water resources between neighbors may take place for the establishment of a compulsory servitude whenever water is needed for domestic and/or irrigation purposes and the parties concerned are unable to reach an agreement.[186]

1.4 Preference of Uses and Status Thereof

Rather than establishing a fixed order of priorities among different uses of water, existing legislation has empowered the administrative authority to establish preferences for water uses;[187] such a preference has been established for municipal and domestic water uses included in the approved national Master Plan for Aqueducts.[188]

The administrative authority may establish preferences for the use of public water for irrigation, land reclamation, inland navigation, railway system improvement, drinking water supply, and other important public services, by means of imposing reservations on an entire watercourse or any part thereof. Such reservations may have a term of up to eight years; as long as they are effective, these waters cannot be allocated except for the planned purpose; whenever water is required by the administrative authorities, summary procedures for their allocation take place.[189]

The administrative authority is also compelled to give preference to municipal and domestic uses, in accordance with the requirements of the above-mentioned Master Plan for Aqueducts, by placing those waters as may be needed under a public bond of destination. This bond has a duration of up to 50 years and, as long as it is effective, these waters cannot be allocated for other purposes. Where such waters are used for other purposes, such use must terminate at the moment these waters are needed for the planned municipal and domestic uses.[190]

1.5 Efficiency Criteria

At the national level, the legislation in force does not prescribe any specific legal criteria for insuring the most efficient use of water resources.

Only Lombardy's regional legislation on water pollution prevention expressly directs that criteria be established by regional regulations for ensuring the most efficient utilization of water in industry while, at the same time, reducing water pollution and promoting the treatment and recycling of industrial water wastes.[191]

1.6 Treatment of Groundwater Resources

As far as ownership and use rights are concerned, the legal regime of groundwater resources is identical to that of surface water: groundwater resources may be public or non-public (private).[192]

Specific legal provisions apply, however, to the exploration and extraction of groundwater resources. The administrative authority may, by decree, establish specified districts in which the exploration, extraction and utilization of groundwaters are subject to the control of the public administration for the purpose of protecting the water balance of said districts.[193] Control powers include the settlement of disputes arising out of drilling and other operations, as well as the power to suspend or terminate exploration and extraction activities and the operation of wells.[194] Outside protected districts, groundwater exploration and extraction are free of administrative interference. However, specified distances and precautions must be observed in order to prevent the impairment of third parties' existing rights on non-public waters[195] and/or undue withdrawals of public water.[196]

Those who discover groundwaters are required to report it to the administrative authority. If the water discovered is declared public and is so registered, the same formalities are required for the use thereof, as in the case of surface water. If the water is not declared public, the landowner may use it freely but he must compensate the discoverer; the compensation is calculated on the basis of the expenses incurred and the increase in the value of the land.

1.7 Quantitative and Qualitative Problems

Existing legislation prohibits waste or misuse of both public and non-public water resources; penalties for waste and misuse of public water include the cancellation of the corresponding administrative authorization.[197]

Prior to granting a right to divert and use public water, the administrative authority is required to investigate and report on the quantitative and qualitative aspects of the proposed utilization. The terms and conditions of the corresponding administrative concession are usually established on this basis.[198] With respect to the prevention of water pollution and the conservation and improvement of water quality, the present legal system is most complex. It includes legislation which aims not so much at protecting water from pollution as at protecting inland fishery,[199] human health,[200] land reclamation,[201] and agriculture;[202] the only provisions expressly providing for the protection of water quality are those requiring that synthetic detergents be at least 80 percent biodegradable,[203] and those prohibiting the disposal of inflammable mineral substances into surface waters.[204] A comprehensive national bill for the prevention of water pollution presently lies before the Parliament.[205]

In addition to national, heterogeneous anti-water pollution legislation, there is extensive regional legislation aiming specifically at the prevention of water pollution, both surface and underground, public and non-public.[206] Regional water pollution laws tend to connect the problems of water pollution with other aspects of over-all water resources management, including rational utilization, protection from harmful effects, and the interrelationship between water and other natural resources within a given area, thus involving town and land-use planning.[207] Thus regional legislation prohibits the disposal of industrial and urban waste on land or in the sub-soil, fixes effluent quality standards and requires an authorization for the disposal of waste into public sewer or into surface waters.[208]

Classification of certain streams as effluent-receiving has been adopted only by the legislation of the Region of Sardinia and of the Province of Bolzano.[209] Local public associations are entrusted with the construction and management of public sewer systems and central treatment plants.[210] The Region of Lombardy is adopting a Regional Master Plan for the regulation of waste disposal and for the restoration of water quality.[211]

Water quality problems are also directly relevant to the protection of human health. National health legislation provides for the enactment of municipal sanitary regulations, which must include provisions for the protection of drinking and domestic water.[212] In addition, control on water quality exists with respect to some food industries, whereby processing and washing water must comply with safe-drinking standards and must be preserved from any source of pollution whatsoever.[213]

1.8 Implementation Provisions

The implementation of legislative and administrative water provisions is, as a rule, the responsibility of the holder of a water right, whether it be a private individual, a public body or an administrative authority.

However, whenever a tardy compliance with an administrative order issued for the implementation of a broad legislative provision is likely to endanger e.g., human health and/or the hydrological balance and/or the navigability of a watercourse its implementation can be enforced directly by the administrative authority. Any expenses incurred by the administrative authority for the direct carrying out of implementation measures are charged to the violator.[214]

1.9 Enforcement Provisions and Procedures

Legislative and administrative water provisions are enforced by a number of judicial and administrative officers vested with control and inspection powers.

Penalties are also provided for with respect to violation or breach of such provisions; penalties include: fines, short-term imprisonment, compulsory restoration to the original state existing prior to the violation, if suitable, and cancellation of duly granted water-use rights.[215]

The controlling and inspecting officers must promptly report to the administrative authority any breach or violation of legislative and/or administrative water provisions;[216] in turn, the administrative authority may either fine the transgressor or, in case such a fine is not paid in due time, or in any other case, forward the report to the judicial authority for application of the relevant penalty.[217]

Compulsory restoration to the original state and cancellation of existing water use rights are the responsibility of the administrative authority.[218]

1.10 Legal Constraints to Rational Water Allocation and Management

The legislation in force allows great mobility and flexibility in the allocation of existing water resources and in the granting of corresponding rights of use; the administrative and also the judicial authority may modify the existing water rights for the use of any public or private water at any time and to a considerable extent. Major facilitators are the administrative authority's power to:[219] i) grant to a later concessionaire all or part of the flow of public water already allocated to earlier concessionaires; ii) repeal, under given conditions, existing rights to use public water; iii) declare the forfeiture of existing water-use rights in those cases provided for by law; iv) redeem water rights when originally agreed upon with the concessionaire; and v) eventually dispossess, under given conditions, the holders of exclusive fishing rights.

The judiciary authority's power to re-allocate and/or modify existing rights to use non-public water in the case of disputes also constitutes a facilitator.

Even when legal constraints seem to exist, the powers conferred by the law to the administrative and judicial authorities facilitate the overcoming of such legal constraints. For instance, existing, valid rights of ownership or use of non-public water resources must be recognized whenever such water is registered as public; such recognition is not automatic and is subject to the presentation of a claim, supported by the requisite evidence, within a prescribed time limit, and takes place through the granting of an administrative deed of recognition or of a preferential concession. In addition, under specified conditions, the law empowers the administrative authority to modify considerably such rights with respect to their duration and the quantity of water involved. Furthermore, unclaimed rights are forfeited.[220]

The above-mentioned powers of the administrative and judicial authorities serve as useful tools for insuring the rational allocation and management of available water resources.

In our opinion the major constraint to rational water allocation is to be found not in the legal framework but rather in the institutional framework, as well as in the lack of an adequate master water plan at the national level. Efforts are being made by some regional governments for the drafting of regional water plans.

1.11 Water Police

Legislative provisions concerning water police are based on the direct prohibition of works likely to impair the hydrologic balance of public water, and on the powers of control conferred to the administrative authority. Such control may be exercized both in advance, whereby works have to be authorized, and subsequently, whereby the administrative authority has the power to stop, modify or remove any work considered harmful to the hydrologic balance of public waters, both surface and underground. The administrative authority has additional powers of enforcement, including those of imposing and undertaking directly (ex officio)any measures deemed necessary, as well as to restore everything to the original state at the expense of the violators.[221]

1.12 Other Particulars of the System

1.12.1 Land Use

Various legislative and/or administrative provisions relate to restructions applying to land ownership and/or use, for the purpose of preventing soil erosion, securing drainage or natural flow of water, and protecting human health.

With regard to soil erosion control, the ownership and use of those lands which have been placed under special administrative bond for the purpose of hydrogeologic consolidation are subject to restrictions with respect to grazing and tilling.[222] On lands along public watercourses any activity likely to interfere with the regular flow of waters is either prohibited or permitted, subject to conditions imposed in an administrative permit.[223]

Restrictions on land ownership also apply with respect to drainage of waters. The owner of a land receiving streams that drain naturally from upper-lying land cannot impede such natural flow.[224] Where natural drainage is lacking he must allow the carrying out of the necessary works in upper-lying lands by the owners thereof. The tolerating landowner must, however, be indemnified for any damage arising from such drainage works.[225] The usage of land for the disposal of waste is prohibited under regional legislation enacted recently for the prevention of water pollution.[226]

1.12.2 Rates and Taxes

Water utilizations granted by deed of the administrative authority are subject to the payment of water rates. These water rates vary according to the purpose of utilization and the amount of water utilized; reduction and exemption from payment of water rates are provided for.[227] State and regional taxes for the issue of concessions, authorizations, etc., are also levied.

Special taxes are levied for the enjoyment of inland navigation services, and temporary inland navigation tolls are levied in favour of provinces and municipalities.[228]

1.12.3 Public Projects Financing and Implementation

Public projects are usually financed by the central government, the regions, the provinces, the municipalities and any other public body or private individual concerned. The share in the financial burden of the project and/or the construction and/or the management of public projects is determined according to a classification of hydraulic works established by law. Hydraulic works are subdivided into five categories and navigation works into four.

In the case of land reclamation, the State's financial participation is determined on the basis of the nature of the works to be undertaken and the area in which such works have to take place (South or North of Italy). As regards water supply and sewerage systems, financial participation takes into account, in addition to the area, the population density.

Central government financial aid is provided with respect to public projects totally or partially undertaken by local government authorities or private entities on the basis of the above criteria.[229] Detailed legal provisions also govern the preparation and approval of construction operation and maintenance of public projects.[230]

1.13 International Aspects

Italy shares with his neighbouring countries sixteen international streams which form part of seven international basins.[231]

Several international agreements have been signed for the utilization and conservation of the waters of these streams by the Government of Italy and the Governments of Switzerland, France and Yugoslavia.[232] These agreements relate to such uses as the provision of water supply in the town of Gorizia (with Yugoslavia) the production of hydro-electric power (with France and Switzerland) and the control of water pollution (with Switzerland).[232bis]

Italian territory is geographically an upper riparian in the case of four streams (two with Switzerland and two with Austria) and a lower riparian in the case of the remaining twelve streams (three with France, six with Switzerland, and three with Yugoslavia).

The legal position upheld by Italy in the matter of international water law seems to be that of accepting the principle of cooperation among basin states, and the principle of equitable utilization of the water of international drainage basins.[233]

In the matter of international water resources, the State practice followed by Italy seems to demonstrate its adherence to these principles and its rejection of the principle of absolute and unrestricted territorial sovereignty.

PART II - WATER ADMINISTRATION, INSTITUTIONS AND ORGANIZATIONS

2. INTRODUCTION: ORGANIZATIONAL FRAMEWORK AND PHILOSOPHY

In Italy, until after the Second World War, most of the functions relating to the management and allocation of water resources, with few exceptions relating to sectorial utilizations, were centralized - at national and peripheral levels - within one single water administration, namely the General Directorate of Waters and Electric Plants of the Ministry of Public Works.

The need to implement those provisions of the Italian Constitution of 1947, which required the granting of autonomous powers and functions to local governments has caused that, at present, different autonomous levels of public administration share in the management and control of water resources: the State, the Regions, the Provinces, and the Municipalities.

Accordingly, functions and powers among the existing levels of public administration follow the territorial dimension of the public concern they involve. Thus, for instance, the State retains control of major utilizations of public water resources, both surface and underground, the Regions minor utilizations of regional concern; the Provinces have administrative jurisdiction on fishing in inland waters, and the Municipalities provide for water supply and sewerage.

Each level of public administration enforces its share of responsibilities through specialized water offices, the effectiveness and sophistication of which vary in accordance with the financial possibilities of each local government. Functions and powers relevant to water management and control are allocated among the branches of the State's and the Regions' inner organization following the sectorial responsibilities peculiar to each branch. In view of the recent implementation of the decentralization process, clear delimitation of responsibilities is not always possible.

A more water resource-oriented approach governs the institutional organization in the judicial field. A water judiciary, consisting of a Supreme Tribunal for Public Waters and of eight Regional Tribunals for Public Waters, has jurisdiction over all legal disputes concerning water resources.

The institutional framework of the Italian water administration also includes the users' level of administration, in the form of water users' associations and consortia; these associations and consortia, which are generally regarded as public institutions, operate at the local, provincial, regional, and even inter-regional levels.

It is to be noted that in Italy, most, if not all, water administrations and organizations are either governmental or public. Private and quasi-public water use and management institutions are almost inexistent. This part of the report, therefore, will describe and define the levels of public and governmental organizations and administrations, as well as the relevant procedures followed.

2.1 At the National Level

At the national - central - level, most aspects of both surface and groundwater resources administration are vested in the General Directorate for Water and Electric Plants of the Ministry of Public Works. Peripherally, this State administration is represented by the Regional Offices for Public Works (Provveditorati Regionali alle Opere Pubbliche), and the Civil Engineering Offices (C.E.O.); a notable exception to these offices are the Water Authority for the Po River (Magistrato per il Po) and for the Veneto-Friulan waters (Magistrato alle Acque).

The Ministry of Public Works' institutional attributions include those of registering water resources as public; allocating public water resources for diversion and use; water policing, both with respect to surface and ground water; overflow control, and the setting up of water use priorities.

Both central and peripheral organs of this Ministry are institutionally responsible for the discharge of these functions.[234]

The local Civil Engineering Offices (C.E.O.) investigate technical aspects relating to the registration of waters as public, claimed water rights, and proposed public water diversions. Within the same procedural framework, the Superior Council for Public Works (Water and Electric Plants Section) and Regional Governments concerned are to consult with the C.E.O.'s report. It is on the basis of the C.E.O.'s report and the Superior Council's and Regional Government's advice, that the Minister of Public Works takes final decisions, in consultation with the Minister of Finance. Appeals against decisions may be made to the Tribunals for Public Waters.[235]

The setting up of priorities in the use of waters is decided directly by the Minister of Public Works in consultation with the Superior Council for Public Works and the regional government concerned.

Water-police powers and functions are the responsibility of the Chief Engineer of the local C.E.O.,[236] and, in the areas under their jurisdiction of the Po River Valley Authority (Magistrato per il Po),[237] and the

Veneto-Friulan Water Authority (Magistrato alle Acque);[238] these two last operating at the inter-regional level in the field of water conservation.

A national Hydrologic Service provides for the systematic collection and analysis of all hydrological and meteorological data. This Service is directly responsible to the Minister of Public Works and is further subject to the control of the Superior Council of Public Works. It consists of three major branches, two of which form part of the respective organizations of the Po River Valley Authority and of the Veneto-Friulan Water Authority, while the third covers the remaining national territory; its local offices form ad hoc autonomous sections of the Civil Engineering Offices (C.E.O.).[239]

The Ministry of Finances' General Directorate for Public Domain is responsible for the administration of the waters flowing in certain public domain canals located mainly in northern Italy. These are administratively grouped under the name of Cavour Canals, Lombard Navigli, and a number of other canals (both navigable and not). At the peripheral level such administration is exercised by the Cavour Canal Administration, the local Revenue Offices (Intendenza di Finanza) and the local Technical Fiscal Offices (Uffici Tecnici Erariali). For the allocation of the water resources under its direct administration, the Ministry of Finance follows the same procedures as those of the Ministry of Public Works.[240]

Other sectorial aspects of water resources management and control fall under the responsibility of other Ministries. Sanitary aspects of waters are thus under the control of the Ministry of Health through its Provincial Health Officers.[241] The Ministry of Interior, which exercises its powers through its Prefects located in each Province, is also responsible for water police [242] and the licensing of floating.[243]

The conservation of water is, with respect to nature and wildlife protection, among the duties of the Ministry of Cultural Property and Environment (Superintendencies for Monuments).[244]

Always at the national level, the National Agency for Electric Energy (ENEL) also exercises important functions with respect to water management; it provides for the production, transmission and sale of hydro- and thermo-electric energy under a monopoly system. The Agency is subject to the control of the Minister for Industry and of the Interministerial Committee for Economic Planning (C.I.P.E.). Concessions for the use of public water have been granted in perpetuity to the Agency for the pursuance of its functions.[245]

In the judicial field, the Supreme Tribunal of Public Waters has nation-wide jurisdiction over i) appeals against the Regional Tribunals for Public Waters' decisions, and ii) petitions concerning final administrative water measures. The Supreme Tribunal is a specialized organ of the judiciary system, as its members are appointed by the President of the Republic from among jurists and technicians expert in the field of water resources. Specific provisions govern the proceedings before the Supreme Tribunal for Public Waters, the decisions of which may be appealed before the Supreme Court of Cassation.[246]

2.2 At the Inter-regional Level

The major autonomous agency operating at the inter-regional level in the field of water resource development is the Fund for the development of Southern Italy (Cassa per il Mezzogiorno). It is responsible for financing, planning and implementing a large number of projects directly or indirectly aimed at the conservation, development and utilization of water resources in south and central Italy.[247]

At the inter-regional level, considerable administrative powers and functions on waters are vested in the Po River Valley Authority (Magistrato per il Po) and the Veneto-Friulan Water Authority (Magistrato alle Acque). Although they form part of the Ministry of Public Works, they enjoy a large degree of autonomy. Both have institutional competence with respect to the conservation of the water balance in the areas under their jurisdiction, including afforestation, land reclamation and water works construction, control and promotion, overflow control and embankment protection.[248]

Other important inter-regional autonomous agencies operate in the fields of water development, conservation, distribution and/or irrigation.[249]

2.3 At the Regional Level

Besides the above-mentioned Superintendencies for Monuments,[250] the Ministry of Public Works regional offices are responsible for the promotion and the implementation of public water-work projects falling within the State's competence.[251]

Autonomous regional governments also have extensive legislative and administrative powers relating to the allocation of water resources, the setting up of priorities, the control and the prevention of water pollution, irrigation, land reclamation, public works, sanitation and fishing in inland waters.

Autonomous regions are of two kinds: regions with "special status of autonomy: and regions with "ordinary status of autonomy".

As for the allocation of waters and the setting up of priorities, the Regions which enjoy a "special status of autonomy"[252] take the place of State administrative authorities whenever public water resources are part of the Regional public domain;[253] the power of those Regions to allocate public water resources is limited to the granting of concessions for "minor diversions".[254] These regional administrative authorities share, to some extent, with the State, the right to allocate regional public waters which are excluded from the Regional sole competence.[255]

All other Italian Regions with "ordinary" status of autonomy also have some administrative responsibilities in the management of public water resources; they may grant the right to use water for "minor" diversions for which no objections nor competing applications have been filed, and for yearly intakes. The exercise of the powers is, however, subject to the control of the Minister of Public Works.[256]

The regional administrative authorities take the place of State authorities for the performance of the procedures required by national water legislation; yearly intakes of public water resources may therefore be licensed by the Chief Engineer of the local Regional Civil Engineering Office.[257]

In addition, regional authorities are consulted by State authorities for the carrying out of the State's responsibilities in public water allocation and control.[258]

With regard to the prevention and control of water pollution, almost all Regions under "special status of autonomy" have full legislative and administrative powers.

The competence of the Regions with "ordinary status of autonomy" is, in this regard, still uncertain; these Regions are deemed to have legislative and administrative powers to the extent allowed in other fields of full regional competence, such as town and land-use planning.[259]

As a consequence, whereas some Regions with "special status of autonomy" have worked out a procedural and organizational framework of their own,[260] some of those with "ordinary" status have expanded the procedures and organizations established by the national legislation on prevention of water pollution.[261]

The legislative and/or administrative competence of both kinds of Regions in the fields of irrigation improvement, land reclamation and public works promotion, financing, implementation and control, fishing in inland waters and sanitation is limited to those matters of regional concern, as provided for in their respective statutes.[262]

Other important regional, autonomous water-development agencies exist for water supply, irrigation and hydropower production.[263] Most of them are under the regional administrations, a few under the State administration.

In the judicial field, Regional Water Tribunals have jurisdiction over such disputes as concern the public nature of both surface and underground water, existing rights and petitions against administrative water decisions. The same Tribunals are specialized organs of the judiciary system, and its members are chosen from among jurists and technicians expert in the water resources field. Specific provisions govern the proceedings before the Regional Water Tribunals, the decisions of which may be appealed before the Supreme Tribunal of Public Waters.[264]

2.4 At the Provincial Level

State governmental institutions having specific competence with respect to water resources management and control at the provincial level are the Civil Engineering Offices, the Prefects, the Provincial Health Officers, the Revenue Offices and the Technical Fiscal Offices.

The Civil Engineering Offices also act as Regional institutions for the discharge of the Region's own administrative functions.[265] Considerable administrative functions and powers are vested in the Chambers of Commerce concerning the prevention of soil erosion, Under procedures set forth by law, they may place a special bond on lands for the purpose of hydro-geologic consolidation and land-use restrictions.[266] The Chambers of Commerce are public, autonomous bodies representing provincial economic interests.[267]

Extensive functions and powers are vested also in the Provincial Administrations with regard to fishing, fish-culture, prevention of water pollution in inland public waters. Provincial Administrations are competent for issuing fishing licences and for granting concessions for fish-culture in inland public water. The procedures follow the pattern governing the State's granting of concessions for diversions of public waters, with the participation of the local ichthyology institute, Civil Engineering, and Revenue Offices. Final decisions are taken by the President of the local Provincial Administration.[268]

In the field of prevention of water pollution, the presidents of Provincial Administrations are empowered with issuing the authorizations required by national fishing legislation for the disposal of industrial waste into public water. These authorizations are granted on the basis of the investigations carried out by the Provincial Hygiene Laboratory and contain all relevant measures to be accepted by the applicant.[269]

In addition, the Provincial Administrations exercize direct control on water pollution deriving from industrial and/or urban wastes on the basis of the measures prescribed by Regional anti-water pollution legislation.[270]

Provincial Administrations may also undertake, under licence from ENEL, the production and distribution of hydro-electric power.[271]

Finally, the same Administrations may join with the Municipalities in the establishment of public associations or consortia for the construction and operation of water supply sewerage and wastewater treatment plants.[272]

2.5 At the Municipal Level

The residual powers on water resources management and control left to the specific competence of Municipal Administrations are the control

of the sources of water pollution deriving from its own sanitary responsibilities, the provision of facilities relating to water supply, and sewerage and wastewater treatment.

As a consequence, Municipalities must ensure the purity of drinking water, the prevention of sub-soil pollution from domestic waste, and the neutralization of industrial waste from factories classified as constituting a danger to public health. Mayors have the power to adopt all such administrative measures as may be required by local sanitation purposes; any required work may be carried out directly by the Municipality ex officio.[273]

The relevant regional legislation entrusts additional power for controlling water pollution to those municipal authorities entrusted with the licensing of building. In most cases, however, regional authorities and/or technical offices cooperate with municipal authorities in the discharge of these functions.[274]

Drinking water supply and sewerage systems must be provided by the municipal administrations, either directly or through ad hoc municipal undertakings.[275] More than one municipality and/or province may join in the organization of such public services through an ad hoc social undertaking.[276] The recently enacted regional anti-water pollution legislation has further obliged municipalities and provincial administrations to provide jointly for the construction and operation of public waste-treatment plants, either directly or through ad hoc social undertakings.[277]

2.6 At the Users' Level

Public organizations for water management and control also exist at the users' level and take the form of water users' associations or consortia for the use of public water;[278] sometimes the associations of riparian landowners join local administrations for the construction, operation and maintenance of public waterworks and/or land reclamation projects.[279]

Although their establishment is left to the users' discretion, both types of association are subject to control by the administrative authorities; such control may range from the simple obligation to register the association statutes, to their establishment by authority (ex officio), and even to the direct participation of the administrative authorities in their management.[280]

2.7 Organizational Facilitators and Constraints for Rational Management and Allocation

From an over-all point of view, the substantial concentration of functions and powers relating to the allocation and management of public water resources in the Ministry of Public Works tends to act as a major "facilitator" for the purpose of achieving rational allocation of

available water resources. However, the Ministry of Public Works' capacity to concentrate solely in water resources management for developing new and more sophisticated approaches, has always been hampered both by this Ministry's responsibilities in other fields and by the fact that other Ministries also have sectorial responsibilities in water management. A logical solution might have been to modify this situation in those aspects constituting a constraint towards the establishment of a more water resources-oriented organization both at the national (central) level and at the basins (or islands) levels. As a consequence of recent decentralization, many of the Ministry of Public Works' own prerogatives in these fields have been transferred, in total or partly, to the autonomous Regional governments.

It is important to note that the most rational management of water resources is achieved at the basin level; with a few exceptions, the administrative boundaries of the autonomous Regional governments do not coincide with those of the drainage basins. As a consequence, the sharing of powers between the State and the Regions for the allocation and management of water resources within the same basin is likely to act as a constraint to speedy and efficient water management.

Furthermore, the Ministry of Public Works has lost direct control over most of its peripheric organs, which have passed to the Regions; this has seriously impaired its capacity to discharge its responsibilities at the local level.

It is worth noting that while traditional national water management institutions are becoming defective, the general concern for rational water management and control is increasing. As a consequence, administration at the regional institutional level is looked upon as the sole alternative for ensuring continuity and for substituting the failing national water administration. Water management and control at the regional level has simplified the procedures for the issuance of regional administrative water utilization/allocation licences. However, it has also acted as a constraint to rational water management, owing to the difficulties arising out of this regional-oriented approach and, at times, to the undesirable manner in which it has been carried out so far.

The lack of adequate organizational structures at the inter-regional level has caused that the allocation of water resources of basins located within the territory of more than one region has fallen under the uncoordinated authority of different regional governments; this applies particularly to the granting of "minor" diversions for which the Regions are responsible. The present process of delegating authority for water management from the central to regional administrations, is at present being the object of doctrinary and judiciary controversies.

As a consequence of the present legislative confusion and of the central institutions' tacit opposition, State water administration is deteriorating and facing serious personnel problems, particularly at the level of Civil Engineering Offices, and regional administrations are prevented from taking over and ensuring the continuity of water management and administration.

2.8 Quasi-public and Private Water Institutions

Private water institutions are very limited in Italy. The only quasi-public water management and control institution existing in the Italian water legal system is the "Adjuster" of existing rights to divert public water.

The Adjuster is a water expert charged with determining such technical measures as to ensure satisfaction of all existing public water use rights.

These Adjusters are appointed by the Minister of Public Works upon water users' request, whenever conflicts arise with respect to the allocation of available public waters among the holders of a right. Despite his being appointed by the administrative authority, the Adjuster is a private expert, vested with a public function, and is fully liable to and paid by water users.[281]

In addition, the landowners' associations set up for preventing mountain land degradation,[282] or for undertaking reforestation and consolidation of hydro-geologically bonded lands,[283] may be considered as quasi-public entities for the prevention and control of harmful effects of waters. In fact, such associations bind the associated landowners to the pursuance of private and public purposes at the same time.

Public concern over the associations is attested by the extensive interference of the administrative authorities with their establishment.

Private water organizations may exist at the users' level, both in the form of water users' associations for the utilization of the same water body or of inter-related water bodies,[284] and of associations of landowners for the collection and conservation of waters, for the prevention and control of harmful effects of water due to lack of drainage or for hydraulic and/or hydro-agrarian land consolidation.[285]

Private water users' irrigation associations or landowners' associations for the above purposes may be established, either by the water users or landowners themselves or by order (ex officio) of the administrative authority upon request of a qualified majority of water users.

FOOTNOTES

1. For a description of earliest hydraulic civilizations, Pan American Union, Irrigation Civilizations - a Comparative Study, 1955, Washington, D.C.; Steward, Julian, Cultural Casualty and Law: a trial formulation of development of early civilizations, in American Anthropologist, 51,1, 1949; Steward, Julian, Evolution and Progress, in Anthropology Today, University of Chicago Press, Chicago, 1953; Whittfogel, Karl, Oriental Despotism; Yale University Press, 1957; Drower, M.S., Water Supply, Irrigation and Agriculture, in A History of Technology, Clarendon Press, Oxford, 1956, Vol. I.

2. The destruction by Timurlane of the retention works on the Hilmand river caused the disruption of the Hilmand Valley community and the decertification of the area; many other such examples exist, such as the destruction of the canalizations in the Neghev; of the Roman aqueducts by the barbarians; of the Singhalese waterworks, etc.

3. On the development of primitive law systems: A. S. Diamond, Primitive Law, Longmans, Green and Co., London, 1935; Armijo, Nolde and Wolff, Recueil de'etudes sur les sources du droit, 3 vol., publ. en l'honneur de F. Geni, 1938; Sir H. S. Maine, Ancient Law, 1906, and Early Law and Custom. With regard to primitive water regulations and administration, Pan American Union, op. cit.; R. Von Ihering, The Evolution of the Aryan, Swan Sonnenschein and Co., Ltd., London, 1897.

4. On primitive Egyptian laws and institutions: J. Pirenne, Archives d'histoire de droit oriental, Vol. 104, 1952; J. Pirenne, Histoire des institutions anciennes d'Egypte, Vol. 103 E. Revillut, Precis de droit Egyptien compare aux autres droits de l'antiquite, Giard et Brière editeurs, Paris, 1903, Vol. I.

5. I and II Dynasties, about 3400-2980 B.C.

6. Borchardt, L.: Nielmesser und Niels marken in Preuss. Akad. Wiss. phil. hist. Abh. nicht zur Akadgehor, Gelehrter, No. 1, Berlin, 1906.

7. III Dynasty 2980-2900 B.C.

8. IV Dynasty 2900-2750 B.C.

9. V Dynasty 2750-2625 B.C.

10. John A. Wilson, The Burden of Egypt, Univ. of Chicago Press, 1951, p. 41-50.

11. On primitive Mesopotamian laws and institutions: A. S. Diamond, op. cit.: C. Leonard Woolley, The Sumerians, Clarendon Press, Oxford; Ihering, op. cit.; p. 149-161; Driver, G. R. and Miles J. C., The Assyrian Laws, Clarendon Press, Oxford, 1935, and The Babylonian Laws, ibidem, 1952; King, L. W., The Letters and Inscriptions of Hammurabi,

Vol. 2-4, Luzac, London, 1898-1900; Adams, M. Robert, Development Stages in Ancient Mesopotamia, in Irrigation and Civilization: a Comparative Study, Pan American Union, op. cit., Washington, D.C., 1955; Cruveilhier, P., Commentaire du Code d'Hammourabi, Librairie E. Leroux, Paris, 1938.

12. Hammurabi Code, Articles 2, 129, 132, 133b, 143, 155

13. The quotations of the Hammurabi Code are taken from S. R. Driver and J. C. Miles, The Babylonian Laws, Vol. II, op. cit. pp. 11, 31, 33, 103-105.

14. Ibidem, p. 337.

15. Assyrian fragments date from the period of Middle Assyrian Empire, 1500 B.C.

16. Friederic Hrozny, Code Hittite provenant de l'Asie Mineure, 1ere partie, Genthner, Paris, 1922, and in German by Zimmerman and Friedrich, Hethitishe Gezetze in Der Alte Orient, 1922, 23, 2, and in 1925, 24, 3.

17. Such as the Nahrwan Canal (400 feet wide and 200 miles long) deriving water from the Tigris to supply Kalach (ancient Nimroud) built between 880-850 B.C. under the King Assournazirpal; the Sennacherib aqueduct, which conveyed waters to Ninive from Khurdistan in the VIIth Century B.C.

18. King, L. W., op. cit., No. 71 and 5.

19. Ihering, op. cit., p. 161.

20. On primitive Hindu law and institutions: Bandayana, Sacred Laws of the Aryans, trans. by G. Bühler, N.Y., 1897; Visnu, The Institutes of Vishnu, tr. Julius Jolly, N.Y. 1900; J. D. Mayne, Hindu Law and Usage; 8th Ed., 1914; F. Max Müller, The Sacred Books of the East, trans. by G. Bühler, Clarendon Press, Oxford, 1886; Diamond, op. cit.; on non-legal aspects of Hindu civilization: S. Piggot, Prehistoric India, Penguin Books, 1950.

21. The Mohan-Jo-Daro civilization (5000 B.C.), Indus Valley civ. 3000 B.C.

22. For a detailed analysis of Hindu water law principles, B. Wohlwend, Hindu Water Law and Administration in Bali, Proceedings of the Valencia Global Water Law Systems, 1975.

23. J. D. Mayne, Hindu Law and Usage, op. cit.; Max Müller, The Sacred Books of the East, op. cit., Vol. XXV; also Diamond, Primitive Law, op. cit.

24. F. Max Müller, The Laws of Manu, The Sacred Books of the East, op. cit., Vol. XXV, p. 103.

25. F. Max Müller, op. cit., p. 379.

26. Rules regarding the Ordeal by Water, in the Institutes of Vishnu, Max Müller, op. cit., Vol. VII, p. 59.

27. For a detailed study on the historical development of Chinese water laws see: Danta A. Caponera, Water Law Principles in the Chinese Legal System, in the Indian Journal of International Law, Delhi, 1960.

28. Caponera, op. cit. p. 246, note 28.

29. On Hebrew law: Diamond, op. cit.; A. Hirsh, International Rivers in the Middle East, thesis, Columbia University, 1957, containing many references on municipal water legislation. Most of the information provided in this section is abstracted from Hirsh's thesis.

30. Book of Exodus, XXIII, 25.

31. Book of Deuteronomy, VIII, 7.

32. Book of Hosea, XIII, 5.

33. Book of Psalms, 104, 10-14.

34. Talmud Bavli Shabbat, 121b; Beitza, 39a; Eiruvin, 46a and 48a; Tosephta Baba Qama, 6, 15, cf. Maimonides, Mishne Torah; Hilkhot Gezeila Vaaveida, 5, 13; Hilknot Yom Tov, 5,14; Orakh Hayim, 397, 15; Also Karo, Shulhan Arukh, Orakh Hayim 397, 15; all quoted in A. Hirsh, op. cit.

35. Talmud Bavli, Beitza, 39a, and Rashi's commentaries there; Talmud Bavli Nedarim, 48a; Tosephta Baba Qama, 6,15, and commentary Magen Avraham there. All quoted in A. Hirsh, op. cit., p. 155.

36. Book of Numbers, XX, 19.

37. Abraham Hirsh, op. cit., p. 155.

38. Ibidem, p. 153; Talmud Bavli, Baba Metzia, 108a; cf. Maimonides Mishne Torah, Hilkhot Shekheinim, 3,5.

39. A. Hirsh, op. cit., p. 153; respectively, Rab and Shmuel; Talmud Bavli, Gittin, 60b.

40. Moshe b. Maimon (1135-1204), Compendium of Jewish Law, 5,10.

41. A. Hirsh, op. cit., p. 153; Talmud Yerushalmi, Gittin, 5,9.

42. Ibidem, p. 154; Talmud Bavli, Nedarim, 80b; Talmud Yerushalmi, Nedarim, 11,1.

43. Talmud Bavli, Baba Metzia, 108a; cf. Maimonides, Mishne Torah, Hilkhot Shekheinim 3,9, quoted by A. Hirsh, op. cit., p. 154.

44. For a description of Islamic water law, see D. A. Caponera, Water Laws in Moslem Countries, FAO Rome, Italy, 1973.

45. Talmud Bavli, Ta'anit, 20a, quoted by Hirsh, op. cit., p. 154.

46. Talmud Bavli, Baba Bathra, 91b. Hirsh, ibid.

47. Mishne Torah, Hilkhot Melakhim, 1,4.

48. On pre-Columbian civilizations and law in general: Central Andes (Peru): Bennet Wendell, The Archeology of the Central Andes, in Handbook of South American Indios, Vol. 2, Bureau of American Ethnology, 1946, Washington, D.C.; same author, in American Antiquity, The Peruvian Co-tradition, 1948; Bird, Junius, Pre-ceramic Cultures of Chicana and Viru, in American Antiquity, 1948; Willey Gordon, Peruvian Settlement and Socio-Economic Patterns, the Civilizations of Ancient America, Univ. of Chicago Press, Chicago, 1951; Meso-America (Mexico), Palerm, Angel, La distribucion del regadio en la area central de Meso-America, Ciencias Sociales, Washington, D.C., 1954; Gomara Francisco Lopez, Conquista de Mexico, Impr. de J. Escalante y Ca. Mexico D.F., 1870; Armillas Pedro, Techniologia, formaciones socio-economicas y religion en Meso-America, The Civilization of Ancient America, Univ. of Chicago Press, Chicago, 1951.

49. At Huaca Prieta, Cerro Prieto, in Donald Collier, Development of Civilization on the Coast of Peru, in Irrigation Civilization, Pan American Union, Washington, D.C., 1955.

50. At Cupisnique, Guañape, Nepeña, Casma, etc., in Collier, op, cit.

51. At Mochica, Maranga, Galinazo, Paracas necropolis, in Collier, op.cit.

52. A. Palerm, The Agricultural Basis of Urban Civilizations in Meso-America, in Irrigation Civilizations, Pan American Union, Washington, D.C.

53. Historical records date only from the Toltec era.

54. J. W. Cecil Turner, Introduction to the Study of Roman Private Law, Bornes and Bowes Publ. Ltd., Cambridge, 1953, p. 12.

55. Digest, 1, 2, 2, 1 to 3.

56. P. F. Girard, Droit Romain (3rd Edition) Paris, 1901, pp. 14, 15 and 255-259.

57. P. F. Girard, op, cit., 33-46.

58. F. Serafini, Istituzioni di diritto Romano, Florence, 1892, 10-13.

59. "De aqua, rivo, itinere actuque": Table V, 3 in Frammenti delle XII Tavole, by F. S. Diliberto, Palermo, 1898, p. 48; also in Fonti del diritto Romano, by P. Cogliolo, Torino, 1885, p. 5; Gravinae, Origines Juris Civilis, 1861, p. 145.

60. "Si aqua pluvia nacet aut aquam arceto aut noxam cepeto" (If the rain waters cause damage, either they have to be directed elsewhere or compensation shall be paid): Table VIII, 9 in F. S. Diliberto, op. cit., p. 96; also in P. Cogliolo, op.cit., p. 6; P. F. Girard, Textes de Droit Romain, Paris, 1937, p. 17, containing subsequent interpretations of Paul, Ulpian, Plinius and Justinian; Gravinae, Origines Juris Civilis, 1861, p. 222.

61. The fragments of this law are reported by T. Mommsen in Corpus Inscriptionum Latinarum, I, p. 79; also in Bruns, Fontes, p. 52. The law confirmed the former Lex Thoria Agraria (cir. 120 B.C.); it prohibited further allotment of ager publicus and confirmed former allotees' possession, subject to payment of a rent (vectigal) to the State; it suppressed the vectigal and turned the former possession of ager publicus into private land ownership (ager optimo iure privatus), subject to the ordinary tax (tributum ex censu - tax stemming from the registration of land in the Census) (Pandelletto-Cogliolo, op.cit., p. 363, footnote c).

62. The Lex Mamilia Roscia stated that whoever prevented the regular flow of waters within the fossae limitales (border ditches) of municipal land be fined, these fines to benefit the Municipality (E. Costa, Le acque nel diritto Romano, Bologna, 1918.

63. The Lex Coloniae Genetivae Iuliae stated that all waters existing within newly-allotted public land for settlers be subject to the same uses and burdens they were subject to under the former land owners (c.79). The same law further empowered municipal authorities (Curia and duoviri) to allocate surplus public waters (aquae caducae) to private utilizations (c. 97 to 100) (E. Costa, op. cit, pp. 16,28).

64. The Lex Sulpicia rivalicia stated that all the inhabitants of the town be allowed to make use of water pipes (sifi) for the distribution of domestic water; it probably had in view private diversions from public aqueducts (E. Costa, op. cit., p. 39).

65. Under classical law, springs and artesian wells were expressly classified as appurtenances of land, "portio agri" (Ulpian, in the Digest, 43, 24, 11, pr.; 39, 2, 24, 12; 39, 3, 8; 10, 3, 4, 1; Pomponius, ibid., 39, 3, 21, and 8, 1, 15 pr.).

66. Frontinus, De condicione agrorum, p. 20, 10.

67. Apportioned public land (ager publicus) came under several main headings: "Agri Quaestorii", public land which could either be sold by the Quaestors, or often be given free to members of a colony ("ager divisus et ad signatus") or to a single citizen ("ager viritanus") for their ownership. "Agri limitati": Italic lands under private ownership. Finally those public lands which were subject to mere occupation ("Agri occupatorii"), became owned by the occupiers under the legislation of the end of the Republic and the beginning of the Principate (from P. F. Girard, op. cit., 280-281).

68. Hyginus, De condicione agrorum, 112, 114, 120, 125; Siconius Flaccus, De condicione agrorum, 150-151, 157; Pomponius, in the Digest, 41, 1, 30, 3.

69. Siconius Flaccus, op. cit. p. 150-151; "Sententia Minuciorum" (116 B.C.), in Bruns, Fontes 400, Iuris Romani Antiqui, Leipzig, 1886.

70. Which were chosen by technicians at the foot of the mountains ("sub radicibus montium et in saxis silicibus" Vitruvius, De architectura, 8, 1). With regard to Rome, it seems that only the "aqua Tepula" had originated from a private, expropriated spring (Costa, op. cit., 3).

71. Ulpian, in the Digest, 43, 14, 1, pr. and 6-7.

72. Ibidem, in the Digest, 39, 2, 24, 12; 39, 3, 1, 12; 39, 3, 8; 43, 20, 1, 6 and 28; 43, 22, 1; 10, 3, 4, 1; Pomponius, in the Digest, 39, 3, 21; 8, 1, 15.

73. Institutiones, 2, 4; Astuti, Acque - storia, in Enciclopedia del diritto, I, 356-357; P. F. Girard, op. cit., 237-238.

74. The legal regime of private land ownership varied according to whether the land was under the status of Italic or of Provincial soil. Italic soil could be the object of Roman private ownership (dominium ex jure Quiritium), which entailed freedom from land tax and the right of use and misuse (utendi et abutendi). Provincial soil (praedia stipendiaria et tributaria) could only be the object of a peculiar kind of private ownership (dominium) or later dominium ex jure gentium which entailed the subjection to land tax and to possession and use (habere, possidere, frui, licere); from P. F. Girard, op. cit., 259-61, 351.

75. Frontinus, De aquaeductibus urbis Romae, 94; Costa, Le acque, op.cit., 38.

76. In the earliest stage the acquisition of prediae servitudes probably followed the rules governing the acquisition of land ownership. Later a distinction appeared between the legal status of Italic land and that of provincial land. As a consequence, the modes of acquisition of a servitude on Italic land were (i) alienation (mancipatio, in jure cessio), (ii) magistrate's judgment (adjudicatio), (iii) last will; servitude could be acquired on provincial land only by an agreement (pactum, stipulatio); from P. F. Girard, op. cit. 368-70.

77. Table V, 3 in the interpretation of G. Padelletti-P. Cogliolo, Storia del diritto Romano, Florence 1886, 253 (c).

78. Table VIII, 9.

79. Padelletti-Cogliolo, op, cit., 222 footnote. This "actio" seems to have had regard only to the "ager" of "heredium" (each family's small holding of public land, constituting its homestead), with the exclusion of the "fundus urbanus" (urban land).

80. Information on water administration in the City of Rome is drawn from L. Homo, Roman Political Institutions, London & New York, 1929; Information on water administration in Italy and in the Provinces from E. Costa, Cicerone Giureconsulto, Bologna, 1927, Vol. I, 399 and ff. also, R. Lanciani, Topografia di Roma antica: I commentarii di Frontino intorno alle acque e gli aquedotti, in Atti dell'Accademia dei Lincei, Serie 3a, Vol. IV, Rome, 1880.

81. Lanciani, op. cit., p. 520-522.

82. Ibidem, p. 592.

83. A double college of "duoviri iuri dicundo" and "duoviri aediles", in the coloniae; and a single college of quattuorviri iuri dicundo and aediles - in the municipia; from E. Costa, Cicerone, op. cit. 401-402.

84. Girard, op. cit. 49-69; Turner, op. cit., p. 91-92.

85. Directing that private connections with public water supply installations had to be made only at "castella" (reservoirs and tanks). The S.C. is reported by Frontinus, De aquaed, op. cit., 106.

86. The law forbade abusive private connections (nova foramina) with public mains, regulated the distribution of water according to the terms and conditions of the existing administrative concessions, and set forth penalties. The law is reported by Frontinus, De Aquaed, op. cit., 129.

87. Directing that a water right over at least two intakes from public mains (lacunae populi Romani) was a condition for admission to the college of laundry-men and dyers, or for the exercise of laundry and dyeing industries (fulloniam facere). The law is reported by Bruns, Fontes, 395-396.

88. This rescriptum sanctioned the opportunity of an apportionment of public water for irrigation, proportional to the needs of lands. This principle wouldn't apply with respect to those water rights which had been granted by an administrative concession. In any case, existing third parties rights had to be safeguarded. The rescriptum is reported by Papirius Justus, in the Digest, 8, 3, 17.

89. Response of Cassius Longinus and Celsus on the applicability of the "interdicta de fluminibus" reported by Ulpian (in the Digest, 43, 12, 1, 1-4); also see Marcianus, in the Digest, 1, 8, 4, 1 (Astuti, op. cit., 350-351; Costa, Le acque, op. cit. 76).

90. On the relationship between "res publicae" and "res fiscales" in Roman Law: F. Vassalli, Studi giuridici, Vol. II, Soc. Foro Italiano, Rome, 1939, Vol. II, pp. 4-11.

91. Ulpian in the Digest, 39, 2, 24; Gaius in the Digest, 43, 14, 1, 1, 41, 1, 7, 5; 1, 8, 5; Institutiones, 2, 1, 1-2 and 4. It is with regard to the basic uses of water for watering of animals, drinking and domestic needs, that running water (aqua profluens) is classified as

"res communis omnium, iure naturali" (thing common to every man according to natural law: Marcianus, in the Digest, 1, 8, 2, 1; also Institutiones 2, 1, 1); it is with regard to fishing and navigation that public water is classified as "res in publico usu" (thing for every man's use).

92. Pomponius, in the Digest, 43, 12, 2, known as "lex quomimus". Ulpian in the Digest, 43, 12, 1, 12, and 39, 3, 10, 2, with regard to diversions of water from nagivable rivers; see also Costa, Le acque, op. cit., 37, 38.

93. Ulpian, in the Digest, 39, 3, 10, 2, and 43, 13, 1, 1 and 9; E. Costa, Le acque, op. cit. 16, 18. See also a Constitution of the Emperors Arcadius and Honorius which aimed at preserving an old water concession (Theodosian Code, 15, 2, 7; Justinianean Code, 11, 43 (42) 4).

94. Papirius Justus, in the Digest, 8, 3, 17; also see Pomponius, ibid., 43, 20, 3, 1; and Diocletian and Maximian Emperors, in the Code of Justinian, 3, 34, 7.

95. Ulpian in the Digest, 43, 20, 1, 12; Paulus, Ibidem, 10, 3, 19, 4; Julianus, Ibidem, 43, 20, 5, 1.

96. Ulpian, in the Digest, 43, 20, 1, 38-9; 43; 7, 1, 27, 3, and 30, 39, 5; Papinianus, Ibidem, 19, 1, 41; Frontinus, De Aquaeductibus, cit., 107, 109. As a consequence, it is with regard to those uses of public water granted under payment of a rate to the State or to a township that public waters were classified also as "res in patrimonio populi", (the people's patrimony).

97. Lanciani, op. cit., 594.

98. A landowner was further entitled to cut aquifers springing on his land, to draw to his land groundwater streams flowing below his neighbour's land, and even to cut aquifers feeding his neighbour's wells (Ulpian, in the Digest, 39, 2, 24, 12; 39, 2, 26; 39, 3, 1, 12; Pomponius, Ibidem, 39, 3, 21 and 8, 1, 15, pr.).

99. Under classical law the "mancipatio" and the "in jure cessio" disappeared and the "pacta et stipulationes" (agreements) took their place as a mode of acquisition of a servitude on both provincial and Italic land (from P. F. Girard, op. cit., 370).

100. Papinianus, in the Digest, 8, 3, 49 (probably amended); the holder of this servitude was entitled to water only so many head of cattle as agreed upon with the owner of the water (Ulpian, in the Digest, 43, 20, 1, 18).

101. Ulpian, in the Digest, 43, 21, 1, pr.; with regard to the terms and conditions of the rights of maintenance, see Costa, Le acque, op. cit., 51-54.

102. Ulpian, in the Digest, 8, 5, 10, 1; Paulus, Ibidem, 8, 3, 9: Pomponius, Ibidem, 8, 4, 11, 1. Water could be conveyed through uncovered

channels (rivi) Ulpian, in the Digest, 43, 21, 1, 2 or by water pipes (fistulae), Paulus, in the Digest, 39, 3, 17, 1; it could be diverted continuously or at intervals, depending on the deed establishing the servitude; Ulpian, in the Digest, 43, 20, 1, 22.

103. See, for instance, a rescriptum by Caracalla, reported by Ulpian, in the Digest, 8, 4, 2.

104. See Africanus, in the Digest, 8, 3, 33, 1.

105. Marcianus, in the Digest, 8, 2, 10; Ulpian, Ibidem, 8, 3, 3, 3; Pomponius Ibidem, 8, 6, 17; Africanus, Ibidem, 8, 3, 33, 1.

106. Ulpian, in the Digest, 8, 3, 1 pr.; and 43, 20, 1, 16; Pomponius, Ibidem, 8, 3, 24 and 25; Paulus, Ibidem, 8, 3, 23, 3.

107. Paulus, in the Digest, 8, 3, 37; Modestinus, Ibidem, 7, 8, 21; Papinianus, Ibidem, 8, 3, 4.

108. Serafini, op. cit., 185-18 ; Girard, op. cit., 1039-1047; Costa, Le Acque, cit. 49.

109. Edictum Perpetum, XLIII, 241-244. These interdicta were the following: (i) The int. "ne quid in flumine publico ripave eius fiat, quo plius navigetur", which aimed at the conservation of the bed, the banks and the regular flow of public navigable rivers. It applied whenever navigation was impaired or threatened by the widering or the restricting of the river-bed, or by too many diversions of water from the river or by any work and structure being carried out or existing thereat (Ulpina, in the Digest, 43, 12, 1, 15-22). On Labeo's authority this interdictum was extended to public non-navigable rivers (reported by Ulpian, in the Digest, 43, 12, 1, 17-18).
(ii) The int. "ne quid in flumine publico ripave eius fiat, quo aliter aqua fluat atque uti priore aestate fluxit" (Digest, 43, 13). It aimed at the conservation of the quantity, the quality, the level and the speed of public rivers, with regard to the inter-equinoxial period of the year. This interdictum was a popular one.
(iii) The int. "ut in flumine publico navigare liceat" Digest, 43, 14), which protected the freedom of navigation on public rivers, lakes, pools and basins, including the freedom of loading and unloading on the banks or shore thereof. This interdictum was extended to the protection of existing water rights on a public lake or a public pool, under lease of the State or of a township (municipium). It also covered the freedom of fishing in public lakes and pools, and the freedom of watering one's cattle at public rivers (Ulpian, in the Digest, 43, 14, 1, 7-9).
(iv) The int. "de ripa munienda" (Digest 43, 15), which protected the riparians' right to build protective works and structures on the banks of public rivers or on the shores of public lakes, public ditches and public pools for overflow-protection purposes.

110. Ulpian, in the Digest, 43, 20, 1, 38-44.

111. Ulpian, in the Digest, 43, 20, 1 pr.-5 and 9-10; Astuti, op. cit., 369.

112. The interdicta "de fonte" and "de fonte reficiendo" protected the servitudes "aquae haustus" and "pecoris adpulsus" (Ulpian, in the Digest, 43, 22, 1). The interdicta "de fonte" and "de rivis" protected the rights to keep the "fons" (source of water), the intake point and the water-channels, pipes and reservoirs in good condition (Ulpian in the Digest, 43, 21, 1, pr., and 43, 22, 1, 6-7).

113. The servitudes were generally protected by the "confessoria in rem actio" (Institutiones, 4, 6; De actionibus, 2; Girard, op.cit., 376 and ff.) However, a specific "actio confessoria de aqua" protected the "servitus aquae ductus" (Edictum Perpetuum XXX, 176).

114. Such as the criminal "actio iniuriarum" which protected human being's freedom to perform lawful activities (Ulpian, in the Digest, 43, 8, 2, 9; Ibidem 47, 10, 13, 7, partly amended).

115. Ulpian, in the Digest, 39, 2, 24, pr.; 39, 2, 7, pr.; 46, 5, 1, 7; 43, 15, 1, pr.-6.

116. Paulus, in the Digest, 39, 3, 2, 9; Gordianus, in the Code, 7, 41, 1; Ulpian, in the Digest, 39, 3, 1, 23.

117. Such interdicta "de fluminibus" protecting existing rights of use from private nuisance may thus also be regarded as judicial instruments whereby private citizens could induce the administrative authorities' intervention for the control on waterworks and structures.

118. P. F. Girard, op. cit., 623.

119. Lanciani, op. cit., 597-598.

120. Ibidem, op. cit., 600-601.

121. Frontinus, op. cit., 127.

122. Ibidem, in Lanciani, op. cit., p. 605.

123. L. Homo, Roman Political Institutions, op. cit., 311-320; Frontinus, op. cit. Lanciani, op. cit.

124. Mommsen, staatw. 2, 416, quoted in Lanciani, op. cit., p. 592.

125. Lanciani, op. cit. 530-543.

126. Lanciani, op. cit., 542.

127. Lanciani, op. cit., 540.

128. Homo, op. cit.

129. From the name of the place where grain distribution cards (tessere frumentarie) were issued; in Lanciani, op. cit., 524.

130. Homo, op. cit.

131. "Quinquennales" corresponded to the republican censors. Lanciani, op. cit., 522.

132. P. F. Girard, op. cit., 70-81; F. Serafini, op. cit., 22-26, 38-47, 54-56; Turner, op. cit. 102-103.

133. This may be inferred from the Institutes 2, 1, 2, in contradiction to Marcianus, in the Digest, 1, 8, 4, 1 (See Astuti, op. cit., 350-351). With regard to the legal regime of private land ownership, the distinction between Roman tax-free land ownership (dominium ex jure Quiritium, which applied only to Italic soil) and taxable provincial land ownership (dominium ex jure gentium) disappeared as Italic soil was gradually subjected to land tax. Finally, this distinction was abolished by Justinian, and all private land ownership became subject to land tax (from P. F. Girard, op. cit., 260-261).

134. See Astuti, op. cit., 356-357; Costa, op. cit., Le Acque, op. cit., 13-14; Vassalli, op. cit., 7.

135. Marcianus, in the Digest, 44, 3, 7, (as probably amended), in opposition to Papinianus, Ibidem, 41, 3, 45, pr.

136. See Bertolo from Sassoferrato, in Primam Digesti novi partem, Venice, 1570, p. 148.

137. Pomponius, in the Digest, 43, 12, 2, as amended (lex quonimus).

138. Concerning this use and those other uses of public water which were granted under payment of a rate to the State, public water seems to have been classified henceforth as "res in patrimonio Caesaris", or fisci, or res fiscales (things in the Emperor's patrimony), Astuti, op. cit., 356-357, Costa, Le Acque, cit. 13-14.

139. Frontinus in Lanciani: op. cit., p. 594.

140. Ulpian, in the Digest, 43, 20, 1, 44, probably amended (Costa, Le Acque, cit., 55).

141. See the Constitutions issued by the Emperors Arcadius and Honorius (in the Theodosian Code, 15, 2, 7, and in the Justinian Code, 11, 43, 4); Valentinian and Theodosius (in the Theodosian Code, 15, 2, 4, and 5-6; and in the Justinianean Code, 11, 43, 2-3-5).

142. Pomponius in the Digest, 43, 20, 4, 4; and the Code of Justinian, 11, 66 (65), 5; (Astuti, op, cit., 367).

143. Ulpian, in the Digest, 39, 3, 1, 12 as amended.

144. Paulus, in the Digest, 8, 3, 9, as amended. Under the law of Justinian, the mode of acquisition of servitudes came under five headings: (i) agreement, (pacta et stipulationes); (ii) last will; (iii) the law; (iv) the magistrate's judgement (adjudicatio); and (v) long-term use (longi temporis praescriptio); from P. F. Girard, op. cit., 370-373; F. Serafini, op. cit., 313-317.

145. Costa, Le Acque, cit. 48, 58.

146. Digest, 39, 3; Astuti, op. cit., 349.

147. L. Homo, op. cit., 371.

148. Lanciani, op. cit., p. 524.

149. Dante A. Caponera, Water Laws in Moslem Countries; FAO, Rome, Italy, 1973.

150. Ecloga of the Isauri, 726 A.D.; Procheiros Nomos, or Prochiron, 886 A.D.; Basilica, 888-911 A.D.: Eparchicon Biblon and Novellae; Hexabiblos of Harmenopoulos, a private collection, 1345.

151. Civil Code, 1827.

152. Zarkan Code, based on the Ecloga.

153. Zacon Soudni Lioudem Code, also based on the Ecloga.

154. Photinopoulos (1765), Hypsilanti (1780), Caradja (1818), Callimachi (1816) codes and the Civil Code of 1864 (based on French Code).

155. Cormtsaja Cniga Code (1284) and Georgian Code (1723) based on the Ecloga; the Hexabiblos, translated in Russian, remained in force in Bessarabia until 1917.

156. Edicts of Ostrogoth Kings (489-553), of Theodoric (500), Lex Romana Visigothorum (506); Lex Romana Burgundionum (501-506).

157. "Flumina navigabilia et ex quibus fliunt navigabilia", in Corpus Juris Civilis, Krigelii, part III, "de feudis", p. 871, title LVI, Quae sunt relalia.

158. Leyes de Indias, titulo XVII, Libro IV, 1550.

159. Venetian Senate's decree of 6.2.1559.

160. See: E. Costa, Le acque nel diritto romano, Bologna, 1919, 57 to 69; P. Bonfante, Il regime delle acque dal diritto romano al diritto odierno, in Arch. giur., 87, 1922, 13 to 16.

161. Law No. 2248 of 1865, Annex F. Arts. 91 to 181. See on the developments of the Italian water legislation since 1865, E. Miccoli, Le acque pubbliche, Turin 1958, 1 to 12.

162. Namely: the R.D. No. 1775 of 1933, as amended, T.U. on public waters and electric plants (Basic Law on Waters); the R.D. No. 523 of 1904, as amended; Testo Unico on hydraulic works; the R.D. No. 959 of 1913, as amended; T.U. on inland navigation and floating; the R.D. No. 215 of 1933, as amended; T.U. on land reclamation; and R.D. No. 1604 of 1931 as amended; T.U. on fishing in inland waters.

163. Civil Code 1942, Arts. 822 to 829, 909 to 921, 1033 to 1050 and 1080 to 1099.

164. E. Miccoli, op. cit., 2; R. Bajno, M. Colucci, F. Rampulla, A. Robecchi Majnardi, Acque pubbliche interne ed usi; disciplina amministrativa e tutela penale, in Riv. Trim. Dir. Pubbl., 1973, II, 579 and following.

165. Basic Law on Waters, 1933, Art. 1(1); following 1942, Art. 909 and following. This legal definition appears first in 1919 (DL No. 2161 of 1919, Art. 3). For an English analysis of basic Italian Water Legislation see, D. Caponera, Water Laws in Italy, FAO Development Paper No. 22, FAO, Rome, 1953.

166. Basic Law on Waters, 1933, Art. 1; R.D. No. 1285 of 1920, Arts. 1 to 3.

167. Civil Code, 1942, Art. 909 and following.

168. Civil Code 1942, Art. 822 (1). The expressions "public water" and "domain water" are nowadays unanimously considered equivalent.

169. Special Statute for Sardinia, Constitutional Law No. 3 of 1948, Art. 14 (1).

170. Special Statute for Sicily, Constitutional Law No. 2 of 1948, and D.P.R. on the transfer of certain powers to the region of Sicily.

171. Special Statute for Valley of Aosta, Constitutional Law No. 4 of 1948, Art. 5(2).

172. Special Statute for the autonomous Region Trentino-Upper Adige, Constitutional Law No. 5 of 1948, as amended by Constitutional Law No. 1 of 1971, Art. 9 (9); and D.P.R. No. 115 of 1973, Art. 8 (e) on the transfer of public property to these provinces.

173. Zanobini, Corso di diritto amministrativo, Milan, 1948, 7; Vitta, Diritto Amministrativo, Turin, 1949, I, 205 and following; Resta; Commentario del Codice Civile, a cura di A. Scialoja e G. Branca, III, dei beni pubblici, 56, and following; Miccoli, op. cit., 17, 71; Romano, Corso di diritto amministrativo, Padua, 1937, 178.

174. Miccoli, op. cit., 18.

175. Civil Code, 1942, Art. 823 (1).

176. Civil Code 1942, Arts. 840, 909, 910.

177. Civil Code, 1942, Art. 912. Astuti, Acque Private, Enciclopedia del Diritto I, 399.

178. Basic Law on Waters 1933, Art. 2, 9 (1) (2), 15 as amended; D.M. 14.1. 1949, Art. 3, R.D. No. 1604 of 1931, Art. 11 (1) as amended, concerning the allocation for fish-culture; R.D. No. 899 of 1937, Art. 8 (1), governing the allocation of public water in public domain canals; R.S. No. 523 of 1904, Art. 97(m) (n), incidentally providing for the

allocation of stretches of public water bodies for quarrying purposes; R.D. No. 1285 of 1920, Art. 16; R.D. No. 121 of 1906, Art. 34, applying to the group of "Cavour" domain canals; D.M. 14.1.1949, Art. 7.

179. Up to one-year time limit for yearly intakes (Basic Law on Waters 1933, Art. 56(3); R.D. No. 899 of 1937, Art. 7(4)); up to 15 years for fish cultivation (D.M. 14.1.1949, Art. 8 (2) (b)); up to 29 years for diversions from public domain canals (R.D. No. 899 of 1937, Art. 8(2)), and up to 30, 60 and even 70 years for diversions from all other public waters (Basic Law on Waters, 1933, Art. 21(1)).

180. Basic Law on Waters 1933, Arts. 9, 11, 15, 45; R.D. No. 899 of 1937, Art. 20. See also: Miccoli, op. cit., 219 and following; Busca, Le Acque nella Legislazione Italiana, Turin, 1962, 138 and following; Pernigotti, Acque Pubbliche, in Enciclopedia del Diritto, I, 425 and following.

181. Miccoli, op. cit., 77.

182. Basic Law on Waters 1933, Art. 93. The Law specifies that domestic uses include watering of gardens and the watering of livestock.

183. R.D. No. 959 of 1913, Art. 64.

184. R.D. No. 1604 of 1931, Art. 22(3) as amended.

185. R.D. No. 959 of 1913, Art. 17.

186. Civil Code 1942, 909-917, 1049, 1050, 1080-1099.

187. Basic Law on Waters 1933, Art. 51(1).

188. Law No. 129 of 1963, Arts. 2(a) (b), 5(a) (b); D.P.R. No. 1090 of 1968, Art. 1. The final project of the Plan has been approved by D.P.R. 3.8.1968, and is presently in force.

189. Basic Law on Waters 1933, Arts. 51(1) (2) (3), 14(2). The reservation may be extended for an additional four years for the electrification of State railways or for the development of Southern Italy (D.P.R. No. 1523 of 1967, Art. 35).

190. D.P.R. No. 1090 of 1968, Arts. 1 to 4, 6(3), 10.

191. Regional Law of Lombardy No. 48 of 1974, Art. 9.

192. Basic Law on Waters 1933, Arts. 1(1), 103(2), 104(1).

193. Ibidem, Art. 94.

194. Ibidem, Arts. 105, 106.

195. Civil Code 1942, Art. 911.

196. R.D. No. 523 of 1904, Art. 96(k). See also in this respect, Supreme Tribunal for Public Waters, Judgement No. 10 of 1967.

197. For non-public waters; Civil Code 1942, Arts. 909 (1), 910. For public waters: Basic Law on Waters 1933, Art. 55(b); R.D. No. 899 of 1937, Art. 15(b); R.D. No. 1604 of 1931, Art. 28(1); D.M. 14.1.1949, Art. 11(a).

198. Terms and conditions may include requirements as to the most rational exploitation of water resources, the amount of water, measuring devices, return flow, the prevention of water pollution and the protection of the water balance (Basic law on waters 1933, Arts. 8(1), 40(1); R.D. No. 1285 of 1920, Arts. 14(A) (1) (3) (4), (C) (3) (6); 16(1) (3).

199. R.D. No. 1604 of 1931, Art. 9 as amended, on fishing in inland waters.

200. R.D. No. 1265 of 1934, Arts. 226, 227 as amended (Health Code).

201. R.D. No. 368 of 1904, Arts. 133(f), 134(g) (i), on Land Reclamation.

202. Law No. 6 of 1957, Art. 33, and Regional Law of Sicily No. 30 of 1950, Art. 9, on hydrocarbons exploration and exploitation.

203. Law No. 125 of 1971, Arts. 1(1), 2(1) (2); and regulations issued by D.P.R. No. 238 of 1974, and by D.M. 19-7-1974.

204. D.P.R. No. 128 of 1959, Art. 103(2), mineral police regulation.

205. Bill No. 3193 of the Chamber of Deputies (1974).

206. Sardinia (Regional Law No. 6 of 1955 as amended by Regional Law No. 16 of 1973; Regional Decree 39 of 1974); Lombardy (Regional Law No. 48 of 1974); Piedmont (Regional Law No. 32 of 1974); autonomous Province of Bolzano (Provincial Law No. 63 of 1973).

207. See: S. Burchi, Evoluzione della riforma legislativa italiana in materia di protezione delle acque dagli inquinamenti, Riv. Trim. Dir. Pubbl. 1975, II; also: Colucci, Rampulla, Robecchi-Majnardi, Piani e provvedimenti nel passaggio dall'amministrazione al governo delle acque, in Riv. Trim, Dir. Pubbl. 1974, IV, 1286 and following; U. Pototschniz, Stato e Regioni nel governo delle acque, paper presented at the international meeting held in Pavia (Italy), 1974, on "Tutela e governo delle acque" (Management and protection of water resources), 10; D.A. Caponera, La protezione dell'ambiente - Considerazioni ed Orientamenti Giuridico-instituzionali, in La Comunità Internazionale, 2, 1971, 6.

208. Regional Law on Sardinia No. 16 of 1973, Arts. 3(2), 4, 6(3); Regional Law of Lombardy No. 48 of 1974, Arts. 1(4), 6 to 8, 10, 14 to 16; Regional Law of Piedmont No. 32 of 1974, Arts. 1, 3; Provincial Law of Bolzano No. 63 of 1973, Arts. 2, 5, 7(1), 16, 17.

209. Regional Law of Sardinia No. 16 of 1973, Art. 6; Provincial Law of Bolzano No. 63 of 1973, Art. 2.

210. Regional Law of Lombardy No. 48 of 1974, Art. 4(4); Provincial Law of Balzano No. 63 of 1973, Art. 19; Regional Decree of Sardinia No. 39 of 1974, Art. 20; Regional Law of Piedmont No. 32 of 1974, Art. 7.

211. Regional Law of Lombardy No. 48 of 1974, Art. 3.

212. R.D. No. 1265 of 1934, Art. 218(d); the Minister of the Interior's Sanitary Directions of 1896, Arts. 81 to 101; R.D. No. 45 of 1901, Art. 125(1) (d).

213. For soda-water and soft drinks (D.P.R. No. 719 of 1958, Arts. 14, 23 (1)), vegetable alimentary preserves (R.D. No. 1927 of 1926, Art. 12 (1)), and beer (Law No. 1354 of 1962, Arts. 8, 14).

214. In the case of prevention of wastes and wastewater from endangering public health: R.D. No. 1265 of 1934, Arts. 217(2), 227(3); of undue alterations affecting the hydrologic balance and/or navigability: Basic Law on Waters 1933, Art. 221(2) (3); R.D. No. 959 of 1913, Art. 57 (1) (2).

215. Basic Law on Waters 1933, Arts. 219, 221, 55 (c) (d); on fishing, R.D. No. 1604 of 1931, Arts. 33-41, 29(1) as amended; on inland navigation R.D. No. 959 of 1913, Arts. 53, 54, 57 as amended; on public domain canals, R.D. No. 899 of 1937, Art. 15 (c) (d); on fish breeding, D.M. 14.1.1949, Art. 11(d).

216. Generally the chief engineer of the Civil Engineering Office.

217. Basic Law on Waters 1933, Arts. 220, 222; R.D. No. 959 of 1913, Art. 56; R.D. No. 1604 of 1931, Arts. 40(1), 41.

218. Basic Law on Waters 1933, Arts. 55(1) as amended, 221(a); R.D. No. 959 of 1913, Art. 57 (1) as amended.

219. Basic Law on Waters 1933, Arts. 32, 55, 56(3), 105(2); R.D. No. 899 of 1937, Arts. 7(4), 15, 19(2); R.D. No. 2503 of 1884, Art. 2(3); R.D. No. 1604 of 1931, Arts. 11(2)(3), 28(1), 29; R.D.L. No. 799 of 1936, Art. 8; D.M. 14.1.1949, Art. 8(2)(g), 11; Civil Code 1942, Art. 912 (by implication).

220. The recognition of existing rights may be claimed on the grounds of either a valid title of acquisition, or of a long-lasting possession (30 years prior to the registration of water as public). If neither a valid title nor possession can be evidenced, the holder may obtain a "preferential" concession. Basic Law on Waters 1933, Arts. 2(a) (b), 3,4, 24(1) (4); R.D. No. 1285 of 1920, Arts. 4-6; R.D. No. 456 of 1924, Art. 7 (governing the recognition of existing rights to divert water from public domain canals); R.D. No. 1604 of 1931, Art. 27(1)(2) (governing the recognition of exclusive rights of fishing). Court of Cassation Judg. No. 1933 of 1955; Nos. 205 of 1942, 1837 of 1954; 2294 of 1959; 891 of 1964.

221. Basic Law on Waters 1933, Arts. 105, 106, 216(1), 217, 221; R.D. No. 523 of 1904, Arts. 2, 93, 96, 97, 98, 101; R.D. No. 959 of 1913, Arts. 43, 44, 50, 51, 52, Law No. 2248 of 1865, Art. 378 as amended; Court of Cassation, Judg. No. 384 of 1949; 2632 of 1956; 3197 of 1946.

222. Civil Code 1942, Art. 866(1); R.D. No. 3267 of 1923, Arts. 1, 4(3), 7 to 9.

223. R.D. No. 523 of 1904, Arts. 96, 97; R.D. No. 959 of 1913, Art. 50.

224. Civil Code 1942, Art. 913.

225. R.D. No. 523 of 1904, Arts. 63 to 66 on hydraulic works.

226. Regional Law of Sardinia No. 16 of 1973, Art. 3(1); Regional Law of Lombardy No. 48 of 1974, Art. 8(1)(2); Regional Law of Piedmont No. 32 of 1974, Art. 1(2); Provincial Law of Bolzano No. 63 of 1973, Art. 5 (1)(3^{o}).

227. Basic Law on Waters 1933, Arts. 35-38, 53, 73 as amended. D.M. Nos. 26490 and 26491 of 1934. Rents due with respect to fish-cultivation and quarrying are fixed on a case by case basis by the administration. (D.M. 14.1.1949, Art. 5(3); Circular Letter of the Ministry of Finance, No. 214/10387 of 1962).

228. R.D. No. 959 of 1913, Arts. 20(1)(2), 21(3)(b), 22; R.D. No. 1514 of 1913, Arts. 38, 41(b), 45(1), 49, 50 (a)(b)(c).

229. For hydraulic works, R.D. 523 of 1904, Arts. 4-11; for navigation improvement works: R.D. 959 of 1913, Arts. 5-14; for land reclamation: R.D. 215 of 1933, for water supply and sewerage: Law 589 of 1949 and D.P.R. 1523 of 1967, Arts. 45, 4 and D.P.R. 1090 of 1968, Arts. 13-15.

230. R.D. No. 422 of 1923, Arts. 1-3, 40(1); D.M. of 29.5.1895, governing the drafting of the Ministry of Public Works' projects; Law No. 595 of 1959, governing the approval of public projects for water supply and sewerage works; D.P.R. No. 136 of 1959 for the construction of dams and D.M. of 16.12.1923 for the diversion of public water.

231. The streams are: Roja, Valle Stretta and Cenischio rivers, in common with France, Diveria, Ticino, Maira (or Mera), Poschiavino, Tresa, Lake of Lugano, Rhine of Lei, Spöl and Röm rivers, in common with Switzerland; Drava and Solisza rivers, in common with Austria; Isonzo and Timavo-Rijeka rivers, plus the town of Gorizia's water supply reservoirs of Fontefredda and Moncorona, in common with Yugoslavia. The above-listed are sub-basins of seven major international basins: the Roja, the Rhine, the Po, the Danube, the Adige, the Isonzo and the Timavo river-basins (from: D.A. Caponera, Lo status giuridico dei fiumi e bacini internazionali in Italia, in La Comunità Internazionale, 1960, 2, 6.

232. Agreements: between Italy and France of 17.12.1914 on the Roja river followed by a dispute which gave rise to a judgement by the Supreme

Court of Italy on February 13, 1939 (Foro It. Rep. 1939, I, 1036); and subsequent Treaty of Peace signed in Paris, Feb. 10, 1947, Art. I, Sec. I; between Italy and Switzerland, April 5, 1951, concerning the modification of the border on the Raggia Molinara torrent; of September 17, 1955, on the regulation of Lake Lugano, of June 18, 1949, for the granting of the Reno di Lei hydro-power, and of November 25, 1952, concerning a border modification on the Reno di Lei; of May 27, 1957 on the Utilization of hydro-power on the Spöl; between Italy and Yugoslavia, Treaty of Peace signed in Paris, Feb. 10, 1947, guaranteeing downstream Italy acquired water rights (Annex IX, B, 5); also with regard to the water supply of Gorizia town and subsequent implementing agreements.

232bis. Convention between Switzerland and Italy concerning the protection of Italo-Swiss waters against pollution of April 20, 1972.

233. On the legal status of international rivers in Italy see D. A. Caponera, op. cit.

234. Basic Law on Waters 1933, Arts. 1, 3, 15 (as amended), 51, 105, 106; Law No. 9 of 1910, Art. 40(b); R.D. No. 1688 of 1921, Arts. 1,2; R.D. No. 523 of 1904, Art. 62(3); D.P.R. No. 1090 of 1968, Art. 1.

235. Basic Law on Waters 1933, Arts. 1,3,7-11, 18; Art. 15 as amended by D.P.R.; No. 8 of 1972, Arts. 8(2) (a), 13 (d), and by the Statutes for the Regions under special status of autonomy; R.D. No. 1285 of 1920, Arts. 1,2, 9-24.

236. Basic Law on Waters 1933, Art. 217; R.D. No. 1688 of 1921, Art. 1 (1) (2).

237. Law No. 1484 of 1962, Art. 5.

238. Law No. 257 of 1907, Art. 14(d) as amended.

239. Basic Law on Waters 1933, Art. 57; R.D. No. 1285 of 1920, Arts. 45-51 as amended.

240. R.D. No. 456 of 1924, Art. 7; R.D. No. 899 of 1937, Arts. 5-7, 21; R.D. No. 83 of 1896, Arts. 6, 7 as amended.

241. R.D. No. 1265 of 1934, Arts. 226, 227 as amended.

242. R.D. No. 523 of 1904, Arts. 2, 57-59, 93-96, 101; R.D. No. 959 of 1913, Arts. 42, 45, 46, 49, 51, 57.

243. R.D. No. 959 of 1913, Art. 64(2).

244. D. L. No. 657 of 1974, Art. 3(1) as amended, in connection with Law No. 1497 of 1939, Arts. 1(1) (4), 2(1) (2), 8, 11.

245. Law No. 1643 of 1962, Arts. 1(1) (2), 4(9); D.P.R. No. 554 of 1967, Art. 1 (2).

246. Basic Law on Waters 1933, Arts. 139, 142-144, 147 to 210.

247. D.P.R. No. 1523 of 1967, Arts. 9(1), 32(1)(4), 33(2), 61(1) to (4), 204(1) (2), 209(1), 318; Law No. 853 of 1971, Art. 1(8).

248. Law No. 257 of 1907, Arts. 2(1), 3(3) as amended, 13(1), 14 as amended; Law No. 735 of 1956, Arts. 1,2,5,9; Law No. 1484 of 1962, Art. 5.

249. The Board for the Apulian Aqueduct (established in 1919), the Board for the improvement of irrigation in the Chiana river, upper Tiber river valleys and the Lake of Trasimeno basin (est. in 1961), the Board for the improvement of irrigation in Apulia and Lucania (est. in 1947), and the Agricultural Development Boards (est. in 1951).

250. Law No. 823 of 1939, Art. 6.

251. D.L. Lgt. No. 16 of 1945, Arts. 1, 3, as amended by D.P.R. No. 8 of 1972, Art. 12(b).

252. Sardinia, Sicily, Friuli-Venezia Giulia, Trentino-Upper Adige and Valley of Aosta (Constitution, 1947, Art. 116). Their legislative and administrative prerogatives are partly concurrent with, and partly exclusive of, corresponding State prerogatives; the State controls both classes of prerogatives. Recently the Region Trentino-Upper Adige has been split into the autonomous Provinces of Trento and Bolzano (Constitutional Law No. 1 of 1971).

253. This is the case of the Regions of Sardinia (Regional Statute of 1948, Arts. 3(1), 6; Regional Law No. 38 of 1956), and Valley of Aosta (Regional Statute of 1948, Arts. 2(m), 4: Regional Law No. 4 of 1956).

254. This is the case of the Friuli-Venezia Giulia Region which, though without possessing public water resources within her territory, has full legislative and administrative powers for allocating "minor" diversions or yearly intakes (Regional Statute of 1963, Arts. 5(14), 8; Regional Law No. 22 of 1967 as amend. Arts. 17(a), 49). Likewise, the Valley of Aosta Region, although not possessing the ownership of part of the public water resources existing in her territory, has full administrative powers for allocating them (Regional Statute, Arts. 7, 8(3)(4); D. L. Lgt. No. 546 of 1945, Art. 1). The Sicilian Regional authorities are competent for allocating all public water resources existing in the Region, with the exception of "major" diversions (Special Statute of 1946, Arts. 14(i), 20, in connection with D.P.R. No. 878 of 1950, Art. 3(h); Regional Law No. 3 of 1956. Similar powers are enjoyed by the Provinces of Bolzano and Trento (Special Statute for Trentino-Upper Adige of 1948 as amended, Arts. 9(9), 16(1), 68. "Major" diversions include those exceeding 100 lt/sec. for drinking and/or industrial and/or fish-breeding purposes (3.53 cfs); 1,000 lt/sec. for irrigation, or even less if it is possible to irrigate more than 500 ha; 5,000 lt/sec. for land reclamation purposes (176.6cfs); production 220 Kw for average yearly nominal powers. All diversions not exceeding these limits are considered "minor"

diversions (Basic Law on Waters 1933, Art. 6; Circular Letter of the Ministry of Public Works, General Directorate for Water and Electric Plants, No. 2020 of 1967.

255. Regions Friuli-Venezia Giulia (D.P.R. No. 1116 of 1965, Arts. 28,29), and Sicily (Regional Statute, Art. 20(1) in connection with D.P.R. No. 878 of 1950, Art. 1); Provinces of Trento and Bolzano (Regional Statute, Arts. 12, 13(4).

256. D.P.R. No. 8 of 1972, Art. 13(2)(d)(3).

257. Basic Law on Waters 1933, Art. 56; R.D. No. 1285 of 1920, Art. 43. A practice has developed whereby yearly licences are renewed automatically.

258. D.P.R. No. 8 of 1972, Art. 8(2)(a)(b).

259. S. Burchi, op. cit.; U. Pototschnig, op. cit., 16, 17; id. Attribuzioni amministrative delle Regioni, paper presented at the I.S.G.E.A. Meeting on "Tutela pubblica dell'ambiente" (Public protection of the environment), held in Milan (Italy), 1974, 5; R. Salimbeni, A. Torricelli, Discipline urbanistica e tutela dell'ambiente nella legislazione delle Regioni a statuto ordinario, paper presented at the I.S.G.E.A. Meeting cit.; M.S. Giannini, Aspetti giuridici dell' ambiente, in Riv. Trim. Dir. Pubbl., 1973, 47 and following; also A. Amorth, Competenze legislative statali e regionali, paper presented at the I.S.G.E.A. Meeting cit., 11.

260. Regional Law of Sardinia No. 16 of 1973, Arts. 3, 4; the Regional Decree of Sardinia, No. 39 of 1974, Arts. 11-20, and the Provincial Law of Bolzano, No. 63 of 1973, Arts. 7, 9.

261. See the Regional Law of Piedmont, No. 32, of 1974, Arts. 2-4, and the Regional Law of Lombardy, No. 48 of 1974, Arts. 12, 13.

262. See the special statutes for the Regions of Friuli-Venezia Giulia (Arts. 4(2)(3)(9), 5(14)(16), 8); Sardinia (Arts. 3(d)(e)(i), 4(c)(i), 6); Sicily (Arts. 14(a)(b)(g)(1), 17(b), 20); Valley of Aosta (Arts. 2(d)(e)(f)(1)(m), 3(d)(1), 4); and the special statute for the Region of Trentino-Upper Adige, which grants broad competences to the Provinces of Trento and Bolzano (Arts. 8(6)(11)(15)(17)(21)(24), 9(10), 16(1). See, with respect to the ordinary Regions, the Italian Constitution, 1947, Art. 117, as detailed by D.P.R. Nos. 4 of 1972, Art. 13(8); 5 of 1972, Arts, 6(2), 15(3)(a)(e); 8 of 1972, Arts. 2(b), 3(e)(f); 11 of 1972, Art. 1(h)(1)(n)(p).

263. Among others, the Sicilian Board for Aqueducts (established in 1942), the Sardinian Board for Aqueducts and Sewerage (est. in 1957), and the Sardinian Board for the Flumendosa River Development (est. in 1946); the Agricultural Development Boards (est. in 1951), etc.

264. Basic Law on Waters 1933, Arts. 138-210.

265. See the D.P.R. No. 8 of 1972, Art. 12(a).

266. R.D. No. 3267 of 1923, Arts. 4(3), 5(1), 7, 8 as amended.

267. D.L.Ltg. No. 315 of 1944, Arts. 1, 9.

268. R.D. No. 1604 of 1931, Arts. 11 and 22(3) as amended; D.M. 14.1.1949, Arts. 1 to 8(1) as amended.

269. R.D. No. 1604 of 1931, Art. 9 as amended; R.D. No. 1647 of 1922, Art. 51(1)(2)(3) as amended; D.M. of 14.2.1956, Art. 2 as amended. See also the Circular Letter of the Ministry of Health, No. 105 of 1973, whereby provisional standards for industrial and urban effluents have been suggested for adoption in the authorizations.

270. R.D. No. 1647 of 1922, Art. 51(4) as amended; R.D. No. 1604 of 1931, Art. 30; regional law of Lombardy, No. 48 of 1974, Art. 4(5)(a); regional law of Piedmont, No. 32 of 1974, Art. 7(1); Provincial law of Bolzano, No. 63 of 1973, Art. 12(1).

271. R.D. No. 2578 of 1925, Art. 1(2); Law No. 1643 of 1962, Art. 4(5).

272. Regional law of Lombardy, No. 48 of 1974, Art. 4(2).

273. R.D. No. 1265 of 1934, Arts. 217, 218 (b)(d); the Minister of the Interior's Sanitary Directions of 1896, Arts. 81-101, 134. Decree of the Minister of Health of 12.2.1971, listing unhealthy factories; R.D. No. 148 of 1915, Art. 153.

274. See, Regional Law of Sardinia No. 16 of 1973, Art. 3(3); the Regional Law of Lombardy, No. 48 of 1974, Arts. 12, 13; the Regional Law of Piedmont, No. 32 of 1974, Art. 4; and the Provincial Law of Bolzano, No. 63 of 1973, Art. 7.

275. R.D. No. 383 of 1934, Art. 91(C)(14); R.D. No. 1265 of 1934, Art. 248.

276. R.D. No. 2578 of 1925, Arts. 1(1)(3), 2, 15(1), 21-23.

277. Regional Law of Lombardy, No. 48 of 1974, Art. 4(4); Provincial Law of Bolzano No. 63 of 1973, Art. 19.

278. Basic Law on Waters 1933, Arts. 59(1), 71(1). See also: Busca, op. cit., 354; Pernigotti, Acque pubbliche-Consorzi, in Enciclopedia del Diritto, I, 431, 432.

279. As to the public nature of such associations see: G. Roehrssen, Opere idrauliche, in Enciclopedia del Diritto, XIX, 971; Busca, op. cit., 394; Sandulli, Manuale di diritto amministrativo, Naples 1966, 299.

280. Basic Law on Waters 1933, Arts. 59(1)(2), 62(2)(3), 65(2)(3), 70; R.D. No. 5231 of 1888 on water use consortia; R.D. No. 523 of 1904 on hydraulic works consortia; R.D. No. 959 of 1913 and R.D. No. 1514 of 1913 on inland navigation works consortia; R.D. No. 215 of 1933 and No. 991 of 1952 on land reclamation consortia; these legal enactments also regulate the financing construction, operation and maintenance of the users' associations and consortia water works.

281. Basic Law on Waters 1933, Art. 43(3); Court of Cassation, Sent. No. 2244 of 1954; Busca, op. cit., 163, 164.

282. Law No. 991 of 1952, Art. 10(1) on mountain land reclamation.

283. R.D. No. 3267 of 1923, Art. 79(1)(2) (Forestry Code).

284. Civil Code 1942, Arts. 863(2), 914; R.D. No. 215 of 1933, Art. 71 in connection with Art. 43.

285. Civil Code 1942, Arts. 914, 921, in connection with R.D. No. 215 of 1933, Art. 71. See also Busca, op. cit., 360-364, 395; Pernigotti, op. cit., 433, 434. Private irrigation associations, if deemed of national interest, may become public by decree of the Minister for Agriculture and Forestry (Civil Code 1942, Art. 863(2).

ISLAMIC WATER LAW

by Abdulla M. A. Maktari*

PART I

1. INTRODUCTION

Today Islamic Law is not a national law (with few exceptions Saudi Arabia and Yemen Arab Republic) in the sense that French law is the law of France and English law is the law of England. It is rather a system of basic legal doctrines and principles and a wealth of Islamized binding traditions and customs which diffuse considerable influence on Muslims all over the world transcending over national boundaries and infiltrating local cultures.

In its purest form Shari'ah (Islamic law) is a divine law which only true believers accept and apply to every aspect of human activity. This was true in the early stage of Islam, the time of the Prophet and the four following successors; this in fact might be termed as the stage of ideal Islamic life. This was, however, followed by the stage of expansion when Islamic law was no longer the law of a small community of faithful men and women, but a law of an Empire. It was at that stage when the divine nature of Shari'ah began to give way to human factors. The Quran was no more the only source of the law. There were other sources as well. Firstly, the Sunna of the Prophet which comprises his statements and actions. This was the true but not only mode of the interpretation of the Quran. The disciples of the Prophet were also regarded as an authority for the law but failing any of these sources, the jurists fugaha were allowed through a system of methodical deduction giās and carefully weighted judgment ijtihād to supplement the law and meet the daily requirements of al-ummah al-islamiyyah, the Muslim Nation. Diversity in interpretation, deduction and judgment came as a natural result of expansion, growth, division and isolation. A good example of this is to be found in the emergence of sectarianism and the presence of numerous cultures and races.

The disintegration of the Islamic Empire and the rise of Muslim independent states or even empires such as the Ottoman Empire changed the role of Islamic law in spite of frequent claims that it remained the law of the state. Gradually these claims were dropped one after the other until in our days Islamic law has become a means of identity and a system for reference and only a law in application where the sheer force of its impact makes this unavoidable. Evidence of the latter is obvious in the aspect of family law in almost all Muslim countries but less obvious in commercial laws, land laws and water laws.

It is therefore no coincidence that Islamic law should have no theory and that its philosophy should aim at the divine and ideal on the one hand and the temporal and practical on the other. This is basically

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the reason why Islamic law distinguishes between things that belong to God and things that belong to mankind, between God's rights haq Allah and man's rights haq al-'abd. Basically the Islamic State is God's State and therefore the State Domain is God's domain, but God reserves these rights not for His own benefit. It is reserved for the benefit of man. "God" the Quran commands "owns all that is in Heaven and Earth and in between,"[1] yet "God made man his successor on Earth,"[2] and "commanded everything in Heaven and Earth" for his benefit.[3] Muslim jurists find these two fundamental rights give way to two other types of rights: one which is a mixture of God's rights and man's rights but here the rights of God dominate; and another which is also a mixture of both but man's rights dominate. In contrast, however, Muslim jurists offer no legal definition of the term 'right,' nor is there anywhere in the vast literature of Islamic law any indication of clear understanding of the distinction of modern systems between 'fundamental or basic rights,' 'public rights' and 'private rights' although the latter seems to be the one best understood in terms of day-to-day problems. Though it may not be possible to explain this feature of Islamic law in the light of modern legal theory it may be possible to understand and perhaps accept it if we note the following:

(a) The legal philosophy of the system aims not at creating the good citizen a notion which the Greeks passed to European legal systems - rather it aims at creating the perfect man good for this world and the other world. Thus all efforts in the system are directed toward achieving an equilibrium between man's material and spiritual needs. Hence everything else is significant only in as much as it contributes toward this goal.

(b) The historical development of Islamic law which besides creating new concepts and reforming old ones, also acknowledged old practices and accepted existing ones sometimes on the pretext of lack of prohibition or direct contravention to the latter of the law, and often because of public interest or simply because the law offers no remedy to a particular case.

Given the above it must be noted that Islamic law knows no theory of public ownership which as in modern legal systems often has water law as a constituent component and offers no clear independent water system with fixed laws rigid or otherwise. In reality the laws governing the water system are to be found among laws governing properties and things in general. Above all much of the Law of the water system is to be found in the existing practices of the particular Muslim community.

2. DEFINITION OF THE POLICY OF THE ISLAMIC WATER LAW SYSTEM

Arabia before Islam was as it is today divided into two geigraphical zones: the vast desert land in the north where often the only source of water is the well; and the chain of highlands in the south extending northward and at intervals eastwards where beside wells, good seasonal rainfall made it possible to rely on perennial and seasonal water courses as a major water resource. Before Islam the northern parts of Arabia had few, if any, regulations governing the use of wells and water holes.

Apart from the areas around Mecca and Medina, Taif, the extension of the southern highlands in the west and some oases in the eastern parts where small numbers were engaged in agriculture, most Arabs in this part were nomads. Among nomads the law was based on first come, first served. In most cases[4] this was enforced by sheer force. Common wells were recognized but often a strong tribe which needed water for the grazing of the animals denied the use of such a common well to another party or a wayfarer who in their opinion constituted a danger to the tribe's interest. Boundaries of grazing land including water holes were fixed at the farthest points where the barking of the tribe's watch dog was audible.[5] Nomads settled in camps extended the harīm or territorial claim to the water source nearest to the camp. 'Urf or customary rules were, however, observed as much as it was not possible to infringe upon them or as long as it was possible to survive without violating them. In practice this meant the rights of other tribes or confederation of tribes were observed. Observing these rights depended very much on the degree of readiness of the particular tribe to protect its hima. The concept of hima consisted of both material defense lines as well as moral and legal boundaries. Violation of either of these limits requires the tribe to stand in defense.

Settled communities in this part of Arabia preserved in most cases their tribal links and applied 'Urf with no doubt a higher degree of rigidity. Trading towns such as Mecca or those located in the North nearest to the borders of Persia and Byzantine, Syria seemed to understand the necessity for providing water for public use. Thus some rules were developed for the regulation of use of public wells. These seemed to distinguish between human, private and commercial consumption as well as necessary and reasonable watering of animals and wasteful exploitive use of water. In Medina and in the oasis where the inhabitants were engaged in cultivation irrigation of plots of land followed a certain pattern depending on whether irrigation water came from wadis or wells. Water rights were attached to plots of land and the general trend seemed to favor a policy of fair distribution.[6]

In South Arabia, that is to say in Yemen, the high percentage of rainfall and favorable conditions encouraged most inhabitants to settled life based mainly on farming. This depended in the highlands mostly on rainfall but in the eastern regions and the low coastal areas - the Tihama - agriculture concentrated around water courses, the wadis in which rain water from the highlands collected and streamed down its course to the sea or desert.

Long before Islam this part of Arabia had various forms of government and laws were devised for all aspects of life including water rights. Irrigation was developed to a degree which achieved technical efficiency and wide acceptance. The country was divided into mikhlāfs (corresponding to a county or province) which was governed by a Qail (prince). Each mikhlāf consisted of a number of 'uzlah in which there were a number of villages. The Qail being the supreme feudal lord and tax collector had great interest in having the greatest number of lands being cultivated. To achieve this he aimed at a policy of water conservation and a system of water allocation which spread whatever quantity of water was available over as many lands as possible in the area.

Islam both as a reforming and innovative force acknowledged most that was practiced in the past but rejected any notion promoting full ownership of water and exclusive rights. Basically, water is regarded as God's property, freely available to all mankind. It stipulates that all men and beasts have the right to shirb, that is use of water for individual and domestic purposes. It declared all common wells as Sabil, that is free for all wayfarers, and encouraged the endowments of water resources as waqf for public use.

Irrigation practices continued to function under Islam as they were before but the rights of the individual were guaranteed against the tribe, the rule, or the feudal lord. The Islamic State aimed at achieving fair distribution of water, not for the ultimate purpose of enriching itself but for treating all members of the community equally.[7]

Generally speaking, jurists of all sections and schools of thought agree that water 'is a thing that is mubāh.' As such, it is free of all restrictions of ownership and conditions which in any way undermine the basic requirement of its free availability for all mankind.[8] This is based on the tradition of the Prophet which proclaims the common ownership of man of three things: brushwood for fuel, and water and grass for grazing.[9] This led to the development of the legal concept of communal or, as in some cases, state ownership of major water resources.[10] Even so, private ownership of water and the concept of usus were nevertheless recognized as it will be seen below.

3. CLASSIFICATION, REGULATION AND USE OF WATER IN ISLAMIC LAW

The classical classification of waters put forward in Al-ahkām al-sultāniyah by the famous jurist Al-Mawardi remain the best in Islamic law to date. This deals with water under three headings according to its three sources: rivers, springs and wells. River waters are classified under three subheadings:

(a) Waters of great natural rivers.

(b) Waters of small natural rivers.

(c) Waters of artificial rivers.

Examples of the first include the Tigris and the Nile rivers. The second type includes, besides streams, dry-bed valleys wadis. Both, however, 'God caused to flow.' The third type which 'man caused to flow' alludes to canals and the various devices of water diversions.

The waters of great rivers are absolutely mubāh, that is free and in no way subject to proprietorial claims insofar as they flow in the natural course of the river. The sheer volume of these waters 'ought to give no rise to disputes.'

In contrast to great rivers the waters of small rivers, though basically regarded as mubāh, are nevertheless thought of as such in relation to those who dwell in their vicinity and not the public-at-large. Furthermore, if the waters of the small river are not

sufficient in quantity to meet the needs of the community dwelling in its vicinity the use of such water becomes subject to regulations which restrict individual rights.

Waters of artificial rivers are held in common by those who dug the artificial water course. However, if the waters of such rivers exceed the needs of those who hold it in common, the law places full legal responsibility to offer surplus waters to nonparticipants in need of such waters. This classification also applies to lakes.

Spring waters are also treated as three categories. The first category is the natural spring 'which God caused its waters to spring out.' This is held in common by all mankind but where the waters of such a spring are limited in quantity, purlic use is extended to as many beneficiaries as can be supplied. Springs which are rendered useful by human efforts but are located on mawāt land are held in common by those who, through their efforts or contributions, made the waters of such springs available for use. Yet here again, participants are obliged by law to offer surplus water to nonparticipants in need of water. The third category is the waters of a spring located in private property and made to flow out by human effort. The law in this case regards the owner of the land on which the spring is located as the owner of the spring through strictly not the owner of the water. This is, as it will be seen later in this section, because of the strict requirement of possession for the establishment of ownership of water.[11] Furthermore, owners of such springs are also required to offer free of charge any surplus water to others who may require it for domestic purposes or watering animals, but here the obligation may fall through on various grounds including damage to property or interest.

Wells are of three types: those dedicated for public use sabīl remain so no matter where they are located, on mawāt land or private property. Wells dug out in mawāt for a private purpose may be used for this purpose but the founder of such a well cannot deny others who did not participate in the digging to use its waters. The best that can be achieved by the founder of such a well is to claim priority and have others wait until all his needs are met. This well once abandoned reverts to the first category and the founder may never again have the privilege of excluding others while his requirements are served first. This rule, however, does not apply where the purpose of the digger of the well is to reclaim mawāt land for, in this case, the well is considered to be located in the land of the occupant and the rule of the third category applies.

The third category concerns wells dug out for private use on private property. The well in such instances is the property of the owner or the occupant of the land.[12]

Ownership of water is difficult to establish. The law regards water as a thing which is fundamentally incapable of ownership. Thus one legal opinion fatwa holds that "the state of ibāhah ownerlessness in water is deep-rooted and firm, hence one view holds that water is incapable of ownership." The same fatwa holds that ownership is recognized where there are strong grounds for it. Such grounds must consist of possession in the narrowest sense. This means storage in a cistern, pool or any means which arrests the water within well defined bounds. Anything

short of this is not to be regarded as ownership. Thus while wells and artificial springs may be claimed as private property the water in these is never regarded as private property until it enters possession (hiyāzah).

Large expanses of water which present no problem in allocation of water rights are shared equally. Small streams and lakes are allocated in the first instance to those dwelling in the vicinity of the water source. If, however, the water is not in sufficient quantity water rights are allocated in the following manner:

(a) Where the water of the stream or source required no artificial means, those nearer to the source take first and then the ones after and so on. Higher ground takes before lower ground.

(b) Where efforts are required to make the water flow allocation is determined on the basis of expenses and efforts contributed for that purpose. In other words the waters of such a source are shared by those who contributed each according to his share. Shares themselves are in the first instance determined by the space of the land of the subscriber.

In both cases, the Islamic law provision regarding offer of surplus water to others strictly applies. Islamic law also requires that the watering of land should not reach above the foot's ankle[13] but this was overruled by jurists such as Al-Mawardi who explained this provision as functioning for general guidance and not strict application. In the view of Al-Mawardi the volume of water required for the irrigation of a plot of land is determined by local custom, the season, the crop and the quantity of water.[14]

Water is also allocated by nawbah turns, time and volume measure. These methods are often used in areas where land irrigation covers an extensive area or in cases where the land owners subscribe to the construction and maintenance of water channels on a pro rata basis.

Islamic law recognizes the following priorities:

(a) Haq al-shafah or/shirb right to quench thirst.

(b) Domestic use including watering animals.

(c) Irrigation of agricultural lands.

Commercial and industrial purposes seem to rank fourth.[15] There is general agreement among all jurists of all sects that the right to quench thirst rests on clear and unfettered, legal and religious provisions. In this sense no one can deny anyone the exercise of this right or else such a person must face consequences. One school of law, the Hanafī goes as far as permitting a man in need of water for survival to take up arms against anyone denying him the right to quench his thirst.[16] In this respect the Hanafis make no distinction between waters within control of private individuals and water made available for public use.

As for animals' rights to drinking water the following hadīth from Bukhari serves as a good example of the stand of Islam on this point:

> He (the Prophet) said [to his disciples],'a man while walking became thirsty. He stopped at a well to drink water from it. After doing so he noticed a dog sniffing at the sand - a sign of thirst. The man said to himself, this dog is suffering what I had suffered before. He then took his shoe off, filled it with water and held the mouth of the dog and had it drink the water. The man then thanked God who bestowed upon him forgiveness.' On hearing this the disciples asked the Prophet: 'Are we also rewarded (by God) for kindness offered to animals?' To this the Prophet responded, 'God rewards for any kindness offered to anything living.'[17]

Basically, therefore, the obligation toward animals in general is moral though the law is strict about making drinking water freely available for domestic animals first and all other animals next where the water is classified as mubāh.

Beneficial use of water is best viewed through the broad provisions against misuse of rights. Use of rights is governed by moral and legal regulations. The former require good conduct and consideration for others as well as conforming to accepted norms. The latter calls for strict application of public interest and observance of the following:

(1) Harmful practices must be eradicated.

(2) Harmful practices may be tolerated only where they form a deterence to other practices considered to be more harmful.

(3) Deterence of damages takes priority over import of interest.

(4) Necessity permits contravening prohibitions.

Furthermore, waste of any kind is strictly forbidden by Islamic law but above all in respect to water use, it must be remembered that most waters are res nullius. This fundamental principle which restricted ownership did, on the other hand, permit use (intifā'). Thus the lack of dominium subjects the user to a number of restrictions mostly geared toward beneficial use. This is to be seen in the strict requirement to offer surplus water to others in need, allow water to run downstream after the lands upstream take their share of water. Muslim jurists stipulate that every individual has the right to benefit from a thing that is mubāh, thus men make use of rivers and lakes that are not owned just as one makes use of air and light. While the use of water may be applied to a variety of purposes the user is not free to dispose of it or to benefit from it in a manner detrimental to others.[18]

It is, therefore, generally understood in Islamic law that while the right of the public to benefit from mubah water is well established, it nevertheless remains under the supervision and direct protection of the law. In this sense any member of the public may seek a judicial

decision to establish a water right or protect it. Such claim may be instituted against a person claiming private ownership of water or a member of the public preventing him from use of water.

To prevent misuse of the banks of rivers and provide necessary protection against physical and legal encroachment, Islamic law adopted the principle of harim or forbidden area. This is a principle which may be extended to almost all water sources, public or private. All schools accept this but disagree on the size of the harim. Most rely on tradition to define its size.[19] Others give certain measurements not exceeding fifty armlengths from the course of the river or a point located in the center of the water source.

As qualitative problems were not encountered or comprehended as they are today in modern laws, Islamic law seemed to give a great deal of attention to quantitative aspects. Yet, for reasons relating to rituals which require personal hygiene, it is possible to find injunctions scattered in the various sections of the law discouraging water pollution and encouraging overt actions to prevent it. Similarly, there is also no reference to the environment yet there is no reason why Islamic law should not extend to cover either of these problems since it is greatly interested in quantitative problems. The interest in the latter stems out from environmental conditions surrounding the birthplace of Islam. Quantitative problems are not dealt with directly by clear provisions but fatwas legal opinions abound in decisions and views underlining the urgency of this problem.[20]

All provisions of Islamic law are implemented either directly by strict supervision of application or by means of judicial remedies. Thus waters which fall under the general category of public ownership are directly supervised by the government. All provisions relating to them are implemented by government officials. Contravening these provisions entails punishment by either jail or fine but more often by fine. Frequently compensation alone is sought for damages resulting from overt acts or omissions. Frequently water disputes are dealt with by special court. Often these courts function the scope of Sharia (Islamic) law proper applying ad hoc procedures and arriving at decisions on the basis of mos majorum. Courts of this nature are formed when there is need for them and are headed by respected members among the farming community. Sometimes simple methods of arbitration are resorted to where it is feared that the formation of customary courts is irregular in view of the law proper.

Al-Majallah Art. 1662 sets time limits for the hearing of cases touching upon water disputes. These are 10, 15 and 36 years. The first applies where the disputed water right is related to a state property miri/amiri. The second applies in relation to private property while the third applies in relation to waqf land, i.e., land devoted for religious purposes.[21]

Constraints to rational water allocation are mostly social, economical or technical but there are instances where the law proper or customs perpetuated malpractice or failed to meet changing requirements. Some of these stem out from the regulations which give upstream priority over

downstream lands. Often this priority right is misused as the upstreamers tend to barrage the water and deflect it to lands on both banks other than those legally entitled to the water. This is legally stealing but passage of time and the wealth of the landlords of upstream farms tend to overcome protests by less prosperous farmers while the law provides no remedy. On the contrary, the law seems to allow recognition after a certain period. As such it is not uncommon to see in most wadis where irrigation depends on seasonal flooding, a great number of plots of land left uncultivated for several seasons. Instances are abundant where the rich and powerful misuse the law by withholding irrigation water in order to force small landholders to sell to them their land. Water rights may also be so patchy as to form an obstacle to attempts at rationalization of the system. Furthermore, the provision of Islamic law which protects owners of wells located in private property against any claims from others relating to harmful effects on other wells or water sources can also prove to be yet another obstacle in the way of rationalizing water use.[22] Other constraints fall properly under organization and administration as shown below in Part II.

There is no direct tax on water use or right but generally the law distinguishes between rain-fed lands and irrigated lands. However, before we examine this we must recognize the main features of the tax system in Islam:

(1) Zakat--this was the only form of tax to which Islamic teachings referred to directly. Basically, there are two categories of Zakat: (a) zakat al-mal levied on liquid funds and livestock and collected annually at the rate of 2-1/2%; and (b) zakat al-fitrah, poll tax collected annually from heads of families at the rate of one sa' of cereals per head (approximately 2,700 gms). This is purely a religious tax basically meant to be collected by the Bait al-mal, public treasury for distribution to the poor and needy of the Muslims. However, numerous Muslim states and rulers disregarded the basic function of zakat and tended to impose under its provisions various secular taxes.

(2) 'Ushr--basically the zakat collected annually on the produce of lands. This is levied on cereals and fruits at the rate of 10% in rain-fed farms and 5% in irrigated farms. The nisāb or the minimum quantity at which the tax is levied is a subject of dispute among the jurists of the various schools but there seems to be general agreement that 300 sa' (1 sa' = 2,700 gms) is the nisab. Again, it must be pointed out that numerous Muslim states disregard the percentage rule and nisab and preferred to collect tax in cash extending it to all types of produce.[23]

Clearly the law regards land produce as the main source of revenue for the Bait al-mal, the public treasury. The law also recognizes that irrigation requires much effort and expense, hence the annual rate for the produce of such lands is reduced to one-half of the regular rate. Sometimes it is said that the law is harsh on the low yield rain-fed lands in arid areas. These it is argued are dependent on rain because they do not enjoy water rights or they lack the source or means of irrigation. To this it must be said that the nisab or minimum quantity of

produce on which tax can be levied is a safeguard against such harshness.

The Islamic Public Treasury for centuries took charge of river banks, public canals and wells. In addition the Islamic state through the institution of Waqf religious endowments also provided care and attention to water sources founded for public use by private persons.[24]

4. TRANS-NATIONAL WATER DEPENDENCIES

Islamic law regards all countries where a majority of Muslims live under a Muslim administration as one and the same land. This is termed as the abode of Islam (dar al-islam). Theoretically the same law applies and therefore no transnational water disputes could or should arise. In practice this is not true. Ever since the Islamic Empire disintegrated there were many instances when one Muslim state confronted another. However, there is no record in Islamic history of any international water disputes arising before this century. Islamic law proper in this sense has little or no provisions at all concerning this.

Non-Muslim countries are generally regarded as enemy land (dar al-harb) abode of war. But peace treaties may exist between the Muslim state and some non-Muslim states in which case friendly and good neighborly relations must be observed. However, in relation to water it must be remembered that most Islamic provisions speak of man and mankind and not of Muslims. Water rights are therefore extended to all human beings. There is, of course, no doubt that where war conditions exist such rights are not extended to enemy. Again, it must be stated that so far there are no known records of water disputes of this nature in Islamic history before the present century though there are hundreds of instances where armies of the enemy were denied water supply or access to water sources as part of military tactics. Consequently, Islamic law offers insofar as it is known today no provisions to cover this aspect.

PART II

ORGANIZATIONAL AND ADMINISTRATIVE ASPECTS

5. INTRODUCTION

Islamic law proper offers very little in terms of organization or administration of the water law system. Much of the system that existed then and now was non-Islamic in origin. Islamic law either acknowledged it or Islamized it according to whether it accorded to its concepts or not. At no time was there an attempt to centralize the system on a national basis though on the local levels the influence of Islamic law was strong which resulted in some central authority which administered water rights. Thus much of the organization and administrative aspects are the result of either local custom or some ancient system and vary according to the area.

6. LEVELS OF ADMINISTRATION

(1) On the National Level: There is very little in Islamic law or custom that indicates interest in a national or universal organization. The lack of such provisions, however, does not preclude the devising of such an organization or administration.[25]

(2) On the Local Level: Most of this is traditional with strong Islamic influence. It varies according to the locality and climatic conditions.

Islamic sources speak of a system of supervision of water distribution. The system administered by amir al-mā/kayyal al-mā,/khabir (water controller) gives only an outline of the ideal method or methods dealing with the administration of water. Practice, however, differs widely from this though among most Muslim communities an Islamic facade is preserved. To cover this aspect it is suggested that information will be drawn from examples of local organization and administration of water in areas in Arabia where conditions have not changed for centuries.

Water for domestic use is often administered in towns and villages by the government but more often by the public. The scarcer the water the more complex is the organization. The water source/sources on which the domestic supply depends is administered by an overseer who may or may not be assisted by aids depending on administrative requirements. Such a person is known as a shaikh or 'aqil. Sometimes he may be the head of the community but where the community is large he may not be so. He is paid by the community by direct contributions from heads of families. Often such contributions are offered annually but there are instances where they are offered seasonally. Such a functioner regulates the turns nawbas and methods of extracting water as well as frequency. Some villages and small communities observe rules such as these without the presence of a water master but breach of regulations is referred to the head of the village or community.

In towns the government may provide administrators where there are water sources large enough to be regarded as public. Frequently households dig wells of their own or share a well with others. All expenses relating to maintenance are shared on a pro rata basis. Where water is collected in cisterns or reservoirs this is done on a collective basis.

Irrigation from flood water in the dry beds of wadis in Arabia requires a complex organization. The wadi is divided into zones comprising of up-stream, mid-stream and low-stream. Each zone is administered by a water master. Sometimes he is known as shaikh or shaikh al-shamal or simply shaikh of the area. These are directly responsible to a supreme shaikh of the whole wadi. Each zone distributes water according to an order of priorities established according to the following rules:

(a) Nearest to the water takes first.

(b) Earlier established water rights are given preference over recent ones.

(c) Lands located on higher ground take water before those located at lower grounds.

Water is deflected to channels. Each of these channels is supervised by a channel water master. This official sometimes known as Shaikh al 'ubar or al-Sharij keeps a record of all water rights of the plots of land attached to the channel. Just as water is deflected to channels according to a well-known sequence, it is also deflected to plots of land according to a known sequence.

Quantity and frequency of watering are determined by the volume of the water and the basic rule which entitles each plot of land to take its full share of water determined by tradition and agricultural practices regardless of the volume of the water or the right of other beneficiaries. Allocation of water rights in the wadi is determined by tradition. Sometimes this is put in writing.[26]

When flood water gushes through in the wadi the Shaikh announces it through a traditional system of warning. Farmers are obliged by customary law to respond to this call and participate in water control and distribution. Barrages located at pre-determined points are constructed well before the flood occurs. Cost of construction is born by the beneficiaries on a pro rata basis. Shares are determined by water masters. The latter also determine the amount of labor each landholder should contribute. He also decides according to local practice the share of the landlord and that of a tenant.

Payment of these officials is made by contributions known as frūq or jirāyah or ujrah. These officials remain in office as long as they act properly and are removable by a majority decision. Often offices of this nature are allocated to sons after fathers so so that whole families for generations act in this capacity preserving tradition and cultivating conformity for the system.[27]

These same officials also act as arbitrators and in some cases may be selected formally as judges sitting in court applying 'urf custom and 'adah common practice. In some instances customary law is codified. Instances of these are to be found in North Africa and in Lahj in Southwest Arabia and to some extent in the Tihama (lowland of Yemen).[28]

Tradition and conformity breed conservatism. Thus much of the constraints in the system and obstacles to rationalization are the result of unwillingness to change or accept the idea that the system is not faultless. The Islamic customary organization and system of administration in its various forms in so many parts of the Muslim world are doubtless suitable to the climatic and socio-economic conditions of the areas in which they are founded. However, over the centuries the system tended to grow fast in rigidity and formal in nature. Some recurring problems were either overlooked or simply took place because the system inadvertently permitted its occurrence. Some of these constraints are listed below:

(1) Formality attached to water rights allows some plots of land already watered by a previous flood to be watered again while others attached to the same channel are left dry.

(2) Sometimes lands watered in a previous flood could not be used to channel water to another plot which was not watered at the same time. The landholder of such a plot of land may rightly express fear that water channeled through his plot of land may result in some damage. Other landholders unless they see an advantage in channeling the water through their land may simply refuse to allow thewater to pass through because it is not customary for that plot of land to be watered in this manner.

(3) Sequence and water measurement are sometimes irrational either because of a good flooding, change in the pattern of land tenure, cultivation or increase in demand for water in an area which previously had little or no water rights while demand for water diminishes in a corresponding area enjoying full water rights.

(4) Lack of remedies for a growing number of breaches of rights through use of legal devices.

(5) Inability to enforce the regulations and decisions because the officials enforcing the system are dependent on the goodwill of those members of the community within their administration. The rich and powerful can grow richer at the expense of the less powerful. Fraudulent listing of water rights, forced sale of land, and intentional breaking of bunds and barrages in order to divert water prematurely or deflect it to lands not entitled to it are some of many examples of this.

There is, however, no doubt that these constraints can be removed either by direct rationalization of the customary practices or through the flexible devices and means readily available in the Islamic legal system.

SYSTEM OF WATER LAW AND ORGANIZATIONS IN THE UNITED KINGDOM

by H. J. Richardson*

PART I
SUBSTANTIVE LAW

1. LEGAL PHILOSOPHY & FRAMEWORK OF THE SYSTEM

Legal philosophy in relation to water will tend to vary with changing circumstances. A framework of law which satisfies the requirements of a largely rural society, based upon an agricultural economy, will certainly need modification with the advance of urbanization; and the more rapid that advance, the more radical will the changes have to be. At the same time, a nation whose legal system is for the most part rooted in the common law will be inclined, in relation to any particular branch of law, to accept statutory controls only where they are clearly shown to be in the public interest. But just as modern industrial societies permit -- indeed expect -- their governments to intervene more and more in the fields of economic and social affairs, so the recognition that water is a valuable commodity, which in some parts of the country is at times in short supply, has led to an increasing realization that regulation by statute is essential in the interests of the community at large.

The United Kingdom has a unitary constitution, and its water law system is a national one. It should be mentioned, however, that water law relating to England and Wales varies slightly, and the organizational aspects vary more substantially, from that relating respectively to Scotland and Northern Ireland. Where such variations occur this report will draw attention to them.

2. EVOLUTION OF CHANGES IN THE LAW AND REASONS THEREFORE

So far as the United Kingdom is concerned, water was regarded, until around the middle of the 19th century, as a plentiful commodity, free to be used without restriction, and subject to scrutiny at law only when, for example, fishing rights were invaded, or riparian rights violated or exercised to excess, or navigation rights impeded. But over the past century or so, the rapidly increasing need for water for industrial, agricultural and domestic purposes, to meet the demands of a constantly expanding population, together with the realization by the public of the value of water for recreation and amenity use, have put a premium on water. As a result, the common law has been progressively encroached upon by statute law. Thus, the rights of owners and occupiers of land in relation to the

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abstraction of water from rivers and underground strata, once governed exclusively by the common law, are now controlled under the Water Resources Act 1963; the control of river pollution, which might perhaps be said to have had its origins as early as the 16th century, is currently effected by the Rivers (Prevention of Pollution) Acts 1951-61 (these Acts will themselves be largely repealed by the Control of Pollution Act 1974, which is to be brought into operation in stages, commencing later this year). Similarly, land drainage law, which was first the subject of legislation in the Bill of Sewers 1531, and subsequently on a number of occasions during the succeeding centuries, was eventually consolidated in the Land Drainage Act 1930, and is now contained in that Act and the Land Drainage Act 1961 (soon themselves to be the subject of a new consolidation); and the Salmon and Freshwater Fisheries Acts 1923-1972 represent the culmination of the policy of regulating such fisheries. Sewerage and sewage disposal are dealt with under the Public Health Act 1936, the discharge of trade effluents under the Public Health (Drainage of Trade Premises) Act 1937 and the Public Health Act 1961; and the provision and distribution of water supply under the Water Acts 1945 and 1948, and the Water Act 1958. Even so, the various public bodies and private interests were operating separately on one aspect or another of water management, because each separate activity developed in response to particular needs over different periods of time. In the field of public water supply, for example, development assumed major proportions in the second half of the 19th century, and in some years during that period as many as 50 bills for the grant or extension of powers to supply water were considered by Parliament. But the new water undertakings came into being in a piecemeal fashion to serve purely local needs, which resulted not only in a multiplicity of statutes, but also in the development of all the local and more easily accessible sources of supply first, so that as the population continued its rapid increase, more distant sources had to be obtained. This led to an unprofitable competition for resources, and eventually indicated the need for longer term planning and a more comprehensive policy for the development of water resources generally. To some extent this need was fulfilled by the Water Act 1945, which brought up to date and extended earlier legislation relating to water supply; and section 1 of the Act conferred on the Minister of Health, the Minister at that time responsible for the supervision of water supply undertakers, a statutory duty "to promote the conservation and proper use of water resources and the provision of water supplies in England and Wales and to secure the effective execution by water undertakers, under his control and direction, of a national policy relating to water". The primary purpose of the Act, however, was to provide a common administrative code for the operations of statutory water undertakers, and to establish by means of the amalgamation of existing units new undertakings of sufficient size and resources to be able to carry out the major new works of supply which it was evident would be required in the post-war period. The powers contained in the Act related, indeed, almost exclusively to the <u>supply</u> of water; and although conservation was mentioned in section 1, the only specific provision enabling the Minister to discharge his duty to promote the conservation and proper use of water resources was section 14, under which he was empowered to designate conservation areas and to control, within those areas, new abstractions of <u>underground</u> water.

Thus the Act contained no machinery for the promotion of an active policy to secure the objectives mentioned above, and although, by virtue of the provisions it contained for amalgamating and regrouping water undertakings, it facilitated the introduction of a considerable degree of rationalization, this reduction in numbers and the consequent enlargement of the average size of undertakings could not of itself clear the way for the necessary degree of comprehensive planning and development.

A step of major significance towards comprehensive management of rivers was, however, taken with the passing of the River Boards Act 1948. This Act concentrated in a limited number of new bodies, known as river boards, the functions previously exercised by catchment boards in relation to land drainage, by local authorities in relation to the prevention of pollution and by fishery boards in relation to fisheries. The Act did not affect the functions themselves, but merely transferred them -- with some additions relating to the gauging and collection of information of river flows -- so that for the first time these functions were exercised by a single authority throughout the watershed of a river or group of rivers. Moreover, whereas the catchment boards which had been established under the Land Drainage Act 1930 had been responsible only for specific isolated river systems, the Act of 1948 provided that the new river boards should together cover the whole of England and Wales, except an area in and around London. Within the areas of the river boards the internal drainage boards (which had also been set up under the Act of 1930) continued to be responsible for the local drainage of internal drainage districts.

It is also pertinent to mention here that in addition to the water taken for public supply by statutory water undertakers, substantial quantities of water were being abstracted from rivers and from underground by private users, in pursuance of the riparian or other common law rights which will be referred to in more detail later in this report. Apart from the control over new abstractions from underground sources in certain areas of England and Wales under section 14 of the Water Act 1945, mentioned above, these abstractions, which for the most part relate to industrial use and to use for agriculture and horticulture (including spray irrigation), and which obviously impose substantial demands on water resources, were free from statutory control.

Thus, immediately before the coming into operation of the Water Resources Act 1963, the long process towards unifying control had produced one authority responsible for each river basin for land drainage, prevention of pollution, and fisheries; and the public water supply industry was being grouped into a smaller number of units. There was still, however, a substantial gap, notably over the control of the abstraction of water direct from rivers by private users, and there was no comprehensive machinery for the control of abstractions from underground sources or for the collection and assessment of the basic data necessary to promote comprehensive conservation measures.

The need for still further unification and extension of control was accentuated by the studies into the growing demand for water in England and Wales carried out by a sub-committee of the Central Advisory Water Committee established under section 2 of the Act of 1945 with the function

of advising Ministers upon matters connected with the conservation and use of water resources. The sub-committee found that demand for water by statutory water undertakers and industry, and for agricultural and horticultural purposes, was likely to go on increasing to such an extent that it could only be met if steps were taken to regulate river flows and provide storage for all requirements. They considered that it should no longer be left to independent initiative to develop the country's water resources, but that the situation called for new authorities to review the various requirements and to plan the ordered development of resources to meet them. They therefore recommended a major change in the administration of the water resources of England and Wales, involving the creation of comprehensive new authorities called "river authorities" to manage the resources of river basins as a whole and to be charged with a positive duty of water conservation.

The sub-committee also recommended that conservation, land drainage and flood control were all so much a part of water management that it was essential for them to be the responsibility of the same authorities; and that a separate central authority accountable to the Minister should be set up to promote an active policy for the conservation and proper use of the country's water resources.

The Government accepted substantially all the sub-committee's recommendations, which were implemented in the Water Resources Act 1963.

With the passing of this Act, the planning and development of water resources entered a new phase. A new legal and administrative structure was established, designed to secure the comprehensive management of such resources. The Act extended the statutory responsibility of the Minister in relation to water conservation, and established the Water Resources Board, which might briefly be described as the central intelligence and planning agency. The Act also established 29 river authorities covering the whole of England and Wales, to whom it transferred the land drainage, fisheries and prevention of pollution functions of the river boards which were abolished. In addition to the transferred functions, the river authorities were given a general duty to take the necessary action for the purpose of conserving, redistributing or otherwise augmenting resources in their respective areas, or of transferring any such resources to the area of another river authority.

Yet, notwithstanding that all aspects of water resources development and river management had thus at last been brought under unified control, it soon came to be recognized that the organization was inadequate to meet the problems created by the increased use of water, and in September 1969 the Central Advisory Water Committee was asked to consider and make recommendations as to how the various functions relating to water conservation, management of water resources, water supply, sewerage, sewage disposal and prevention of pollution could best be organized.

There was widespread agreement in the evidence submitted to the Committee that changes in the organization were necessary. The Committee's finding was that there were increasing conflicts of interest between the various authorities responsible for providing water services and inadequate

mechanisms for resolving them, apart from intervention by central government. They identified as the most important areas and causes of conflict inflexibility in the use of existing resources; the division of responsibility for new sources between river authorities and water undertakers; the promotion of joint or national schemes; and the treatment of water after use. They concluded that, in addition to detailed improvements in legislation and reductions in the number of operating units, the relationship between the various authorities must be changed so that a comprehensive water management plan could be drawn up for every river basin, and so that the system of organization and the financial arrangements would permit the implementation of such a plan.

The Committee's deliberations resulted, as has been indicated in Part II of this report, in the enactment of the Water Act 1973.

One final development remains to be dealt with in this outline of the evolutionary nature of recent water law, as experienced in England and Wales: namely, the enactment of the Control of Pollution Act 1974, which sets up a systematic anti-pollution policy broadly reflecting all-party support. The first steps towards the creation of such a policy had been taken some years ago, with the establishment of the Royal Commission on Environmental Pollution, the formation of the Department of the Environment's Central Unit on Environmental Pollution, and the publication of the White Paper on the Protection of the Environment - Command 4373. That White Paper identified three basic requirements for an effective pollution control policy: firstly, the need for comprehensive, scientific and technical knowledge as a basis for effective action; secondly, the need to establish the right framework of economic analysis; and thirdly, the need for an adequate administrative organization; and it formulated proposals for achieving these requirements. Much of the material in the White Paper had been thoroughly debated in Parliament on a number of occasions, and was ultimately enshrined in the Bill which became the Act of 1974. The Act contains comprehensive provisions for bringing up to date the whole framework of legislative controls over pollution, and for extending the powers and duties of the controlling authorities. In as much as the Act is designed to deal with all forms of pollution, it is to a great extent outside the scope of this report; nevertheless, it will not be out of place to give a brief indication of its general effect.

Part I of the Act concerns the disposal of waste, and is based largely on the Report of Working Parties on Refuse Disposal and on the Disposal of Solid Toxic Wastes. Society has of course always needed some means of disposing of the various wastes produced by human life and human activity. But today waste disposal, for a number of reasons, presents far greater problems than ever before. We produce a greater quantity of waste due to higher population and to higher living standards. The diversification of products and industrial processes often throws up new and potentially dangerous or troublesome forms of waste. At the same time, we face a growing and natural demand for improved standards of disposal in order to reduce nuisance and dereliction. Increasingly it is realized that the resources of the planet are not unlimited and that steps must be taken urgently to reclaim and re-utilize waste materials wherever possible. It is therefore no longer enough for waste disposal to consist simply of carting away

rubbish and tipping it on the nearest available vacant site, though this is not to deny the value of properly controlled tipping in suitable places. What is now needed, in a way that it has not been needed in the past, is a thorough examination of the quality and nature of the waste arising in each part of the country and of the best ways of dealing with it, taking into account both environmental and economic aspects. Part I of the Act is designed to achieve these requirements.

Part II of the Act deals with water pollution. The Rivers (Prevention of Pollution) Acts 1951 to 1961 (which are dealt with in more detail elsewhere in this report) established a system of controls which has achieved a fair degree of success; these Acts will, however, be largely repealed when the Act of 1974 comes into force, and the purpose of Part II is to re-enact them in an extended and strengthened form.

Part III of the Act deals with noise. Excessive noise is one of the curses of modern society; indeed many people would say it is the worst of all forms of pollution. The Act takes up the particular problem of "neighbourhood noise" -- that is to say, the noise from industrial and other premises which affects people living within the surrounding area. The provisions in the Act are largely derived from the Noise Advisory Council's Report of 1972, which examined the working of the Noise Abatement Act and made recommendations for strengthening it. The Act contains four principle innovations: first, a strengthening of the procedures by which action can be taken in the courts to get noise nuisances abated; second, an important procedure for controlling noises from construction sites, under which local authorities will be able to lay down their requirements for noise control before work begins; third, a power for local authorities to establish noise abatement zones, in which they can require existing noise levels first to be held constant and then ultimately reduced; and fourth, power for the Secretary of State to make regulations about the noise of machinery from factories or construction sites and the use of adequate methods of silencing machinery such as pneumatic drills or air compressors.

Part IV of the Act is concerned with air pollution. Unlike the three earlier Parts, it does not introduce a completely new code of control since the existing code was comparatively recent; nevertheless it does deal with three significant topics in this field. Firstly, there is a new power to regulate the composition of motor fuel, through which the control of the lead content of petrol can be achieved; secondly, power has been taken to regulate the sulphur content of oil fuel; and thirdly, there are provisions requiring industry to supply, and enabling local authorities to collect, information about air pollution and atmospheric emissions in their areas.

The remainder of the Act deals with subsidiary matters, and the only one of these to which attention might be drawn is the provision for substantial increases in a wide range of penalties for pollution offenses to bring them into line with modern levels.

Society now accords a much higher priority to preserving and protecting the environment than has ever been the case in the past. The

Control of Pollution Act 1974 is, hopefully, the embodiment of this more enlightened attitude; its significance, in the context of the evolutionary development of United Kingdom water law, is that control of water pollution takes it place alongside measures to control other forms of pollution, in an Act which constitutes a comprehensive attempt to afford all such protection to the environment as is necessary in a highly technological age.

3. DELINEATION OF THE POLICIES OF THE LAW

The policies of the law might best be summarized, in a modern context, as designed to secure the fulfillment of the general policies of the Government which were set out in "A Background to Water Reorganization in England and Wales", published by the Department of the Environment and the Welsh Office in 1973, at the time when the Bill to reorganize water services in England and Wales was presented to Parliament. Those policies are:

> To secure an ample supply of water or appropriate quality to meet the growing demands of the people, industry and agriculture -- while at the same time ensuring that it is not wasted.
>
> To provide adequate sewerage and sewage disposal facilities to cope with the natural increase in water use and with new housing, industrial and agricultural developments.
>
> To ensure that the vital contribution of land drainage and flood protection to both urban and agricultural areas alike is maintained and, where appropriate, expanded.
>
> To achieve a massive clean up of the country's rivers and estuaries by the early 1980's.
>
> To make the widest use of water space for other purposes, including recreation and amenity and, where appropriate, the protection and development of salmon and freshwater fisheries and the provision of water needed for navigation.
>
> To protect the interests of those who may be affected by proposals for the development of water resources in any of these respects.

4. CLASSIFICATION OF WATERS AND CONCEPTS OF OWNERSHIP

Waters may be conveniently classified under the following broad headings:

(a) the sea and seashore;

(b) rivers, both tidal and non-tidal;

(c) lakes and ponds;

(d) artificial watercourses;

(e) underground and percolating water.

The concept of ownership has a twofold aspect: firstly, ownership of water as such; and secondly, the right to the use and enjoyment of water (which is usually associated with ownership of the soil and bed). Both aspects need to be examined in relation to each of the foregoing categories which may, however, need further subdivision. Thus, for example, the sea will for the purpose of this report be understood to comprise the high seas (which include the whole of the seas beyond low water mark) and territorial waters.

4.1 The Sea and Seashore

Although the high seas are available to all for navigation, commerce and fishing, it is clear that they are by their very nature incapable of being owned, in the sense of being continually possessed. Likewise, the soil of the bed of the sea cannot be the exclusive property of any one person or state, except in those rare cases where one state might have occupied a part of the bed for a sufficient period to have acquired a prescriptive right over that part to the exclusion of other states. In addition, exclusive rights of navigation or fishing may be obtained by treaty, and under the Continential Shelf Act 1964 rights of exploration and exploitation of natural resources may be exercised by the Crown over areas of the sea bed and subsoil designated by Order in Council under the Act.

So far as territorial waters are concerned the preamble to the Territorial Waters Jurisdiction Act 1878 provides for the jurisdiction of the Crown to extend "over the open seas adjacent to the coasts of the United Kingdom and of all other parts of Her Majesty's dominions to such a distance as is necessary for the defense and security of such dominions." Section 7 of the Act defines "territorial waters" as meaning "such part of the sea adjacent to the coast of the United Kingdom or any other part of Her Majesty's dominions as is deemed by international law to be within the territorial sovereignty of Her Majesty, and for the purposes of the Act any part of the open sea within one marine league of the coast measured from low water mark is deemed to be open sea within the territorial waters of Her Majesty's dominion." The Act was passed to give effect to the minority decision of the judges in the case of R. v. Keyn (1876) 2 Ex. D. 63; it did not however uphold their view that the sea within 3 miles of the coast of England was part of the territory of that country. Thus English law appears to accept that the Crown has no common law right or property in the sea bed below low water mark. It may, however, acquire a statutory title thereto as against a subject (the Cornwall Submarine Mines Act 1858 provides an example of this); and it has also been held that an individual may own property beyond low water mark (Gann v. Free Fishers of Whitstable (1865) 11 H.L.C. 192).

The seashore (which in a legal context is synonymous with foreshore) is that portion of land lying between the high and low water mark of

ordinary tides (Scratton v. Brown (1825) 4 B & C 485); that is to say, the land which is subject to the flow and re-flow of ordinary tides.

A long line of cases has established that the soil of the foreshore vests in the Crown unless ownership has passed to a subject by express grant, prescription or possessory title. Much of the foreshore is in fact now owned by the National Trust, local authorities, or lords of the manor. Ownership is however subject to the rights of the public with respect to navigation (including rights to anchor and moor vessels) and fishery.

Contrary to popular supposition there is no common law right for the public to bathe from the foreshore without the consent of the owner, though the right to use the foreshore for that purpose may arise by custom, prescription or statute. Similarly, the public has no right, other than from grant, prescription or statute, to remove seaweed, sand, shells, shingle, or other materials which vest in the owner of the foreshore as part of the freehold.

4.2 Rivers

We turn now to the concept of ownership in relation to rivers.

The first point to be made is that there is no ownership in the water of a river, whether tidal or non-tidal, or indeed in the water of any natural stream. Flowing water is regarded as *publici juris* -- that is to say, it is common to all who can claim a right of access to it. Such water may give rise to property rights -- rights, for example, to the use and enjoyment of the water -- but while flowing in a natural stream it is not capable of being owned.

Accordingly, the word "ownership" in the context of the rivers is relevant only in relation to the soil or bed and differs in its meaning and significance according to whether the river is tidal or non-tidal. A river is tidal only as to such lengths as are within the regular ebb and flow of the highest tides (Rees v. Miller (1882) 8 Q.B.D. 626), and the bed of the river in those lengths, and of any estuaries, vests *prima facie* in the Crown (Lord Fitzhardinge v. Purcell (1908) 2 Ch. 139) as far up the river as the tide flows and up to high water mark of ordinary tides along the shore of estuaries. Here again however a subject may be the grantee of the Crown's title, or the bed may have been the subject of statutory vesting. Ownership is in any event subject to the public rights of navigation and fishing, and a grant by the Crown must be expressly subject to such rights.

As regards non-tidal rivers there is a presumption, in the absence of evidence to the contrary, that the ownership of the bed vests in the owners of the abutting lands up to the middle of the river; an owner of the lands on both sides of the river will be presumed to own the whole bed. The public has no right to fish in such a river, except with the license or consent of the riparian owner, but a non-tidal river which is navigable is subject to a public right of navigation.

The owner or occupier of land abutting on the banks of a natural stream is entitled ex jure naturae to the use and enjoyment of the water flowing past his land as an incident of his ownership or occupation of such land. These rights to the use of flowing water are known as "riparian rights".

What is perhaps the basic common law problem with regard to riparian rights was stated by Lord Wensleydale in the case of Chasemore v. Richards (1859) 7HL Cas 349: Namely that a riparian owner has the right to have the water come to him "in its natural state, in flow, quantity and quality, and to go from him without obstruction, upon the same principle that he is entitled to the support of his neighbour's soil for his own in its natural state. His right in no way depends on prescription or the presumed grant of his neighbour, nor from the presumed acquiesence of the proprietors above and below." While, therefore, the possessor of land through which a natural stream runs has a right to the advantage of that stream flowing in its natural course, and to use it when he pleases for any purpose of his own not inconsistent with the similar rights in the proprietors of the land above and below, a proprietor above cannot diminish the quantity or injure the quality of water which would otherwise descend, nor can a proprietor below throw back the water without his license or consent (Mason v. Hill (1835) 5 B & A 1). Apart, therefore, from a use authorized by statute, grant or prescription, any unreasonable and unauthorized interference with the use of the water to the prejudice of a person entitled to its use may be the subject of an action for damages, and may be restrained by injunction, even if there has been no actual damage to the plaintiff (Sampson v. Hoddinott (1857) 1 CBNS 590).

Since riparian rights derive entirely from possession of the land abutting on the river or stream, it follows that the grantee of any such land will become a riparian owner and have similar rights.

The right of access to a stream, which ownership of the abutting land necessarily gives, includes the right for a riparian owner whose land abuts on a navigable river to moor vessels alongside his frontage.

In Attwood v. Llay Main Collieries (1926) Ch 444, consideration was given to the question whether land extending some distance back from a river can be regarded as a separate tenement, so as to allow the owner to exercise riparian rights over the whole of the land. The expression "riparian tenement" was held to connote "reasonable proximity" to the river in addition, of course, to the need for some part of the land to be abutting.

At common law a riparian owner may abstract water for his own domestic purposes, which have been held to include drinking and culinary purposes, cleansing and washing, and feeding and supplying the ordinary needs of cattle. If abstraction for domestic purposes exhausts the water, lower riparian owners cannot complain (McCartney v. Londonderry Railway (1904) AC 301); but the case of Attorney-General v. Great Eastern Railway (1871) 6 Ch App 572 established that an owner who does not take water for such purposes is not entitled to take for other purposes the quantity he could lawfully have taken for domestic purposes.

Nevertheless, a riparian owner is not restricted to taking water for domestic purposes only; in addition to such purposes, he may take water for extraordinary purposes, provided he does not thereby interfere with the right of other riparian owners above or below his tenement; and provided that the use is a reasonable one connected with the riparian tenement, and the water is in due course restored to the river substantially undiminished in quantity and unaltered in quality (Swindon Waterworks Co. v. Wilts and Berks Canal Co. (1875) LR 7 HL 697). "Extraordinary purposes" have been held to include manufacture, milling and irrigation; but in the case of irrigation, the abstractional diversion must not be continuous and the water must be returned to the river substantially undiminished; indeed, a recent case laid down that there is no right at common law to abstract water for spray irrigation because the water is not returned to the river (Rigby Joint Water Board v. Walters (1966) 3 11 ER 497). The obligation not to interfere with the rights of the riparian owners is a strict one, and in Young and Co. v. Bankier Distillery Co. (1893) AC 691, an owner who had taken water from a river and compensated for the deficiency by discharging into it from his land water from other sources was held not to have complied with the obligation -- the Court considered that the lower owner had a right to receive natural water, and did not have to accept water of a different quality and character.

It is desirable to emphasize at this point that what has so far been considered is the position of riparian owners under the common law. In due course, it will be necessary to deal with the substantial changes effected by the Water Resources Act 1963 (c. 38).

4.3 Lakes and Ponds

Lakes and ponds comprise the next category of waters to be considered in relation to the concept of ownership. The position here is very little different from that in relation to flowing water; the soil and bed of non-tidal lakes and ponds vest in the riparian owners ad medium filum acquao. In Bristow v. Cormican (1878) 3 AC 641 HL, it was held that the Crown had no right in law to the soil or fisheries of an inland non-tidal lake, while the case of Johnston v. O'Neill (1911) AC 552 determined that the Crown had no common law right to the soil or waters of such a lake, whatever its size; and that the public have no right at common law to fish therein (thus the right of fishery may be presumed to belong to the riparian owners).

Again, as in the case of non-tidal rivers, there is no public right of navigation on non-tidal lakes, but rights to navigate may be acquired by statute, dedication or immemorial user. The vast increase in the use of lakes and ponds for recreational activities has inevitably led to a corresponding increase in the granting of rights to sail or fish on such waters.

Although lakes and ponds are here mentioned separately, there is no significant distinction in law between them.

4.4 Artificial Watercourses

So far as rights in artificial watercourses are concerned, the essential difference from natural watercourses is that any right to the flow of water derives from proven or presumed grant or arrangement, or under statute. The nature of the artificial watercourse, the circumstances under which it originated and the use and enjoyment to which it has been put will all be relevant in determining the rights of persons owning the banks. For example, in Sutcliffe v. Booth (1863) 32 LJQB 136, it was held that an artificial watercourse may have been constructed under such circumstances, and have been so used, that the "riparian owners" have acquired the same rights as they would have acquired had it been a natural watercourse; conversely, an ancient watercourse constructed and maintained solely for the purposes of a mill gave no right to the purchaser of the mill to the use of the water in the watercourse (Burrows v. Lang (1901) 2 Ch 502).

In the case of a canal, perhaps the best known of artificial watercourses, the legal powers, rights and obligations of the undertakers will have been laid down by the Act which provided for the construction of the canal. In some cases, ownership of the bed and banks is vested in the undertakers; in others, the Act gives them possession of the site together with powers to construct the works. It has been held that rights of fishery in a canal belong to the owners of the soil if the enabling Act makes no specific provision, so that the public has no right of fishery in such a case (Mussett v. Burch (1876) 35 LT 486). On the other hand, any member of the public who pays the appropriate toll is entitled to navigate on a canal, and owners or undertakers who levy a toll for this purpose have a duty at common law to take reasonable care to ensure the safety of the public (Parnaby v. Lancaster Canal Co. (1839) 11 A & E 223).

4.5 Underground and Percolating Water

Finally, we consider ownership in relation to underground and percolating water.

Where underground water is flowing in a known and defined channel, the position regarding ownership and riparian rights is the same as in the case of water similarly flowing above ground (Chasemore v. Richards, ibid). Whether or not a particular channel is "known and defined" depends on the facts of each case. It has been held, for instance, in an Irish case that a "defined" channel means "a contracted and bounded channel, although the course of the stream may be undefined by human knowledge"; and "known" was construed in the same case as "the knowledge by reasonable inference from existing and observed facts in the natural or pre-existing conditions of the surface of the ground, and is not synonymous with 'visible', nor is it restricted to knowledge derived from exposure of the ground by excavation" (Black v. Ballymena Commissioners (1886) 17 LR Ir 459).

So far as underground percolating water is concerned -- "ground water", as it is usually called by water engineers -- the situation is different.

Such water was said in another Irish case to be "not a subject of property or capable of being granted" (Ewart v. Belfast Poor Law Commissioners (1881) 9 LR Ir 172). At common law an owner may abstract percolating water under his land, without regard to the effect this may have on the supply of water to springs or other wells or boreholes (Bradford Corporation v. Pickles (1895) AC 587). Again, however, it is perhaps desirable to emphasize that this right has been substantially affected by the Water Resources Act 1963.

5. MANNER OF ALLOCATION AND CONTROL

5.1 River Authorities

Since the coming into operation on 1 July 1965 of the Water Resources Act 1963, it is necessary in most cases to obtain a license before abstracting water from an inland water or underground strata. The Act was passed following publication of the Government White Paper entitled "Water Conservation in England and Wales" (Cmd 1693), which resulted from the Report of the Proudman Committee -- a sub-committee of the Central Advisory Water Committee -- on the Growing Demand for Water. The purpose behind the Act was to promote measures for conservation, augmenting and securing the proper use of water resources in England and Wales. To this end, it established 27 river authorities and a Water Resources Board, and conferred upon them these "new functions" relating to water resources. The river authorities also inherited the land drainage, pollution, fisheries and navigation functions ("transferred functions") carried out by river boards, which were abolished by the Act.

5.2 Licenses

Part IV of the Act sets up a comprehensive system of control of the abstraction and impounding of water. Under section 23, a license is necessary before water can be abstracted from a source of supply -- that is to say, an inland water or underground strata; nor, in the case of underground strata, can any well, borehole or other work be constructed or extended, or any machinery or apparatus for taking additional water be modified, unless the abstraction of the water is authorized by a license under the Act and the works concerned fulfill the requirements of that license as to the means of abstraction. If the section is contravened, or a condition or requirement of a license not complied with, then under section 49 the offender is liable to a fine. Clearly, however, a system of licensing which sought to include all abstractions would be unworkable, and section 24 of the Act provides for a number of exceptions from the general restrictions contained in section 23. The most important of the exceptions relates to abstractions not exceeding 1,000 gallons, and not forming part of a continuous operation or a series of operations whereby in the aggregate more than 1,000 gallons are abstracted; abstraction by or on behalf of a riparian owner for use for domestic or agricultural purposes (other than spray irrigation); and abstraction from underground strata by or on behalf of an individual for the domestic purposes of his household.

In addition to the categories of exemption specified in section 24, the Secretary of State for the Environment is empowered by section 25 to make an order, on the application of relevant authority, exempting one or more sources of supply from the requirement of licensing on the grounds that it is not needed in relation to such source or sources.

An application for a license is not to be entertained by the water authority (as successor to the river authority -- see Part II of this report) unless the applicant is entitled to make it under section 27, as amended by section 1(2) of the Water Resources Act 1968 (c.35) -- that is to say, in the case of an inland water the occupier of land contiguous to it or a person who has, or will have, a right of access to it; and in the case of underground strata, the occupier of land consisting of or comprising such strata. A person will be regarded as an occupier if he has entered into negotiations for the acquisition of an interest in the land which would entitle him to occupy it, or has been (or can be) authorized to acquire the land compulsorily.

Applications must be made to the water authority on the appropriate form, as prescribed in Schedule 1 to the Water Resources (Licenses) Regulations 1965 (S.I. 1965 No. 534); copies of the two most common forms are attached hereto and form part of the Appendix. The application must be accompanied by an ordinance map showing the point or points of abstraction, the land occupied by the applicant and (except in the case of applications by statutory water undertakers) the land on which the abstracted water is to be used, distinguishing between parts of the land on which the water will be used for different purposes. The applicant must publish a notice for two successive weeks in one or more newspapers circulating in the locality where the proposed abstraction is to take place, and also in the London Gazette; and where the application relates to an abstraction from an inland water, a copy of the notice must be served on any navigation, harbor or conservancy authority having functions in relation to the inland water at any proposed point of abstraction, and on any internal drainage board within whose district any proposed point of abstraction is situated. The notice must be in the form prescribed by Schedule 2 to the regulations, which contains the forms of notice for the purposes of section 28 of the Act. It must name a place within the relevant locality where a copy of the application, and any accompanying map or plan, may be inspected free of charge at all reasonable times; it must also state that any person may make written representations to the authority within a period of not less than 28 days from the date on which notice is first published in the local newspapers and 25 days from the date of publication in the London Gazette. Again, a copy of a typical notice is included in the Appendix to this report.

Copies of the local newspapers containing the notice, together with a declaration that the notice has been properly published and served, must accompany the application. The water authority may either grant a license containing such provisions as they consider appropriate; or if they consider it necessary or expedient to do so having regard to the provisions of the Act, they may refuse to grant a license. Section 29, however, contains a number of provisions governing the manner of determining applications for licenses -- in particular the authority must not grant a license

so as to derogate from what are known as "protected rights" under the Act (these will be considered in detail presently); and must have regard to any written representations received by them within the period set aside for such purpose.

Section 30 of the Act provides for the matters which are to be specified in licenses; and by section 31, in any action brought against a person in respect of the abstraction of water from a source of supply, it shall be a defense for him to prove that the water was abstracted in pursuance of a license and that the provisions of the license were complied with. This provision does not, however, exonerate a person from any action for negligence or breach of contract.

An applicant for a license may appeal to the Secretary of State if he is dissatisfied with the water authority's decision, or if they fail to notify him of their decision within three months from receipt of the application. The appellant must provide the Secretary of State with copies of all relevant documents, and the water authority must serve copies of the notice of appeal on all persons who made written representations, and the Secretary of State will take account of any further representations made to him by such persons. The Secretary of State may, if he thinks fit, and must, if so requested by the applicant or the river authority, cause a local inquiry to be held or afford an opportunity to the parties to be heard by a person appointed by him. The Secretary of State's decision is final, and he may allow or dismiss the appeal.

A license holder may apply to the water authority to revoke or vary his license, in which case the provisions of the Act relating to publication and determination of the application, reference of applications to the Secretary of State and appeal against decisions of the water authority will apply with the necessary modifications (though this requirement is to some extent relaxed where the proposed variation would reduce the quantity of water authorized to be abstracted).

5.3 Protected Rights

Mention has been made of protected rights under the Act, and these must now be explained.

The definitions of "inland water" and "underground strata" are so wide as to effectively include virtually all waters. Thus the Act has largely substituted, for the common law rights of riparian owners (in relation to flowing water) and landowners (in relation to underground water not flowing in a defined channel), a system of compulsory licensing (albeit subject to exemptions). The Act has, however, created "protected rights", so as to secure the protection of abstractors -- whether license holders or exempt from the need for a license -- in the exercise of their abstraction rights. Thus, section 26 provides that the holder of a license to abstract has a right to abstract to the extent authorized by the license and in accordance with the provisions contained in it; and that a person who is entitled to abstract without the need for a license may do so to the extent permitted by the appropriate provision of section 24.

These rights are referred to in the Act as "protected rights", and as stated earlier, an application for a license must be refused if the proposed abstraction would have the effect of derogating from such rights. If the water authority were to grant a license which did derogate from a protected right, the license would not thereby be rendered invalid, but the authority would become liable, by virtue of section 50, to a civil action for damages for breach of statutory duty. Only if the authority could prove that the abstraction which caused the derogation was wholly or mainly attributable to an exceptional shortage of rain or to an accident or other unforeseen event outside their control, would they have a defense to the action.

In addition to requiring licenses for the the abstraction of water, the Act also provides (in sections 36 and 37) for the licensing of impounding works in inland waters. As with the case of abstraction, there are exceptions from the need to obtain a license; and the provisions of the Act relating to publication and determination of applications for licenses to abstract are applied, as are those relating to revocation, variation and appeals. Again, it is a defense to an action (other than for negligence or breach of contract) in respect of obstructing or impeding the flow of an inland water by means of impounding works that the licensee was acting in pursuance of a license to impound. There is also a duty upon the water authority not to grant an impounding license which would impede the flow of an impounding water so as to prevent or restrict abstraction by a person entitled to a protected right. A typical form of application for a license to abstract or impede the flow of an inland water by means of impounding works, and an example of a notice, are included in the Appendix of this Report.

Part IV of the Act does not extend to Scotland or Northern Ireland, so that the law in those countries, which is not significantly different from English common law, remains unaffected.

6. PREFERRED USES & STATUS OF PREFERENCES

The Water Resources Act 1963 does not contain a formal order of preferred uses, but the preference frequently accorded in legal systems to the use of water for domestic purposes has its manifestation in England and Wales in section 103 of the Act, which required river authorities, in assessing the demand for water, to have particular regard to the duty of statutory water undertakers to provide supplies of water for domestic purposes, for extinguishing fires, for cleansing sewers and drains, for cleansing and watering highways and for supplying any public pumps, baths or washhouses.

Section 103 was in fact repealed by the Water Act 1973, Section 24 of which places upon water authorities the far more comprehensive duty -

> To carry out a survey of the water in their area, the existing management of that water, the purposes for which it is being used and its quality in relation to its existing and likely future uses, and to prepare a report setting out the results of the survey.

> To prepare an estimate of the future demand for use of that water during the period of twenty years from the date on which the survey is completed or such longer or shorter period from that date as the appropriate Minister or Ministers may in any particular case direct; and
>
> To prepare a plan as to action to be taken during that period by the authority (whether by way of executing works or securing the execution of works by other persons or otherwise) for the purpose of securing more efficient management of water in their area, including the meeting of future demands for water and the use of water and restoring or maintaining the wholesomeness of rivers and other inland or coastal waters in their area.

It also appears to be the policy of the Act of 1963 that spray irrigation (defined by section 135(1) as the irrigation of land or plants by means of water or other liquid emerging from apparatus designed or adapted to eject liquid into the air in the form of jets or spray) is subordinate to some other uses. For example, restructions on the abstraction of water do not apply where the riparian occupier of land uses water for the domestic purposes of his household or for agricultural purposes other than spray irrigation. A farmer using spray irrigation, and who had used it prior to 1 April 1965, may not usually claim a quantity of water based on his estimated requirements as non-statutory users for other purposes may do if they had likewise used water prior to that date. He may claim such quantity only if he had used water for irrigation before 31 July 1963, or had begun to construct a reservoir before then and had brought it into use before 1 April 1965. Otherwise, he is placed on the same unprivileged footing as if his application were for an ordinary licence and not a licence of right.

Licences of right were not referred to in the previous section of this Report, because the period for applying for and granting such licences has now expired. But the purpose of a licence of right was to preserve and maintain the rights of those who were abstracting, or were entitled to abstract, at the date of coming into force of the Act of 1963 on 31 July 1963; and if an application for such a licence was properly made before 1 July 1965, the river authority were under a statutory duty to grant the licence. So those entitled to a licence of right, namely, those who were entitled to abstract by virtue of a statutory provision in force on 1 April 1965, or who had, otherwise than by virtue of such a provision, actually abstracted water at any time within the period of 5 years ended on 1 April 1965, may perhaps be said to have been accorded the status of preferred users.

7. RELEVANCE TO QUANTITATIVE & QUALITATIVE PROBLEMS

7.1 Water Quantity

In quantitative terms, the substantive law will be relevant if, and only if, it is apt to assist in every possible way the availability of

water to meet the ever-increasing demand for domestic purposes in both urban and rural areas, for industry and for food production through irrigated agriculture. Moreover, many of the areas of growth are in those parts of the country which have a lower rainfall than elsewhere, or whose main sources are in any case already fully exploited. This means that it will be increasingly necessary to pursue schemes involving transfers of major quantitites of water from source to point of use: there will be a general tendency to have to move water - either by pipeline or regulated river - eastwards and southwards from the areas of heavier rainfall to those of lower rainfall, which latter happen to be the areas of highest consumption.

It is therefore vital that the water law is sufficiently comprehensive to secure the implementation of major works schemes of the kind here contemplated. In this connection, section 9 of the Water Act 1975 (substantially a re-enactment of section 4 of the Act of 1963) places upon water authorities the duty to take all such action as they consider necessary or expedient for the purpose of conserving, redistributing or otherwise augmenting water resources in their area, of securing the proper use of water resources in their area, or of transferring any such resources to the area of another authority. Other provisions of the Act of 1963 (notably Part VI, and particularly section 67) empower water authorities to acquire the land (compulsorily if need be) and carry out the works required for the implementation of schemes of river regulation, conjunctive use (that is, schemes involving the use of two or more sources of supply), artificial recharge of aquifers, exploitation of local sources or any other appropriate scheme needed to meet the demand for water. Furthermore, water authorities are obliged, under section 24 of the Water Act 1973, to estimate the future demand for the use of the water in their area, and to prepare a plan of the action to be taken by them (whether by way by executing works or securing the execution of works by other persons or otherwise) during the period of 20 years from the completion of the survey which the section also requires them to carry out. The purpose of this requirement is to secure more efficient management of water, including the meeting of future demands for water and restoring or maintaining the wholesomeness of rivers and other inland or coastal waters. The plan must be revised and brought up to date at intervals of not more than seven years, and must take account of any operation proposed to be undertaken by statutory water companies who are supplying water in the authority's area. The licensing provisions of Part IV of the Water Resources Act of 1963, already described, are also clearly relevant in the quantitative context, being designed to secure the regulation of the use of water in the best interests of the community.

7.2 Water Quality

As the demand for water grows, it will become more and more difficult to ensure that water of the required quality is available. In the past, water supplies have been abundant, and broadly speaking it was possible until fairly recently for water undertakers to seek and obtain the purest supplies for their consumers. But it is evident that if rivers used as carriers also receive effluent, the quality of the water could be impaired.

This applies not only in the case of water for domestic purposes, where the need for high quality is self-evident, but also in the case of supplies for industrial purposes, where water of an inferior quality may be harmful to, or unsuitable for, certain processes.

All this has two implications: first, it is necessary to be sure that water supplied is wholesome, so as to avoid the risk of causing harm to the public health; and second, it may be desirable, if it is an economically sound proposition, to avoid supplying water of a higher quality than is strictly needed. For these reasons, the water quality aspects must be taken fully into account in water resources planning; and accordingly these aspects are among those to which a modern system of water law must be addressed.

So far as domestic supplies are concerned, there is a requirement in section 31 of the Third Schedule to the Water Act 1945 that statutory water undertakers shall provide in their mains and communication pipes a supply of wholesome water sufficient for the domestic purposes of all owners and occupiers of premises within the limits of supply who are entitled to demand a supply for those purposes. The Act does not enlarge on the meaning of "wholesome", which would therefore in the last resort be a matter for the courts to determine; in practice, however, undertakers rely on the advice of their professional staffs and consultants, and will have regard to such authoritative public works as the World Health Organisation's International and European Water Standards.

7.3 Water Quality Control Under Common Law

Water quality cannot be considered in isolation from a consideration of water pollution; and before dealing with statute law, it is again necessary to consider the common law position. It has been noted earlier in this Report that a riparian owner has a right to receive the water flowing past his tenement in its natural state of purity, unimpaired in quality. If anyone pollutes the water the riparian owner is entitled to bring an action against him without the need to prove actual damage, and may obtain an injunction to restrain the continuance of the pollution, unless the person polluting can show that he has obtained a legal right to pollute (Pride of Derby Angling Association Limited v. British Celanese Limited [1953] Ch 149). Pollution is in itself an unlawful act and a nuisance and differs from the diversion or obstruction of a stream, which when done in a lawful manner and on a man's own land is a lawful use of property (Oldaker v. Hunt [1855] 6 de GM and G 376).

The plaintiff in an action for pollution may claim an injunction and damages for nuisance and trespass, and sometimes negligence (Esso Petroleum Co. Limited v. Southport Corporation [1956] AC 218) or he can base the claim on the principles of Rylands v. Fletcher, alleging that the defendent is absolutely responsible for the escape of polluting matters (Smeaton v. Ilford Corporation [1954] Ch 450).

Apart from a riparian owner, the owner of a fishery has a right of action against anyone who discharges injurious or offensive matter into

a river and unlawfully disturbs the exercise or enjoyment of the fishery by polluting the water and killing or driving away fish (Nicholls v. Ely Beet Sugar Factory Limited [1931] 2 Ch 84). Other non-riparian owners who have legal rights in respect of pollution include the owner of an off-shore oyster bed (Owen v. Faversham Corporation [1908] 73 JP33) and the owner of a well (Hodgkinson v. Ennor [1863] 4 B & S 229).

The rule that an action lies for polluting the waters of a natural river applies also to tidal waters (Lyon v. Fishmongers' Co. [1876] 1 App Cas 662) and to ponds and inland lakes.

In an action for pollution it is not necessary to show deterioration of a stream in general, but that something has been added to the water which detracts from the purity and quality at the point where the offending matter enters the stream (Attorney-General v. Birmingham, Tame and Rea District Drainage Board [1908] 2 Ch 551). In order to ascertain whether the quality of the water of a stream has deteriorated, any polluting matter already present must not be taken into account; what has to be decided is whether the matter which is added would appreciably pollute the stream if its waters were otherwise pure (Staffordshire County Council v. Seisden Rural District Council [1907] 5 LGR 347). It is no defence to an action for pollution to show that the river is already polluted from other sources (Attorney-General v. Leeds Corporation [1870] 5 Ch App 583), and where a number of manufacturers cause a nuisance to a lower riparian owner by discharging polluted matter into a stream, he will have a right of action against each of them (Blair Sumner v. Deakin [1887] 57 LD 522).

Not all alleged acts of pollution will give rise to an action; an isolated instance in allowing sewage matter to escape to a river on a particular day may not be sufficient to show that the defendant has been guilty of an affence (Lee Conservancy Board v. Leyton Urban District Council [1906] 70 JP 318), and the fact that river water is discoloured, or has a disagreeable smell or an unpleasant taste, will not necessarily of itself provide sufficient ground to support an action, though it will if the water is thereby rendered unfit (Oldaker v. Hunt [1855] 19 JP 179).

A legal right to pollute water may be acquired by statute, prescription, custom or grant. An Act of Parliament may empower a public body to discharge effluent purified to a stipulated standard of quality, and if that standard is complied with, no action will lie even if pollution occurs, because the statutory provisions supersede all common law rights (Lea Conservancy Board v. Hertford Corporation [1884] 48 JP 628). A private Act, too, may preserve existing rights to pollute (Somerset Drainage Commissioners v. Bridgwater Corporation [1899] 81 LT 729).

A right to pollute a watercourse may also be claimed as an easement by user or otherwise. Under the Prescription Act 1832, a prescriptive right has been established to discharge mine water which has been impregnated with metallic substances to another person's watercourse (Wright v. Williams [1836] 1 M & W 77). Prescription may only be claimed, however, for some act which can have a lawful origin at common law, and a prescriptive right to contaminate water cannot be claimed for anything which would cause a public nuisance or be injurious to public health (Blackburne v. Somers [1879] 5 LR Ir 1), or would contravene a statute: thus, the status

of a natural stream cannot be altered to that of a sewer by the discharge or sewage into it since the coming into operation of the Rivers Pollution Prevention Act 1876 (George Legge and Son Limited v. Wenlock Corporation [1938] AC 204).

Apart from proceedings which may be taken in the criminal courts in respect of the contravention of statutory provisions prohibiting pollution, a private person whose rights have been injuriously affected may be entitled to claim damages and an injunction to prevent the continuation of the injury. An injunction will not normally be granted if the nuisance is not likely to recur and damages are considered by the court to be an adequate remedy, and an injunction has also been refused in a case where the nuisance had largely abated since the action began, and the defendants had taken steps to repair the injury (Lillywhite v. Trimmer [1867] 16 LT 318).

An injunction will usually be issued where the plaintiff's rights have been violated and the injury is, or is likely to become, permanent (Goldsmid v. Tunbridge Well Commissioners [1866] 1 Ch App 349), and a common practice is for the court to grant an injunction to restrain any furtherance of the nuisance and to suspend its operation for a time to enable the defendants to make the necessary arrangements to comply with the order (Pride of Derby Angling Association Limited v. British Celanese Limited [1953] ibid). Damages may be awarded in addition to, or in lieu of, an injunction; the measure of damages will be calculated to represent the loss suffered by the plaintiff as the natural result of the wrong done to him by the acts of the defendant (Marquis of Granby v. Bakewell Urban District Council [1923] 87 JP 105).

Where an act of pollution causes annoyance to the public which amounts to a public nuisance, an aggrieved party may apply for the sanction of the Attorney-General to institute civil proceedings on behalf of the public (Attorney-General v. Basingstoke [1876] 45 LJ Ch 726), or the Attorney-General may himself institute such proceedings. He has complete discretion to decide in what cases it is proper for him to sue on behalf of a relator; and where he acts, it is not necessary to prove actual injury to the public, and an injunction with costs will be granted to restrain the continuation of the nuisance (Attorney-General v. Dorchester Corporation [1903] 69 JP 363).

7.4 Water Quality Control Under Statutory Law

Whilst the common law thus provides effective remedies in favour of an individual whose private rights are interferred with, it is an offence under various Acts of Parliament to pollute specific waters or to discharge or deposit certain matters into waters. In the context of this Report, however, the most important statutory provisions are those contained in the Rivers (Prevention of Pollution) Acts 1951-61, which will be largely repealed when the Control of Pollution Act 1974 (c. 40) is brought fully into operation, but which still constitute the law for the time being and in any event are re-enacted in the Act of 1974.

Section 2(1) of the Rivers (Prevention of Pollution) Act 1951 (c. 64) provides that a person who causes or knowingly permits to enter a stream any poisonous, noxious or polluting matter, or any matter tending to impede the proper flow of the stream so as to lead to a substantial aggravation of pollution, commits an offence for which he is liable on conviction on indictment of a fine not exceeding £200, or on summary conviction not exceeding £100. Offences which are substantially a repetition or continuation of an earlier offence render the offender liable to imprisonment. Where a water authority apprehends that a contravention of the subsection as respects a stream in their area is likely to occur, the authority may apply to the County Court which, if satisfied of the matters complained of in the application, may make an order prohibiting the use complained of or permitting it only on terms designed to remove the grounds of complaint, or such other order as the court thinks fit (section 3).

The expression "stream" is apt to include most rivers and watercourses (whether natural or artificial), but not lakes or ponds which do not discharge to a stream, and not sewers vested in water authorities.

Section 7 of the Act of 1951 enables water authorities to control the making of new discharges of trade and sewage effluents to streams, that is, discharges begun since 1 October 1951, and not being substantially the continuation of a previous discharge; and the use of new or altered outlets for such discharges, that is, outlets constructed or substantially altered after that date.

The section provides that a person shall not without the consent of the authority (which consent must not be unreasonably withheld) bring into use any new or altered outlet for the discharge of trade or sewage effluent to a stream. On an application for consent the authority may grant consent subject to reasonable conditions which, in the case of an outlet, must relate to the point of discharge into the stream or the construction of the outlet, or as to the use of that outlet or any other outlet or effluent from the same land or premises; and in the case of a discharge must relate to the nature and composition, temperature, volume or rate of discharge of effluent from the land or premises from which the discharge is to be made.

Any question as to whether consent has or has not been unreasonably withheld, or as to the unreasonableness of the terms of a consent, may be referred to the Secretary of State for the Environment for his determination within three months from the giving of the consent or within three months from the giving of notice to the applicant by the water authority that consent has been refused.

The conditions of a consent may be varied or revoked by the water authority giving notice to the person making the discharge or using the outlet, but such notice cannot be given within two years from the date on which the consent takes effect (this date must be specified in the terms of each consent), except with the written consent of the person to whom the notice is given.

A similar system of control was established by sections 1-3 of the Rivers (Prevention of Pollution) Act 1961 in respect of discharges of trade or sewage effluent to streams which were commenced before 1 October 1951,

and which a water authority is not empowered to deal with under section 7 of the Act of 1951.

Each water authority is required to maintain a register containing specified details of conditions imposed under the Acts of 1951 and 1961, and such part of the register as relates to an outlet or to land or premises may be inspected at all reasonable hours by any person appearing to the water authority to be interested in the outlet or in the land or premises or by a person authorised by him.

The provisions of the Acts of 1951 and 1961 apply for the most part to non-tidal streams, but under section 6 of the Act of 1951 the provisions of that Act relating to the prohibition of pollution of streams, preventative proceedings and certain other functions may by order of the Secretary of State for the Environment be extended to estuaries and tidal waters. Section 7 of the Act of 1951 controlling post-1951 discharges of effluent to streams is, under the Clean Rivers (Estuaries and Tidal Waters) Act 1960, applied automatically to most tidal estuaries in England and Wales, and also to tidal waters already covered by orders made under section 6 of the Act of 1951; by order of the Secretary of State section 7 may be applied to further tidal waters or parts of the sea. Sections 1 to 3 of the Act of 1961 controlling pre-1951 discharges of effluent to streams are also applied automatically to estuaries and tidal waters already covered by orders made under section 6 of the Act of 1951. So far as concerns discharges into underground strata, control was first sought to be effected by section 72 of the Water Resources Act 1963, which provided that no trade or sewage effluent, or any other kind of poisonous, noxious or polluting matter, may be discharged into underground strata by means of a well, borehole or pipe without the consent of (then) the river authority, which must not be unreasonably withheld, and may be given subject to conditions. There is the usual provision for appeal to the Secretary of State by an aggrieved applicant for consent, and for the holding of a local inquiry or hearing before determination of the appeal; there is also provision for a person who discharges without consent, or fails to comply with a condition of consent, to be guilty of an offence and to be liable to a fine not exceeding £100. The fact that the section requires effluent to be passed through a well, borehole or pipe clearly limits its effect, for discharges through natural fissures are excluded, as also is matter deposited on the surface which may percolate through the subsoil and affect underground water sources.

8. IMPACT ON THE ENVIRONMENT

However, section 72 and its associated sections 73-6, like the bulk of the provisions of the Rivers (Prevention of Pollution) Acts 1951-61, are to be repealed on the coming into force of the appropriate replacement provisions of the Control of Pollution Act 1974. This is a comprehensive measure which seeks to deal not only with water pollution but also with waste disposal, noise, and atmospheric pollution - indeed its remit is the proper control of all environmental pollution - its impact on the environment, after it has been fully in operation for sufficient time, is likely to be most marked. This is not to say or imply that existing

legislation is ineffectual in relation to the environment. There have unquestionably been improvements in the quality of many rivers since the present system of control was developed in recent years, and outlined above, and even though there is considerable scope for further improvement and hence no room for complacency, the existing legislation can fairly be said to have produced beneficial effects on the rivers of this country.

The need to include what might be called an environmental dimension into water legislation was also recognised in section 101 of the Act of 1963, which required river authorities, the Water Resources Board and any Minister having functions under the Act, in formulating or considering any such functions, to take account of any effect which the proposals would have on the natural beauty of the countryside, or on flora, fauna, geological and physiographical features of special interest, and buildings and other objects of architectural or historic interest; the authorities must also take into account any effect which the proposals would have on the preservation of rights of access to areas of mountain, moor, heath, down, cliff or foreshore and other places of natural beauty. This section has been re-enacted in the Water Act 1963, which itself contains provisions for making the widest use of water space for recreational and amenity purposes, and will be dealt with in more detail in Part II of this Report.

9. LAND DRAINAGE AND FISHERIES

These two topics have been placed together at the end of Part I of this Report, because the central authority whose concern they are is the Minister of Agriculture, Fisheries and Food, whereas the Secretary of State for the Environment is the central authority in respect of the other laws and functions so far mentioned.

The main purpose of land drainage may be said to be the improvement of agricultural land, the protection of land from flooding and the conservation of rivers for the benefit of riparian and other users. These objectives are achieved by the periodic cleansing, scouring and improvement of the channels of rivers and other watercourses and the removal of obstructions therefrom; the erection and maintenance of dams and sluices for controlling the flow of water; and the execution of drainage and flood release schemes for lowering the water levels in river channels and constructing new channels. Drainage works of this kind are carried out mainly by drainage boards on the watercourses under their jurisdiction, but works are also done on other watercourses by farmers, private landowners and some local authorities exercising land drainage functions.

The Land Drainage Act 1930 (c. 44) is the principal statute relating to land drainage; it was amended in many respects by the Land Drainage Act 1961 (c. 48), and again by the Water Act 1973. Nevertheless, the Acts of 1930 and 1961 may be said to be the most important of the statutes concerning land drainage. The Act of 1930 established drainage districts, with a drainage board for each district to exercise a general supervision over all matters relating to the drainage of land within that district,

and possessing the powers and performing the duties conferred or imposed by the Act. The drainage districts originally set up by the Act have been considerably changed, first by the River Boards Act 1948, and then by the Water Resources Act 1963 and the Water Act 1973; and the present drainage boards are water authorities and internal drainage boards. The structure, functions and financing of these boards will be considered in more detail in Part II of this Report.

The Acts of 1930 and 1961 do not extend to Scotland or Northern Ireland.

The statute law relating to salmon and freshwater fisheries is contained in the Salmon and Freshwater Fisheries Acts 1923-72 which, except as otherwise expressly provided, extend only to England and Wales. There are, in fact, limited applications, for example to the rivers Esk (section 94(3) of the Salmon and Freshwater Fisheries Act 1923), to the Solway Firth (section 85 ibid) and to the Severn (section 86, ibid); the Acts do not, however, apply to the river Tweed (section 82, ibid), which for part of its course forms the boundary between England and Scotland. Nothing in the Act of 1923 is to prejudice the legal rights of any person to dredge, scour, cleanse or improve a navigable river, canal or other inland navigation; at the same time, in the exercise of the powers conferred by the Land Drainage Acts 1930 and 1961, due regard must be had to fishery interests.

The Minister of Agriculture, Fisheries and Food is the Minister of the Crown responsible for the general superintendence of salmon and freshwater fisheries in England and Wales; local supervision, through the medium of the Salmon and Freshwater Fisheries Acts, now vests in the water authorities. Section 37 of the Act of 1923 established fisheries districts, but the River Boards Act 1948 provided for the replacement of these districts by river board areas, and further provided that for the purpose of functions relating to fisheries, such areas should include tidal waters and those parts of the sea adjoining the coast within which His Majesty's subjects had exclusive right of fishing (at present, as far as the six-mile limit (Fishery Limits Act 1964, section 1(1)). Under the Water Resources Act 1963 river authorities were substituted for river boards, and the Water Act 1973 completed the transformation by transferring fisheries functions to water authorities.

The principle functions of water authorities under the Salmon and Freshwater Fisheries Acts are to grant licences to fish upon payment of licence duties; to make and enforce bye-laws for the protection, preservation and improvement of fisheries; to construct and maintain fish passes in dams; to take legal proceedings in respect of offences against the Act, or for enforcing the provisions of the Acts, or for the protection of fisheries against pollution; to expend moneys in any manner conducive to the maintenance, improvement or development of the fisheries in their area; to purchase or lease any fishery or fishing rights for the artificial propagation or rearing of salmon, trout or freshwater fish; and generally to execute such works, do such acts and incur such expenses as they deem expedient.

PART II
ORGANISATIONAL AND ADMINISTRATIVE ASPECTS

1. INTRODUCTION INTO ORGANISATIONAL PHILOSOPHY AND FRAMEWORK

It is hardly an exaggeration to say that the organisation and administration of water services in England and Wales has been revolutionised with effect from 1 April 1974, the date of operation of the Water Act 1973 - indeed, Professor Daniel Okun, of North Carolina State University, has been reported as describing the reorganisation as "the most massive and most rapid reorganisation of water management in history anywhere in the world". It is clearly fitting, therefore, that an account of the organisational and administrative aspects of the water law system in the United Kingdom should be prefaced by a summary of the reasons for, and the broad objectives of, the reorganisation.

First, it is desirable to place the administration of water services into a constitutional context. The United Kingdom has a unitary constitution: the sovereign power vests in a single legislature, and is not distributed, as it is under the federal constitutions of, for example, the United States of America, Canada and Australia, between the federal legislature and the individual state legislatures. This does not mean, of course, that governmental and Parliamentary functions are conducted entirely from the centre; statutory responsibilities are placed by Parliament upon public corporations, such as those responsible for the nationalised gas and electricity industries; local authorities, such as county councils and district councils; and certain other public agencies. In the field of water services, prior to 1 April 1974 there were in England and Wales 29 river authorities dealing with the management and conservation of water resources, pollution control, land drainage and flood protection and fisheries; 160 statutory water undertakers responsible for supplying water; and some 1,200 sewerage authorities (borough, urban and rural district councils) providing sewerage and sewage disposal services. Even taking into account the considerable reduction in the number of sewerage authorities to be achieved by local government reorganisation (which also came into effect on 1 April 1974) the Government were convinced that the major problems facing the water industry could not be effectively tackled, and the necessary massive investment programme carried through, by means of the structure existing at that time.

Accordingly, proposals were put forward in December 1971 for the reorganisation of water services in England and Wales. These were contained in Department of Environment Circular 92/71 entitled "Reorganisation of Water and Sewage Services: Government Proposals and Arrangements for Consultation", which followed the publication, earlier that year, of a report by the Central Advisory Water Committee on "The Future Management of Water in England and Wales". A copy of the circular is included in the Appendix to this Report.

It was recognised that the policy for water services must be designed to meet the needs of the community as far as practicable, with due regard to both cost and economy; and that although the quantity of water available

in the country is likely to be adequate to meet demands in the foreseeable future, investment on a large scale will be required to provide it in the right places and in the right quality at the right time. It was also emphasised that the various uses of water are interdependent to a varying extent, and that particular uses will sometimes conflict with each other, or one use may limit - or even preclude - another: for example, the use of a river as a source for public water supply might well limit the kind of discharge that could be made to it upstream of the point of abstraction. It was therefore considered essential to ensure that sufficient knowledge, if necessary through the medium of sophisticated research, should be available to the new authorities to enable them to take a broad view of all the functions involved, and to make a rational choice between the conflicting demands upon water resources and river management. In the light of these various needs, the Government's policy was stated in "A Background to Water Reorganisation in England and Wales" to be designed to achieve the major objectives set out on page 3 of this Report.

The Government's conclusion was that these desiderata required a multi-use approach, bringing together all the functions associated with the various aspects of the water cycle under the control of a single authority in any one region, so as to lead to an integrated system of water management within each region.

These conclusions were enshrined in the Water Bill introduced in the House of Commons in the 1972/3 session of Parliament. The Bill received the Royal Assent on 18 July 1973.

2. LEVELS OF ADMINISTRATION

Part I of the Act establishes the administrative structure for the control of water services in England and Wales.

3. PUBLIC AND GOVERNMENTAL ENTITIES

At the national level, it is the duty of the Secretary of State and the Minister of Agriculture, Fisheries and Food to promote jointly a national policy for water in England and Wales and to secure the effective execution of that policy by the responsible bodies at regional and local level.

It should perhaps be explained that the office of Secretary of State is constitutionally one indivisible whole, and it is only relatively recently that certain statutes have referred to individual Secretaries of State by reference to the name of their Department. However, the Act of 1973 refers throughout to the Secretary of State, leaving it to be understood that the functions of the Secretary of State which relate to the English regional water authorities are to be discharged by the Secretary of State for the Environment, and those relating to the Welsh National Water Development Authority by the Secretary of State for Wales; even though the area of the latter authority includes a part of England, and a part of Wales falls within the area of an English authority.

The Secretary of State's duty is to secure the effective execution of so much of the national policy for water as relates to -

(a) the conservation, augmentation, distribution and proper use of water resources, and the provision of water supplies;

(b) sewerage and the treatment and disposal of sewage and other effluents;

(c) the restoration and maintenance of the wholesomeness of rivers and other inland water;

(d) the use of inland water for recreation;

(e) the enhancement and preservation of amenity in connection with inland water; and

(f) the use of inland water for navigation.

The Minister of Agriculture, Fisheries and Food's similar duty relates to land drainage and to fisheries in inland and coastal waters; but the Secretary of State and the Minister will act jointly in the case of a matter which falls partly within the jurisdiction of one and partly within that of the other.

The Secretary of State must collate and publish information from which assessments can be made of the actual and prospective demand for water, and of actual and prospective water resources in England and Wales; he may also, if he considers it appropriate to do so, collaborate with others in collating and publishing information relating to the same matters, whether in England and Wales or elsewhere.

3.1 National Water Council

An important provision of the Act relates to the establishment of the National Water Council, which consists of a chairman appointed by the Secretary of State, the chairmen of the water authorities and not more than ten other members of whom not more than eight are to be appointed by the Secretary of State and not more than two by the Minister of Agriculture Fisheries and Food. The duties of the Council are set out in section 4(5) of the Act, as follows:

"(a) to consider, and advise any Minister on, any matter relating to the national policy for water, and to consider and advise any Minister and the water authorities on any other matter of common interest to those authorities, including in either case any such matter as may be referred to the Council by any Minister;

(b) to promote and assist the efficient performance by water authorities to their functions, and in particular their functions relating to research and their functions with respect to the preparation, review and provision of plans under section 24 below;

(c) to consider and advise any Minister on any matter on which the Council are consulted by him in pursuance of a requirement imposed by this Act;

(d) with a view to the establishment throughout the United Kingdom of a scheme for the testing and approval of water fittings for ascertaining whether they comply with regulations and byelaws for preventing the waste, misuse or contamination of water, to consult with statutory water companies in England and Wales, regional water boards and water development boards in Scotland, the Ministry of Development in Northern Ireland, the Greater London Council and such associations of manufacturers, professional associations, local authority associations, trades unions and other organisations as the Council think appropriate;

(e) to prepare, after consultation with statutory water companies and with such associations of employees and such educational and other authorities or bodies (including authorities and bodies in Scotland and Northern Ireland) as the Secretary of State may direct, a scheme for training and education in connection with the services provided in England and Wales by water authorities and the corresponding services provided in Scotland and Northern Ireland and, in so far as appears to the Council after the like consultations to be appropriate, the provision by the Council of facilities or assistance by the Council in the provision of facilities by others."

After preparing a scheme under paragraph (e) above, the Council are required to submit it to the Secretary of State, who may approve it, with or without modifications; the Council must then implement the scheme as so approved. They may also furnish technical assistance in connection with education and training for the benefit of any country or territory outside the United Kingdom.

The Secretary of State or the Minister of Agriculture, Fisheries and Food may, after consulting the Council, give to the Council directions of a general character regarding the exercise and performance by the Council of their functions in relation to matters which appear to affect the execution of the national policy for water or the national interest; or directing them to discontinue, or not to extend, any activity.

Similar directions may be given by the Secretary of State or the Minister of Agriculture, Fisheries and Food to a particular water authority or, after first consulting the Council, to water authorities generally.

3.2 Regional Water Authorities

The Act provides for the establishment, by an order made by the Secretary of State and the Minister of Agriculture, Fisheries and Food ("the Ministers"), of nine regional water authorities for England and the Welsh National Water Development Authority (referred to as "the Welsh authority"). Each authority came into existence on a day appointed by

the order, and typical examples of such orders form part of the Appendix to this Report. It will be seen that, initially as any rate, the area of a water authority will, or might, be different for the purposes of different functions: for example, the area of the Northumbrian Water Authority for the purposes of water conservation and the management of water resources coincides with that of the former Northumbrian River Authority, which previously exercised those functions; but the authority's area for water supply purposes is different, and is described in the constitution order by reference to the limits of supply of the former statutory water undertakers. This is because the area of the former river authority was based on natural watersheds, whereas the former limits of supply of statutory water undertakers did not necessarily conform to the same boundaries, and it was felt desirable, in the interests of securing as smooth a transition as possible, to retain broundaries which coincided with the previous ones. A map showing the ten water authorities forms part of the Appendix to this Report.

Each authority consists of a chairman appointed by the Secretary of State, who also appoints such a number of experienced persons as is specified in the constitution order; between two and four members appointed by the Minister of Agriculture, Fisheries and Food, and a number appointed by local authorities (county and district councils), based in most cases on the population resident within the area of the particular water authority. The total number of members appointed by the Ministers must be less than the number appointed by the local authorities. Because part of the Welsh authority's area lies in England, and part of the English Severn-Trent authority's area lies within Wales, one of the members of the latter authority appointed by the Secretary of State must be a member of the Welsh authority.

Part II of the Act confers on water authorities the functions by means of which they will provide an integrated control system for water - within the ambit of the national policy laid down by the Ministers. It should perhaps be pointed out here that as the Act was designed primarily for the purpose of reorganising water services, most of the functions exercised before 1 April 1974 by river authorities, local authorities and statutory water undertakers are simply transferred to the water authorities (though some will continue to be exercised on behalf of water authorities by other bodies); new functions are relatively few, though very important.

There is a specific obligation laid upon water authorities, like that laid upon the former river authorities by the repealed section 4 of the Water Resources Act 1963, to take all action considered necessary or expedient for the purpose of conserving, redistributing or otherwise augmenting water resources in their area, of securing the proper use of such resources or of transferring them to the area of another water authority.

In the water supply field, the water authorities are placed under a duty to supply water within their areas, and are given all the functions previously exercised by statutory water undertakers under other enactments. Local authorities lose the functions they formerly exercised under Part IV of the Public Health Act 1936, which Part is almost entirely repealed; however, local authorities remain responsible for taking whatever

steps are necessary for ascertaining sufficiency and wholesomeness of water supplies in their area, and notifying the water authority of any unwholesomeness or insufficiency. Where the limits of supply of a statutory water company is wholly or partly within the area of a water authority, the authority is to discharge its water supply duties through the company, who, however, are no longer under a duty to supply water, except for certain public services. The company must enter into binding arrangements with the water authority whereby the company undertake to act on behalf of the authority within its own statutory limits of supply. The duties of statutory water authorities under such arrangements may be enforced by the default procedures set out in the Act (being a substitution of procedures formerly contained in the Water Act 1945) whenever complaint is made to the water authority, or the authority are of opinion that an investigation should be made as to whether the company have failed to perform their duties. In those parts of an authority's area where the authority are not supplying through a company, they are themselves subject to these default procedures if complaint is made to the Secretary of State, or he is of opinion that an investigation should be made.

Statutory water companies will be considered in more detail later in the Report in relation to private and quasi-public use and management entities.

The functions formerly exercised by local authorities under the Public Health Acts in respect of sewerage and sewage disposal are, by section 14 of the Act of 1973, exercisable by water authorities who are placed under a duty to provide such public sewers as are necessary for effectually draining their area, and to make provision, by means of sewage disposal works or otherwise, for effectually dealing with the contents of their sewers. The Act provides no procedure for enforcing this duty, so that where appropriate, an action for mandamus would lie at the suit of a person having a sufficient interest. In the case of the "inherited" duties under the Public Health Acts, however, the remedy of a person who alleged default on the part of an authority would be by way of complaint to the Secretary of State under section 322 of the Public Health Act 1936, requesting him to inquire into the complaint and, if he considers it well-founded, to order the authority to carry out their obligations. Section 16 of the Act of 1973 introduces an important new right for owners of premises, on giving certain financial undertakings, to require the water authority to provide a public sewer for domestic purposes. Where such a requisition is made, the authority must provide it within six months or such longer period as may be agreed or determined by a referee.

The Act provides for each water authority to enter into arrangements with the district councils in their area for the discharge by the latter of the authority's sewerage functions under Part II of the Public Health Act 1936; such arrangements do not extend, however, to sewage disposal works. The arrangements (a copy of the model is included in the Appendix hereto) require the district council to prepare an annual statement of the sewerage works which they consider necessary for effectually draining the district; whereupon the water authority provide the council with a statement of policies, priorities and proposals for the maintenance and development of sewerage systems in the area of the authority. The council then prepare a capital programme of the works required during the ensuing

five years, and a programme of expenditure chargeable to revenue account which the council expects to incur over a similar period on sewerage systems in their district. After the capital programme has been approved by the water authority, the council are under a duty to carry it out.

Provision for these arrangements is an interesting venture which was introduced into the Act because it was considered that in view of the close relationship between the pattern of local development and sewerage, some way should be found to continuing the involvement by district councils in the provision of sewerage facilities. Only after the arrangements have been in force for some time will it be possible to assess whether or not there has been the close and understanding co-operation between the water authorities and the district councils which will be necessary if the arrangements are to work properly.

Water authorities also become responsible under the Act of 1973 for licensing of discharges under the Rivers (Prevention of Pollution) Acts 1951-1961, the salient provisions of which were described in Part I of this Report, and for the other functions of the former river authorities under those Acts; while under section 17 of the Act of 1973, regulations have been made under which the bringing into use of a new or altered outlet by a water authority will require the consent of the Secretary of State.

It is the duty of every water authority to maintain, improve and develop the various kinds of fishery for which they exercise functions under the Salmon and Freshwater Fisheries Acts 1923-1972; and to establish regional and local advisory committees of persons interested in any such fisheries, and to consult them as to the manner in which the authority are to discharge their duties of maintenance, improvement and development. In this way, account will as far as possible be taken of local knowledge and the very varied local fishery circumstances found in different parts of the country.

The authorities will also exercise general supervision over all matters relating to land drainage in their areas, but must arrange for the discharge by regional land drainage committees of all land drainage functions except the making of drainage charges, the levying of precepts and the borrowing of money. These committees are required to submit to the authority a scheme for the establishment of local land drainage committees; and the authority is empowered to give to the regional land drainage committees directions as to the exercise of land drainage functions (except those exercisable by internal drainage boards under certain sections of the Land Drainage Acts of 1930 and 1961) so far as they affect the authority's management of water for other purposes.

For the time being, land drainage activities will continue to be financed by precepts on local authorities and internal drainage boards and, where appropriate, by charges on owners and occupiers of agricultural land, together with government grants. A water authority may, however, after 31 March 1978, on the recommendation of their regional land drainage committee, apply to the Minister of Agriculture, Fisheries and Food for what the Act calls a "charges option order", the effect of which would be that

the financing of land drainage services would be brought into line with that appertaining to the other functions of the authority: that is to say, they would be based upon charges on users of the water services, in accordance with Part III of the Act, which will be considered in a later section of this Report.

Part II of the Act is not concerned only with the transfer of functions from the former authorities to water authorities; it contains important new provisions relating to recreation, the use of water space and periodical reviews, plans and programmes.

Even before re-organisation, considerable progress had already been made in developing the use of water space. In a survey undertaken in 1970, about one-half of the statutory water undertakers had extended the facilities for the recreational and amenity use of their reservoirs; the use of rivers and canals for cruising had also been extensively developed by navigation authorities. Arrangements of this kind enabled such bodies as the Countryside Commission, the Sports Council and the Tourist Boards to encourage recreational and amenity use of water space.

Under the Act of 1973, water authorities have a duty to make the best use of the waters under their control for recreation and amenity in its widest sense: for this purpose, they will need to undertake a comprehensive review of the water space for which they are responsible, and to prepare and carry out plans for the development of those waters for the purposes of sport, recreation, conservation and amenity. The aim is to achieve a balanced provision of facilities, taking account of all the interests involved and the character of the waters concerned. In developing their plans, water authorities are required - as they are in respect to their other functions - to have regard to the structure plans of the appropriate planning authorities; and the provision of facilities will, of course, be subject to the usual planning procedures. Moreover, the authorities will be under an obligation to have regard to the desirability of conserving the natural beauty and amenity of the countryside in exercise of their functions - this means that they will not only give particular attention to the location of new reservoirs, but also accept a responsibility for sensitive landscape and design treatment in respect of work which they carry out.

The Act also provides for the setting up, under the aegis of the National Water Council, of a Water Space Amenity Commission, to advise the Secretary of State, the Council and the water authorities on the discharge of their respective functions relating to the recreational and amenity use of water in England. The Commission consists of a chairman appointed by the Secretary of State from among members of the Council, the chairmen of the water authorities and up to ten other members appointed by the Secretary of State; it will provide a forum in which the water authorities will be able to discuss common problems and concert common policies in relation to recreation and amenity.

So far as periodical reviews, plans and programmes are concerned, each water authority must carry out the surveys and prepare the plans for which section 24 makes provision, and which have been referred to in Part I of this Report; and in the light of such surveys and plans, they

are required to prepare rolling programmes. In carrying out their duties under the section, the authorities must consult the local authorities whose areas are wholly or partly included in their area, and must have regard to any structure plans, local plans or development plans prepared for any part of their area under the Town and Country Planning Act 1971 (c. 78).

Water authorities are further required by the section to make arrangements for the carrying out of research and related activities, and the Secretary of State or the Minister may give them directions with respect to the making of such arrangements. A soundly based research and development programme is, of course, an essential part of a comprehensive water policy. Prior to re-organisation, responsibility for research and development was somewhat fragmented, the Department of the Environment being concerned with research into all aspects of water services and management, except land drainage and fisheries, which was the responsibility of the Ministry of Agriculture, Fisheries and Food; the Water Pollution Research Laboratory undertook studies both of treatment processes and of the effect of pollutants in water; the Hydraulics Research Station was dealing with such civil engineering problems as flood protection, and the silting and scouring of rivers, estuaries and harbours; the Building Research Establishment investigated the structural properties of materials, design of dams, earthworks and slopes and other subjects relevant to water services; the Institute of Hydrology was responsible for a national programme of basic hydrological research; and the Water Resources Board (which was abolished by the Act) carried out an extensive research programme, broadly divided between new techniques (for example, controlled ground water abstraction, artificial recharge of aquifers and the application of desalination techniques), operational research techniques and data acquisition and processing. Moreover, many of the activities mentioned are relevant to Scotland and Northern Ireland, for there is considerable common interest throughout the United Kingdom in relation to research and development: in particular, the Scottish Development Department have their own research programme and operate in much the same way as the Department of the Environment; but their work is carried out largely through local authorities and river purification boards.

3.3 Water Research Center

Following re-organisation, a substantial part of the work that needs to be done for the water services industry has been grouped into the Water Research Centre which now covers all the functions of the water authorities, who are represented on it. The Centre also includes representatives of the industry in Scotland and Northern Ireland, equipment manufacturers and government. Its funds are provided by the organisations represented upon it, who also place contracts with it.

3.4 Financial Administration of Water Authorities

Part III of the Act is founded on the principle that water authorities are to be financially self-supporting. The method of financing water

services (other than land drainage) would in any event have required review, because the water authorities were in effect established by amalgamating existing authorities with differing methods of finance. These included direct charges for water abstraction, charges by quantity for water supply to industry and agriculture; water rates for domestic water supply; general rates for sewerage and sewage disposal services; and Exchequer grants for certain purposes.

If the objectives of re-organisation are to be met, the water authorities will have to employ in the most efficient manner both the resources they have inherited and those which they will invest in the expansion of water services. In the financial year 1974/5, water authorities were expected to incur revenue expenditure of some £650m. and capital expenditure of about £400m. and for subsequent years the figures are likely to be appreciably higher. Expenditure of this magnitude clearly necessitates techniques of investment appraisal which ensure that demand is met in the most efficient way, with due regard to the timing of investment. Sections 29 to 31 of the Act are designed with these ends in view, and are also intended to secure that revenue is sufficient to balance recurring expenditure over a period of years. The Secretary of State may, with the approval of the Treasury, and after consultation with the National Water Council, direct that an authority shall so discharge their functions as to achieve a specified rate of return on their net assets. Even before the water authorities had formally taken over their responsibilities, the Department of the Environment had set up a Steering Group, consisting of representatives of the water industry and of Government, with terms of reference "to consider and advise the Secretary of State on the economic and financial policies that should be adopted by the Regional Water Authorities; and in particular to consider what methods of investment appraisal and pricing policies should be adopted and how these should relate to the associated financial objectives". The Steering Group made three Reports to the Secretary of State; it has now been disbanded, the purposes for which it was set up having been substantially achieved. In so far, however, as the matters within its terms of reference need continuous review, it will be the responsibility of the National Water Council to provide for this.

Section 32 of the Act empowers water authorities to install meters for measuring the volume of water supplied to any premises, or the volume of effluent discharged therefrom. At present, the only charges which may be made in respect of the discharge of effluent from premises are those payable under the Public Health (Drainage of Trade Premises) Act 1937, as amended by the Public Health Act 1961. Under section 59(1)(g) of the Act of 1961, a water authority may attach to a consent a condition with respect to "the provision and maintenance of such meters as may be required to measure the volume and rate of discharge of any trade effluent being discharged from the trade premises into the sewer, and for the testing of such meters". The power under section 32 is, however, more general in its application.

The foregoing summary of the financial provisions of the Act completes this review of its salient provisions - a review which seeks to demonstrate the radical effect of the Act on the organisational and administrative aspects of the water law system in England and Wales. Before proceeding

to the final section of this Report, however, it is necessary to refer briefly to the administration of water services in Scotland and Northern Ireland.

3.5 Water Administration in Scotland and Northern Ireland

Until 15 May 1975, when the re-organisation of local government in Scotland, provided for in the Local Government (Scotland) Act 1973, came into operation, public water supply was the responsibility of thirteen regional water boards which covered the whole of Scotland, including the islands. These water boards were established under the Water (Scotland) Act 1967, to replace more than 200 separate local authority water undertakers.

The regional water boards were not local authorities, but all their members were drawn from the constituent town councils and county councils and they obtained their finance (other than by way of, for example, income from metered supplies and from Government grants) by requisitioning on the local authorities.

The Act of 1967 also established the Central Scotland Water Development Board, the function of which was, broadly, to supply water in bulk to the regional water boards and to develop major new sources of supply (the two schemes which the Water Development Board have so far undertaken are the Loch Lomond scheme and the Loch Turret scheme). The constituent water boards represented on the Water Development Board were the Ayrshire and Bute Board, the East of Scotland Board, the Fife and Kinross Board, The Lanarkshire Board, the Lower Clyde Board, the Mid-Scotland Board and the South East of Scotland Board.

The regional water boards were not responsible for sewage treatment, sewage disposal, or river purification. Sewage treatment and disposal were the responsibility of the local authorities (town councils and county councils); and river purification was the responsibility of nine river purification boards established under the Rivers (Prevention of Pollution) (Scotland) Act 1951 and a number of local authorities (mostly in the Highlands and the north east of Scotland) who had river purification functions.

On 15 May 1975, the present town councils and county councils were replaced by nine regional councils, three islands councils and fifty or so district councils. Regional water boards established by the Water (Scotland) Act 1967 were abolished, and water supply became the function of regional councils and islands councils as water authorities.

Generally, the limits of supply of each regional council coincide with the area of the region for the purposes of the other functions of the local authority; in two cases, however, adjustments are made for practical reasons so that the limits of supply of the regional council as water authority extend into the area of another regional council.

The regional council and islands councils are also responsible for sewage disposal and sewage treatment. River purification will be carried out by a number of new river purification boards (the present intention is that there should be seven) covering the whole of Scotland, except in the areas of the three islands councils, where those councils will be the river purification authorities.

The Central Scotland Water Development Board remains in being, and will continue to carry out its former functions of supplying water in bulk and developing major new sources. The constituents of the Board are the regional councils of the Tayside, Fife, Lothian, Borders, Central and Strathclyde Regions.

The position in Northern Ireland is that with effect from 1 October 1973, the responsibility for the provision of water supplies and sewerage services was transferred from the borough and district councils to the Ministry of Development. The country is divided into four divisions - Northern, South, Western and Eastern - and the services are administered through a chain of local offices. The Minister of Development has similar duties to the Secretary of State for the Environment in respect of the conservation, augmentation, distribution and proper use of water resources, provision of water supplies, sewerage and sewage disposal and treatment of effluents.

The Act also established the Northern Ireland Water Council which is an advisory body similar to the National Water Council. The Chairman is appointed by the Minister of Development.

4. PRIVATE AND QUASI-PRIVATE WATER ENTITIES

So far as private and quasi-public use and management entities are concerned, only statutory water companies fall into this category. As has been indicated earlier in this Report, section 12 of the Act of 1973 makes provision for the supply of water by such companies on behalf of water authorities.

Statutory water companies are among that class of companies which were formed, mainly during the 19th century as the population became denser and towns expanded, for the purpose of constructing and carrying out works of public benefit and utility which necessitated obtaining Parliamentary powers. Such companies were, accordingly, incorporated by special Act of Parliament, and by the year 1845, the provisions usually inserted in such Acts as to the raising of share and loan capital, the rights of the shareholders and mortgagees, and as to the constitution and internal management of the company, had become almost common form; but it was necessary to repeat them in every special Act by which a company was incorporated. Moreover, the number of companies so incorporated was increasing. Accordingly, in 1845 the Companies Clauses Consolidation Act was passed in order to comprise in one general Act the provisions usually introduced into special Acts incorporating a company, and the Companies Clauses Act 1863 was passed with the like object. Unlike the Act of 1845, which was expressed to apply to all companies incorporated by special Act,

the various parts of the Act of 1863 only apply when incorporated by the special Act (except Part III, which applies to every company having power to raise money on mortgage or bond by virtue of an Act of Parliament but not having power to create and issue debenture stock). In 1869 and 1888 short Acts were passed, amending respectively the Acts of 1863 and 1845; and the Act of 1888 was itself slightly amended by an Act of 1889 (subsequently repealed by the Statute Law Revision Act 1908). These Acts now regulate the constitution and management of companies incorporated by special Act and, by virtue of the Short Titles Act 1896, are known as the Companies Clauses Acts 1845 to 1889. It may be added that the statutory company is much more inelastic than the company formed or registered under the Companies Act 1948, or preceding similar Acts. The powers of a registered company are governed by the Memorandum of Association and can be enlarged in various ways. An increase or reduction of capital, or an extension of the scope of its operation, can usually be affected (though in certain cases the sanction of the Court is necessary) by resolution in accordance with its Articles of Association. The statutory company, however, has no such facilities; its capital, both share and borrowed, is fixed by its special Acts, and its objects cannot be extended without a further special Act - though in relation to such companies, included in the expression "special Acts" are Ministerial orders under such provisions as section 23(1)(c) of the Water Act 1945.

The relationship between the water authorities and the companies is governed by the arrangements entered into under section 12 of the Act of 1973, and a copy of the model arrangements forms part of the Appendix to this Report. The arrangements may be varied by agreement or, in default of agreement, by direction of the Secretary of State; the arrangements as varied are then binding on the parties, although the variation must not have the effect of obliging the company to fix their charges at a level which will endanger their ability to provide a reasonable return on their paid-up capital, having regard to their probable future expenditure and to the need to provide for any contributions which they may lawfully carry to any reserve fund or contingency fund, to make good depreciation (in so far as provision therefor is not made by any such fund) and to meet all other costs, charges and expenses properly chargeable to revenue. It is the duty of a water authority on whose behalf water is being supplied by a statutory water company to take all reasonable steps for making water available to the company to enable them to meet the foreseeable demands of consumers within their limits of supply; and so much of the company's enactments as impose a duty on the company to supply water ceased to have effect on 1 April 1974, except in relation to supply for certain public purposes.

Thus statutory water companies constitute the only category of former statutory water undertakers who survive reorganisation (apart from one or two small joint water boards and joint water committees constituted under section 9 of the Water Act 1945 and on which a statutory water company is represented). They were retained in existence primarily because the Government of the day considered that reorganisation of the water industry did not justify the abolition of private companies who had fulfilled their obligations to the public efficiently, and who in any event were limited by statute in relation to the payment of dividend and interest on share

and loan capital respectively. This has resulted in the curiosity that the companies continue to exercise the functions for which their local Acts and the Water Acts provide (except the duty to supply water), but are now subject to the further discipline of the arrangements under section 12 of the act of 1973. It will be interesting to see, as time goes on, whether this "hybrid" system produces constraints to rational water allocation and management; so far, it does not appear that any practical difficulties have arisen.

5. CONCLUSIONS

In this Report, an attempt has been made to demonstrate the salient features of the substantive law relating to water, and the organisational and administrative structure which forms a back-cloth to the exercise of modern management techniques. From common law origins which, even today, have not been entirely subsumed, water law has been constantly fashioned and adjusted over the last century or so, to meet the requirements of a rapidly expanding population and the ever-increasing demand for water for a variety of purposes. The re-organisation of water services last year, designed as it was to accommodate projections to the end of the century, is the latest example of the determination of the Government, and all those concerned with the water industry, to keep ahead of the problems for ever looming on the horizon; even so, it is recognised that further amendments of the substantive law, and streamlining of the administrative arrangements, will undoubtedly be required from time to time.

In this way, the water law system of the United Kingdom can be expected to remain an appropriate and efficient instrument for securing the maximum benefit from the most recent technological processes, and thus play a major part in meeting the material needs of the community, while at the same time making a significant contribution to the proper protection of the environment.

APPENDIX

Model Form 1

WATER RESOURCES ACT 1963

APPLICATION FOR A LICENCE (OTHER THAN A LICENCE OF RIGHT) TO ABSTRACT WATER FROM AN INLAND WATER

APPLICANT

1. Name of applicant (in BLOCK LETTERS) .....

2. Address of applicant to which communications about this application are to be sent .....
.....

3. Name and address of professional adviser or agent (if any) to whom communications about this application are to be sent .....
.....
.....

INLAND WATER TO WHICH THIS APPLICATION RELATES

4. Give the name of, or sufficient description to identify, the inland water (*see note* (*a*)) from which you propose the licence should authorise the abstraction (*see note* (*b*)) of water .....
.....

POINTS OF ABSTRACTION TO WHICH THIS APPLICATION RELATES AND CLAIM TO BE ENTITLED TO MAKE THE APPLICATION (*see note* (*c*))

5. In Table I below—

(*a*) in column (1), enter the reference number, as shown on the map (*see note* (*d*)) accompanying this application, of each of the points at which you propose the licence should authorise abstraction from the inland water referred to in paragraph 4 above;

(*b*) to show how you claim to be entitled (*see note* (*e*)) to make this application for a licence to abstract water at each point referred to in column (1)—

(i) in column (2), opposite the reference number of that point, enter—

" occupier ",	if you are the occupier of land contiguous (*see note* (*f*)) to the inland water at that point; or
" potential occupier ",	if you have entered into negotiations to acquire an interest which will entitle you to occupy such land; or
" right of access ",	if you have a right of access to such land; or
" potential right of access ",	if you expect to have a right of access to such land; and

(ii) in column (3), specify the land (by reference to the map accompanying this application) (*see note* (*g*)); and

(iii) in column (4), opposite each entry in column (3) which is " potential occupier " or " potential right of access ", specify the date upon which you expect to acquire the interest in, or the right of access to, the land.

TABLE I

Map ref. no. of point (1)	Occupation or access (2)	Contiguous land (3)	Expected date of acquisition of interest or right of access (4)

PROPOSED MEANS OF ABSTRACTION AND METHODS OF MEASURING

6. In Table II below—

(*a*) in column (1), enter the map reference number of each point of abstraction referred to in Table I above;

(*b*) in column (2), specify the works (if any), and in columns (3) and (4) specify the type and capacity of the machinery or apparatus, by means of which you propose the licence should authorise abstraction at each point referred to in column (1);

(*c*) in column (5), specify the way in which you propose the licence should require the quantities of water abstracted at each point referred to in column (1) to be measured or assessed.

TABLE II

Map ref. no. of point (1)	Means of abstraction			Method of measuring or assessing quantities abstracted (5)
	Work (2)	Machinery or apparatus		
		Type (3)	Capacity (in thousand gallons per hour) (4)	

WATER REQUIRED AND LAND ON WHICH AND PURPOSES FOR WHICH IT IS TO BE USED

Note:—If so desired, map reference numbers may be bracketed together in column (1) *of Table III below for the purpose of specifying in column* (2) *an aggregate quantity in respect of a group of points of abstraction* (*see note* (*h*)).

7. In Table III below—

(*a*) in column (1), enter the map reference number of each point of abstraction referred to in Table I above;

(*b*) in the remaining columns, specify under the appropriate headings the quantities of water you propose the licence should authorise to be abstracted at each point referred to in column (1) in the various

28(1)(*b*) of the above-mentioned Act (*see note* (*f*)) .....
.....
.....
.....

I also enclose the map required by the above-mentioned Regulations of 1965.

Signed.....

*[Authorised on behalf of.....]

Date.....

* *Delete where inappropriate.*

It is an offence to make a false statement in applying for a licence. (See section 115(1) of the Act.)

NOTES

(*a*) For the meaning of "inland water", see section 135(1) of the Act. (Section 2 is also relevant.)

(*b*) For the meaning of "impounding works", see section 36(6) of the Act.

(*c*) The Water Resources (Licences) Regulations 1965 require the application to be accompanied by an ordnance map showing certain particulars.

(*d*) All relevant statistics should be given, including gaugings and rainfall figures.

(*e*) In the case of an application for a combined licence to obstruct or impede the flow of an inland water and to abstract, the FORMAL APPLICATION should be adapted as necessary, and should include such additional statements as to documents or evidence enclosed or to be produced as are appropriate to an application for a separate licence to abstract and relevant to the case.

(*f*) Certain of the authorities mentioned in section 28(1)(*b*) of the Act are defined in section 135(1).

RELEVANT STATUTORY PROVISION

4. Identify (*see note* (*a*)) the statutory provision (*see note* (*b*)) in force on 1st April 1965 by virtue of which you claim to be entitled to abstract (*see note* (*c*)) water from the source of supply (*see note* (*d*)) to which this application relates .....
.....

SOURCE OF SUPPLY TO WHICH APPLICATION RELATES

5. (*a*) If you claim to be entitled to a licence of right to abstract water from an inland water (*see note* (*e*)), give the name of, or sufficient description to identify, that water .....
.....

(*b*) If you claim to be entitled to a licence of right to abstract water from underground strata (*see note* (*f*)), in Table I below—

(i) in column (1), enter the reference number, as shown on the map (*see note* (*g*)) accompanying this application, of each of the points at which you propose the licence should authorise the abstraction of water;

(ii) in column (2), give the description (e.g. Chalk, Lower Greensand, etc.), or such particulars as you are able to obtain for the purposes of this application, of the underground strata from which you propose the licence should authorise abstraction at each point referred to in column (1).

TABLE I

Map ref. no. of point (1)	Underground strata (2)

periods, and the land (*see note* (*i*)) on which, and the purposes (*see note* (*j*)) for which, you propose the licence should authorise water abstracted at each point to be used, showing which quantity relates to which period, purpose and land, etc. (*see note* (*k*)).

TABLE III

Map ref. no. of point	Maximum quantity (in thousand gallons)			Period (e.g. Nov.–Feb., any period of .. consecutive days in March–May, etc.)	Purpose	Land
	per year or other period specified in col. 5	per day	per hour			
(1)	(2)	(3)	(4)	(5)	(6)	(7)

SPRAY IRRIGATION

8. If the purposes specified in column (6) of Table III above consist of or include spray irrigation—

(*a*) in Table IV below—

(i) in column (1), specify each crop you propose to irrigate;

(ii) if you propose to irrigate any crop during a particular period or periods of the year, specify the period(s) in column (2);

(iii) in column (3), specify the acreage of each crop;

(iv) in column (4), specify the maximum number of inches of water you propose to apply to an acre of that crop annually or, if any period is specified in column (2), in that period; and

(*b*) specify the maximum number of acres you propose to irrigate daily .....

TABLE IV

Crop	Period (e.g. April–June, any period of .. consecutive days in March–May, etc.)	Acreage	Maximum no. of inches to be applied per acre per year or period
(1)	(2)	(3)	(4)

DISCHARGE OF WATER AFTER USE (*see note* (*l*))

9. In Table V below—

(*a*) if you propose to discharge water after it has been used for any pur-

pose specified in column (6) of Table III above, specify that purpose in column (1);

(*b*) in column (2), enter the approximate proportion of any quantity of water used for that purpose that is likely to be discharged after use;

(*c*) in column (3), opposite each entry in column (2), specify the point of discharge, e.g., where the water will enter an inland water (giving the name of, or sufficient description to identify, the inland water), where it will enter a public sewer (giving the name of the sewerage authority), where a soakaway will discharge, etc.

TABLE V

Purpose (1)	Approximate proportion (2)	Point of discharge (3)

POINTS OF ABSTRACTION TO BE USED IN CONJUNCTION

Note:—You need not make any entries in Table VI below unless you wish to use any of the points of abstraction referred to in Table I above in conjunction with points of abstraction not referred to in that Table.

10. In Table VI below—

(*a*) in column (1), describe (if practicable, by reference either to the map accompanying this application or to the relevant licence under the Act or to the relevant application for a licence) the location of each point of abstraction which you wish to use in conjunction with the points of abstraction referred to in Table I above (whether simultaneously or as an alternative or otherwise);

(*b*) in column (2), give the name of, or sufficient description to identify, the inland water or underground strata (*see note* (*m*)) (e.g. Chalk, Lower Greensand, etc.), from which you are abstracting or propose to abstract water at that point;

(*c*) in column (3), specify the serial number of the licence under the Act (if any) which authorises the abstraction of water at that point or the date of your application (if any) for such a licence.

TABLE VI

Point of abstraction (1)	Inland water or underground strata (2)	Serial no. of licence or date of application (3)

OTHER MATTERS

11. Have you asked any water undertakers for a supply of water for any of the purposes specified in column (6) of Table III above (*see note (n)*)?..... If so, state when, which purposes, and with what result.....
.....
.....
.....

12. Is the licence required only for a limited period? ..... If so, for how long? .....

13. Give details of any other matters which you wish the River Authority to take into account in considering this application (e.g. the facilities which will be available on your land for storing water abstracted under the licence, how the maximum use is made of existing supplies, the extent to which water abstracted under the licence will be re-used, matters to which you have had regard in formulating your proposals in this application, the reasons for your proposals as to quantities, etc.) .....
.....
.....
.....
.....
.....
.....

FORMAL APPLICATION

I hereby apply to the ..... River Authority for a licence under the Water Resources Act 1963 to abstract water in accordance with the proposals indicated above, and I declare that to the best of my knowledge the statements made above are true.

I enclose with this application copies of the newspaper(s) dated .... and ..... in which the notice in the form prescribed by the Water Resources (Licences) Regulations 1965 was published. I declare that the notice was also published in the London Gazette dated ..... and that a copy of the notice was served on ..... on the following authorities in accordance with section 28(1)(*b*) of the above-mentioned Act (*see notes (c) and (o)*):— .....
.....
.....

I also enclose the map required by the above-mentioned Regulations of 1965.

I *[also enclose] [can produce] the following evidence for the purpose of satisfying the River Authority that I am entitled to apply for a licence to abstract at the points of abstraction to which this application relates:—
.....
.....
.....
.....
.....

Signed.....

*[Authorised on behalf of .....]

Date.....

* *Delete where inappropriate.*

It is an offence to make a false statement in applying for a licence. (See section 115(1) of the Act.)

NOTES

(*a*) For the meaning of "inland water", see section 135(1) of the Act. (Section 2 is also relevant.)

(*b*) For the meaning of "abstraction", see section 135(1) of the Act.

(*c*) The British Waterways Board applying for a licence in respect of abstraction from an inland water to which section 131 of the Act applies need not make any entries in column (2), (3) and (4) of Table I, or make the declaration in the FORMAL APPLICATION about service.

(*d*) The Water Resources (Licences) Regulations 1965 require the application to be accompanied by an ordnance map showing certain particulars.

(*e*) See section 27 of the Act and the above-mentioned Regulations of 1965.

(*f*) For the meaning of "contiguous", see section 135(7) of the Act.

(*g*) E.g. "the land coloured blue on the map".

(*h*) If so desired, entries in columns (3) and (4) of Table III may be omitted. Attention is, however, drawn to sections 29(8)(*a*) and 30 of the Act under which it will be open to the River Authority to specify a quantity in respect of each point of abstraction and to lay down maximum quantities for any specified period (e.g. weekly, daily, hourly) if they see fit to do so.

(*i*) E.g. "the land hatched black on the map".

(*j*) Purposes should be described as follows:—

water undertaking
spray irrigation
cooling purposes
use in a process of manufacture (other than for cooling purposes)
use as means of conveying any material as a slurry or otherwise
other uses (briefly described), e.g. agriculture or horticulture, other than spray irrigation.

(*k*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking should enter "water undertaking" in column (6) but need not make any entries in column (7) of Table III.

(*l*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking need not make any entries in Table V.

(*m*) For the meaning of "underground strata", see section 135(1) of the Act.

(*n*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking need not answer this question.

(*o*) Certain of the authorities mentioned in section 28(1)(*b*) of the Act are defined in section 135(1).

Model Form 2

WATER RESOURCES ACT 1963

APPLICATION FOR A LICENCE (OTHER THAN A LICENCE OF RIGHT) TO ABSTRACT WATER FROM UNDERGROUND STRATA

APPLICANT

1. Name of applicant (in BLOCK LETTERS) .....
.....

2. Address of applicant to which communications about this application are to be sent .....
.....

3. Name and address of professional adviser or agent (if any) to whom communications about this application are to be sent .....
.....
.....

UNDERGROUND STRATA AND POINTS OF ABSTRACTION TO WHICH THIS APPLICATION RELATES AND CLAIM TO BE ENTITLED TO MAKE THE APPLICATION

4. In Table I below—

(*a*) in column (1), enter the reference number, as shown on the map (*see note* (*a*)) accompanying this application, of each of the points at which you propose the licence should authorise the abstraction (*see note* (*b*)) of water;

(*b*) in column (2), describe the underground strata (*see note* (*c*)) (e.g. Chalk, Lower Greensand, etc.) from which you propose the licence should authorise abstraction at each point referred to in column (1);

(*c*) to show how you claim to be entitled (*see note* (*d*)) to make this application to abstract water from the underground strata specified in column (2)—

(i) in column (3), opposite each point of abstraction referred to in column (1), enter—

" occupier ", if you are the occupier of land consisting of or comprising the underground strata from which you propose the licence should authorise abstraction at that point; or

" potential occupier ", if you have entered into negotiations to acquire an interest which will entitle you to occupy such land;

(ii) in column (4), specify (by reference to the map accompanying this application) (*see note* (*e*)) the situation of the land;

(iii) in column (5), opposite each entry in column (3) which is " potential occupier ", specify the date upon which you expect to acquire the interest in the land.

TABLE I

Map ref. no. of point (1)	Underground strata (2)	Occupier or potential occupier (3)	Land consisting of or comprising underground strata (4)	Expected date of acquisition of interest (5)

PROPOSED MEANS OF ABSTRACTION AND METHODS OF MEASURING

5. In Table II below—

(*a*) in column (1), enter the map reference number of each point of abstraction referred to in Table I above;

(*b*) in column (2), specify the work (e.g. well, borehole, extension of an existing borehole, catchpit, etc.) by means of which you propose the licence should authorise abstraction at each point referred to in column (1);

(*c*) in respect of each work specified in column (2)—

(i) specify the depth (*see note* (*f*)) of the work in column (3);

(ii) specify the diameter of the work in column (4);

(iii) describe in column (5) how, if at all, the work is or will be lined.

TABLE II

Map ref. no. of point (1)	Work			
	Description (2)	Depth (3)	Diameter (4)	Lining (5)

6. Indicate which work (if any) specified in column (2) of Table II above is artesian, and describe how overflow and leakage will be prevented .....
.....
.....

7. Indicate which work (if any) specified in column (2) of Table II above includes headings or adits, and specify the point of communication, length, diameter and orientation of each heading or adit.....
.....
.....
.....

8. In Table III below—

(*a*) in column (1), enter the map reference number of each point of abstraction referred to in Table I above;

(*b*) in columns (2) and (3), specify the type and capacity of the machinery or apparatus by means of which you propose the licence should authorise abstraction at each point referred to in column (1);

(*c*) in column (4), describe the way in which you propose the licence should require the quantities of water abstracted at each point referred to in column (1) to be measured or assessed.

TABLE III

Map ref. no. of point (1)	Machinery or apparatus		Method of measuring or assessing quantities abstracted (4)
	Type (2)	Capacity (in thousand gallons per hour) (3)	

WATER REQUIRED AND LAND ON WHICH AND PURPOSES FOR WHICH IT IS TO BE USED

Note:—If so desired, map reference numbers may be bracketed together in column (1) *of Table IV below for the purpose of specifying in column* (2) *an aggregate quantity in respect of a group of points of abstraction (see note* (*g*)).

9. In Table IV below—

(*a*) *in column (1)*, enter the map reference number of each point of abstraction referred to in Table I above;

(*b*) in the remaining columns, specify under the appropriate headings the quantities of water you propose the licence should authorise to be abstracted at each point referred to in column (1) in the various periods, and the land (*see note (h)*) on which, and the purposes (*see note (i)*) for which, you propose the licence should authorise water abstracted at each point to be used, showing which quantity relates to which period, purpose and land, etc. (*see note (j)*).

TABLE IV

Map ref. no. of point	Maximum quantity (in thousand gallons)			Period (e.g. Nov.-Feb., any period of .. consecutive days in March-May, etc.)	Purpose	Land
	per year or other period specified in col. 5	per day	per hour			
(1)	(2)	(3)	(4)	(5)	(6)	(7)

SPRAY IRRIGATION

10. If the purposes specified in column (6) of Table IV above consist of or include spray irrigation—

(*a*) in Table V below—

(i) in column (1), specify each crop you propose to irrigate;

(ii) if you propose to irrigate any crop during a particular period or periods of the year, specify the period(s) in column (2);

(iii) in column (3), specify the acreage of each crop;

(iv) in column (4), specify the maximum number of inches of water you propose to apply to an acre of that crop annually or, if any period is specified in column (2), in that period; and

(*b*) specify the maximum number of acres you propose to irrigate daily .....

TABLE V

Crop	Period (e.g. April-June, any period of .. consecutive days in March-May, etc.)	Acreage	Maximum no. of inches to be applied per acre per year or period
(1)	(2)	(3)	(4)

DISCHARGE OF WATER AFTER USE (*see note (k)*)

11. In Table VI below—

(*a*) if you propose to discharge water after it has been used for any purpose specified in column (6) of Table IV above, specify that purpose in column (1);

(*b*) in column (2), enter the approximate proportion of any quantity of water used for that purpose that is likely to be discharged after use;

(*c*) in column (3), opposite each entry in column (2), specify the point of discharge, e.g., where the water will enter an inland water (giving the name of, or sufficient description to identify, the inland water), where it will enter a public sewer (giving the name of the sewerage authority), where a soakaway will discharge, etc.

TABLE VI

Purpose (1)	Approximate proportion (2)	Point of discharge (3)

POINTS OF ABSTRACTION TO BE USED IN CONJUNCTION

Note:—You need not make any entries in Table VII below unless you wish to use any of the points of abstraction referred to in Table I above in conjunction with points of abstraction not referred to in that Table.

12. In Table VII below—

(*a*) in column (1), describe (if practicable, by reference either to the map accompanying this application or to the relevant licence under the Act or to the relevant application for a licence) the location of each point of abstraction which you wish to use in conjunction with the points of abstraction referred to in Table I above (whether simultaneously or as an alternative or otherwise);

(*b*) in column (2), give the name of, or sufficient description to identify, the inland water (*see note (l)*) or underground strata from which you are abstracting or propose to abstract water at that point;

(*c*) in column (3), specify the serial number of the licence under the Act (if any) which authorises the abstraction of water at that point or the date of your application (if any) for such a licence.

TABLE VII

Point of abstraction (1)	Inland water or underground strata (2)	Serial no. of licence or date of application (3)

OTHER MATTERS

13. Have you asked any water undertakers for a supply of water for any of the purposes specified in column (6) of Table IV above (*see note (m)*)? .....
If so, state when, which purposes, and with what result .....
.....
.....
.....

14. Is the licence required only for a limited period? ..... If so, for how long? .....

15. Give details of any other matters which you wish the River Authority to take into account in considering this application (e.g. the facilities which will be available on your land for storing water abstracted under the licence, how the maximum use is made of existing supplies, the extent to which water abstracted under the licence will be re-used, matters to which you have had regard in formulating your proposals in this application, the reasons for your proposals as to quantities, etc.) .....
.....
.....
.....
.....
.....

FORMAL APPLICATION

I hereby apply to the ..... River Authority for a licence under the Water Resources Act 1963 to abstract water in accordance with the proposals indicated above, and I declare that to the best of my knowledge the statements made above are true.

I enclose with this application copies of the newspaper(s) dated .....
..... and ..... in which the notice in the form prescribed by the Water Resources (Licences) Regulations 1965 was published. I declare that the notice was also published in the London Gazette dated .....

I also enclose the map required by the above-mentioned Regulations of 1965.

I *[also enclose] [can produce] the following evidence for the purpose of satisfying the River Authority that I am entitled to apply for a licence to abstract from the underground strata to which this application relates:—
.....
.....
.....
.....
.....
.....
.....

Signed.....

* [Authorised on behalf of.....]

Date.....

* *Delete where inappropriate.*

It is an offence to make a false statement in applying for a licence. (See section 115(1) of the Act.)

NOTES

(*a*) The Water Resources (Licences) Regulations 1965 require the application to be accompanied by an ordnance map showing certain particulars.

(*b*) For the meaning of "abstraction", see section 135(1) of the Act.

(*c*) For the meaning of "underground strata", see section 135(1) of the Act.

(*d*) See section 27 of the Act and the above-mentioned Regulations of 1965.

(*e*) E.g. "the land coloured blue on the map".

(*f*) The depth should be inserted only after competent technical advice has been obtained, since a further application may be necessary if, when the work is under construction, it is found necessary to increase the depth beyond the figure stated.

(*g*) If so desired, entries in columns (3) and (4) of Table IV may be omitted. Attention is, however, drawn to sections 29(8)(*a*) and 30 of the Act under which it will be open to the River Authority to specify a quantity in respect of each point of abstraction and to lay down maximum quantities for any specified period (e.g. weekly, daily, hourly) if they see fit to do so.

(*h*) E.g. "the land hatched black on the map".

(*i*) Purposes should be described as follows:—

water undertaking
spray irrigation
cooling purposes
use in a process of manufacture (other than for cooling purposes)
use as a means of conveying any material as a slurry or otherwise
other uses (briefly described), e.g. agriculture or horticulture, other than spray irrigation.

(*j*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking should enter "water undertaking" in column (6) but need not make any entries in column (7) of Table IV.

(*k*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking need not make any entries in Table VI.

(*l*) For the meaning of "inland water", see section 135(1) of the Act. (Section 2 is also relevant.)

(*m*) Water undertakers applying for a licence to abstract water for the purposes of their water undertaking need not answer this question.

Model Form 3

WATER RESOURCES ACT 1963

APPLICATION FOR A LICENCE UNDER SECTION 36 TO OBSTRUCT OR IMPEDE THE FLOW OF AN INLAND WATER BY MEANS OF IMPOUNDING WORKS

APPLICANT

1. Name of applicant (in BLOCK LETTERS) .....
.....

2. Address of applicant to which communications about this application are to be sent .....
.....

3. Name and address of professional adviser or agent (if any) to whom communications about this application are to be sent .....
.....

INLAND WATER TO WHICH APPLICATION RELATES

4. Give the name of, or sufficient description to identify, the inland water (*see note (a)*) the flow of which will be obstructed or impeded by means of the impounding works you propose to construct or alter .....
.....

EXISTING LICENCE

5. If a licence under section 36 of the Act is in force, authorising impounding works at the point at which you propose to construct works or at which the works you propose to alter are situated, give the serial number of that licence .....

IMPOUNDING WORKS TO BE CONSTRUCTED OR ALTERED

6. Give a brief description (with plans and sections) of the impounding works (*see note (b)*) you propose to construct or, if you propose to alter existing impounding works, give a brief description (with plans and sections) of the existing works and of the proposed alterations, sufficient to show the manner in which the works, when constructed or altered in accordance with your proposals, will obstruct or impede the flow of the inland water .....
.....
.....
.....
.....
.....

WORKS FOR IMPOUNDING WATER

7. If you propose to construct or alter a dam, weir or other works whereby water may be impounded—

(*a*) state the object(s) of impounding water by means of the works (e.g. the provision of a reservoir as a source of supply, the provision of a reservoir as an ornamental lake, the provision of a reservoir for regulating the flow of the inland water referred to in paragraph 4 above or of some other inland water, giving the name of, or sufficient description to identify, that other inland water) .....
.....
.....

(*b*) state, by reference to height above Ordnance Datum (Newlyn), what the overflow level of the reservoir will be if the works are constructed or altered in the manner you propose .....
.....

(*c*) state what capacity the reservoir will have at overflow level if the works are constructed or altered in the manner you propose .....
.....

(*d*) if the reservoir will be used as a source of supply, specify the maximum quantity of water which will be required to be abstracted per year .....

(*e*) if water will be discharged from the reservoir downstream, or into the other inland water (if any) referred to in sub-paragraph (*a*) above,

whether to supplement the flow for the purposes of river regulation or to provide compensation water, and if the water will be so discharged with a view to maintaining a specified minimum flow or flows at a specified control point or points—

(i) specify (by reference to the map accompanying this application) (*see note (c)*) the point(s) at which the water will be discharged into the inland water .....
.....

(ii) specify (by reference to the map accompanying this application) the control point(s) at which the flow(s) will be required to be maintained .....
.....

(iii) specify the flow which will be required to be maintained at each control point .....
.....

(iv) specify the method which will be used for measuring the flow at each control point .....
.....

(v) state how you estimate that, if the works are constructed or altered in the manner you propose, the reservoir will be capable of yielding not only the quantities of water required to be discharged to maintain the specified minimum flow(s) at the specified control point(s) but also (where the reservoir will be used as a source of supply) the maximum quantity you have specified in sub-paragraph (*d*) above (*see note (d)*) .....
.....
.....
.....
.....

WORKS FOR DIVERTING THE FLOW

8. If you propose to construct or alter works for diverting the flow of the inland water in connection with the construction or alteration of a dam, weir or other works whereby water may be impounded, state how you estimate that the works, if constructed or altered in the manner you propose, will be capable of diverting the flow to the required extent .....
.....
.....
.....
.....
.....

FORMAL APPLICATION (*see note (e)*)

I hereby apply to the .....River Authority for a licence under the Water Resources Act 1963 to obstruct or impede the flow of the inland water referred to in paragraph 4 above by means of impounding works, and I declare that to the best of my knowledge the statements made above are true.

I enclose with this application copies of the newspaper(s) dated .... and ..... in which the notice in the form prescribed by the Water Resources (Licences) Regulations 1965 was published. I declare that the notice was also published in the London Gazette dated ..... and that a copy of the notice was served on .....on the following authorities in accordance with section

Form N 1

WATER RESOURCES ACT 1963

NOTICE OF APPLICATION FOR LICENCE TO ABSTRACT WATER

Notice is hereby given that an application is being made to the (*a*) .... River Authority by (*b*) .... for a licence to abstract the following quantities of water from (*c*) .... at the following point(s) of abstraction:—

(*d*) ..... gallons per (*e*) ..... at (*f*) .....

*[(*d*) ..... gallons per (*e*) ..... at (*f*) .....]

*[(*d*) ..... gallons per (*e*) ..... at (*f*) .....]

*[(*d*) ..... gallons per (*e*) ..... at any point between (*g*) ..... and .....]

*[Further details of the application are:—

(*h*) ....]

A copy of the application and of any map, plan or other document submitted with it may be inspected free of charge at (*i*) .... at all reasonable hours during the period beginning on (*j*)..... and ending on (*k*) .....

Any person who wishes to make representations about the application should do so in writing to the Clerk of the (*a*) ..... River Authority at (*l*) ..... before the end of the said period.

Signed.....

*On behalf of.....

Date.....

* *Delete where inappropriate.*

(*a*) Insert name of River Authority.

(*b*) Insert name and address of applicant.

(*c*) Insert name of, or sufficient description to identify, the inland water or underground strata.

(*d*) Insert number of gallons.

(*e*) Insert period.

(*f*) Specify (by reference to identifiable geographical features or to Ordnance Survey national grid map co-ordinates, followed by names of civil parish and district) the point of abstraction.

(*g*) Specify (by reference as mentioned in note (*f*) above) any points between which it is proposed to abstract by mobile means of abstraction.

(*h*) Give further brief details, if desired.

(*i*) Insert an address within the locality of the point(s) of abstraction.

(*j*) Insert a date which is not earlier than the date on which the notice is first published in a newspaper other than the London Gazette.

(*k*) Insert a date which is not less than 28 days from the date on which the period begins and not less than 25 days from the date on which the notice is published in the London Gazette.

(*l*) Insert address of office of River Authority to which the application is transmitted.

Form N 2

WATER RESOURCES ACT 1963

NOTICE OF APPLICATION FOR LICENCE TO OBSTRUCT OR IMPEDE THE FLOW OF AN INLAND WATER BY MEANS OF IMPOUNDING WORKS

Notice is hereby given that an application is being made to the (*a*) .... River Authority by (*b*) .... for a licence to obstruct or impede the flow of (*c*) .... by means of (*d*) .... at (*e*) .....

*[The object of impounding water by means of the works is (*f*) ....]

*[The capacity of the reservoir at overflow level will be (*g*) ..... gallons]

*[Further details of the application are: —

(*h*) ....]

A copy of the application and of any map, plan or other document submitted with it may be inspected free of charge at (*i*) .... at all reasonable hours during the period beginning on (*j*) ..... and ending on (*k*) .....

Any person who wishes to make representations about the application should do so in writing to the Clerk of the (*a*) ..... River Authority at (*l*) ..... before the end of the said period.

Signed.....

*On behalf of.....

Date.....

* *Delete where inappropriate.*

(*a*) Insert name of River Authority.

(*b*) Insert name and address of applicant.

(*c*) Insert name of, or sufficient description to identify, the inland water.

(*d*) Insert brief description of works it is proposed to construct or alter.

(*e*) Specify (by reference to identifiable geographical features or to Ordnance Survey national grid map co-ordinates, followed by names of civil parish and district) the point at which the flow of the inland water will be obstructed or impeded by means of the works.

(*f*) Specify object, if the works are for impounding water.

(*g*) Insert number of gallons, if the works are for impounding water.

(*h*) Give further brief details, if desired.

(*i*) Insert an address within the locality of the works.

(*j*) Insert a date which is not earlier than the date on which the notice is first published in a newspaper other than the London Gazette.

(*k*) Insert a date which is not less than 28 days from the date on which the period begins and not less than 25 days from the date on which the notice is published in the London Gazette.

(*l*) Insert address of office of River Authority to which the application is transmitted.

Form N 3

WATER RESOURCES ACT 1963

NOTICE OF APPLICATION FOR A COMBINED LICENCE TO OBSTRUCT OR IMPEDE THE FLOW OF AN INLAND WATER BY MEANS OF IMPOUNDING WORKS AND TO ABSTRACT WATER

Notice is hereby given that an application is being made to the (*a*) .... River Authority by (*b*) .... for a combined licence to obstruct or impede the flow of (*c*) .... by means of (*d*) .... at (*e*) ..... and to abstract (*f*) ..... gallons of water per (*g*) .... from the said inland water at or near that point.

The capacity of the reservoir at overflow level will be (*h*) ..... gallons.

*[Further details of the application are:—

(*i*) ....]

A copy of the application and of any map, plan or other document submitted with it may be inspected free of charge at (*j*) .... at all reasonable hours during the period beginning on (*k*) ..... and ending on (*l*) .....

Any person who wishes to make representations about the application should do so in writing to the Clerk of the (*a*) ..... River Authority at (*m*) ..... before the end of the said period.

Signed.....

*On behalf of.....

Date.....

* *Delete where inappropriate.*

(*a*) Insert name of River Authority.

(*b*) Insert name and address of applicant.

(*c*) Insert name of, or sufficient description to identify, the inland water.

(*d*) Insert brief description of works it is proposed to construct or alter.

(*e*) Specify (by reference to identifiable geographical features or to Ordnance Survey national grid map co-ordinates, followed by names of civil parish and district) the point at which the flow of the inland water will be obstructed or impeded by means of the works.

(*f*) Insert number of gallons.

(*g*) Insert period.

(*h*) Insert number of gallons.

(*i*) Give further brief details, if desired.

(*j*) Insert an address within the locality of the works.

(*k*) Insert a date which is not earlier than the date on which the notice is first published in a newspaper other than the London Gazette.

(*l*) Insert a date which is not less than 28 days from the date on which the period begins and not less than 25 days from the date on which the notice is published in the London Gazette.

(*m*) Insert address of office of River Authority to which the application is transmitted.

Circular 92/71

Circular from the

Department of the Environment

2 Marsham Street London SW1P 3EB

Sir

2 December 1971

REORGANISATION OF WATER AND SEWAGE SERVICES: GOVERNMENT PROPOSALS AND ARRANGEMENTS FOR CONSULTATION

1. I am directed by the Secretary of State for the Environment to draw your attention to the statement announcing the Government's intention of reorganising the water and sewage services on the basis of all-purpose Regional Water Authorities, which he made today in the House of Commons.

2. This statement follows upon the Government's study of the report of the Central Advisory Water Committee, **The future management of water in England and Wales,** which was published in April and copies of which were sent to the bodies concerned under cover of Circular No. 20/71. The proposals are set out in more detail in an explanatory memorandum, which is appended to this Circular. Subject to the consideration by Parliament of the necessary legislation, the aim is to bring the new structure into operation on 1 April 1974, at the same time as the new local authorities.

3. The Department of the Environment is at once initiating consultations with the bodies at present responsible for the provision of water services and with their associations. These consultations will take place within the broad principles already announced and their scope is described in the explanatory memorandum. Paras 4-6 below invite comments on the boundaries proposed for Regional Water Authorities. The Ministry of Agriculture, Fisheries and Food will be undertaking consultations with the interested bodies on the future organisation of land drainage and fisheries.

Boundaries

4. The Government have concluded after studying the evidence submitted to the Central Advisory Water Committee and the Committee's report that there ought to be 10 all-purpose authorities (including one for Wales). The explanatory memorandum puts forward (paras. 44-50 and schedule) proposals for the boundaries of these authorities. Special arrangements, described in

the explanatory memorandum, will be made for those river basins which cross the Anglo-Welsh border.

5. It is intended to define the areas of the all-purpose authorities in legislation. This will be done after taking into account the comments submitted in response to this Circular. It is emphasised however that such consideration will be based on the principles already announced. In particular the Government takes the view that boundaries should be based on natural watersheds and in most instances on boundaries of existing river authorities; and that special arrangements should be made in the relatively small number of cases in which existing water distribution networks cross the boundaries proposed. Wherever possible the control of discharges to major estuaries should be unified in the hands of a single authority.

6. Any suggestions you may wish to submit for modifications to the proposed boundaries should be sent to the Department of the Environment at the above address (Room C8/18) not later than 1 March 1972.

Proposals for boundary changes in advance of reorganisation

7. There may be a very small number of exceptional cases in which an urgent need for additional sewage treatment plant justifies the creation or enlargement of a joint sewerage board in advance of reorganisation. In general it is thought unlikely that any circumstances will arise which are sufficiently exceptional to justify the further regrouping of water undertakings in advance of that date. In view of the decision to preserve water companies as separate bodies however the Secretary of State will be prepared to consider on their merits proposals for voluntary regrouping submitted to him by statutory water companies.

Consultations on other matters

8. The Department of the Environment (in conjunction, where appropriate, with other Government departments) intends to circulate consultation papers to the associations concerned in the near future on the other matters reserved for consultation.

Maintaining continuity

9. In the period before reorganisation takes place, it is essential that all the bodies responsible for water services should press ahead with the projects that are immediately required to cope with the increased use of water and to reduce pollution. Subsequently, it will be equally essential that there should be no loss of momentum over the period in which the new authorities are establishing their organisation. The Department will collaborate with the existing bodies in formulating short-term capital investment programmes in order to prevent any hiatus occurring. Work is already in hand to this end on various fronts.

10. The need to maintain normal services and plan to meet future needs, while at the same time implementing a far-reaching reorganisation, will inevitably throw a heavy burden on those working in the industry and on their associations. The Government are convinced however that the change now proposed is essential if water supplies are to be safeguarded and if the quality of water in rivers and estuaries is to be improved, or even maintained. Given that this is so, there would be considerable disadvantages in delaying it. They believe that the great majority of the people working in

WATER AND SEWAGE SERVICES: ENGLAND
EXPLANATORY MEMORANDUM ON PROPOSALS FOR REORGANISATION

I. INTRODUCTION

1. The purpose of this memorandum is to set out the background to the proposals for the reorganisation of water services contained in the statement made in the House of Commons by the Secretary of State for the Environment on 2 December 1971, and to provide the framework for the consultations on detailed aspects of these proposals which the Government will now be undertaking. The term 'water services' is used to cover water conservation, water supply, treatment and disposal of collected sewage, pollution control, inland navigation and (insofar as this is done by the bodies responsible for the foregoing services) the provision of facilities for water-based recreation. It excludes land drainage and fisheries administration.

THE PROBLEMS

2. In a densely populated country like England, with smaller resources of water in relation to its population than any of its European neighbours, the increasing use of water for both domestic and industrial purposes is now posing major problems, which it will require careful planning and considerable effort to solve. Substantial and increasing capital investment will be needed to increase supplies of water to keep pace with increased demand, to treat this increased volume of water after use, and to reduce the present degree of pollution of rivers and coastal waters.

3. In 1971/72 capital expenditure on water supply, sewerage and sewage disposal will be about £280m and the forecasts contained in the White Paper on Public Expenditure in 1969/70 to 1974/75[1] allow for an average annual rate of growth of 7 per cent in real terms, far higher than the rate of growth envisaged for the economy as a whole.

4. The Water Resources Board estimated in 1967 that the demand for water in England and Wales would double by the end of the century. This estimate remains the basis for long-term planning. Certainly by the end of the seventies the demand on water undertakers over large areas of the country will exceed the reliable yield of their present sources, and in some areas it has done so already. Unless further sources are developed on a large scale, a dry year could lead to widespread restrictions on the use of water, with potentially serious effects on public health and industry.

5. Most of the water supplied ultimately returns to rivers as effluent. Additional sewage treatment capacity must therefore be provided to keep pace with this additional demand for water. Furthermore, despite improvements, the existing state of many rivers and estuaries is unsatisfactory. In too many cases there is pollution which destroys fish and other forms of life, impairs amenity and the use of rivers for recreation, and interferes with the reuse of water. This is emphasised in the First Report of the Royal Commission on Environmental Pollution[2] and in the Report of the Jeger Committee. The Department of the Environment has just carried out a detailed and comprehensive survey of the state of English rivers, in collaboration with

1 Cmnd. 4578.

2 Cmnd. 4585.

3 Ministry of Housing and Local Government/Welsh Office, Working Party on Sewage Disposal. **Taken for granted.** HMSO, 1970.

the river authorities and the Confederation of British Industry; and the results, which are to be published shortly, have now to be converted into proposals for action.

6. Land drainage and sea defence, navigation, fisheries and the provision of facilities for water-based recreation have their special problems and are of great importance to particular areas and particular groups of people. Their requirements have to be reconciled, where necessary, with those of public water supply and sewage disposal. Both sets of requirements may need to be reconciled with the needs of private abstractors and dischargers.

7. The problems created by the increased use of water have to be solved in a way that preserves, and wherever possible improves, the natural beauty of the environment and the richness of the living systems it supports. All this has to be done at the least possible cost, particularly as all investment has to be weighed carefully against competing claims within the public sector.

8. The system of organisation necessary to achieve these objectives has been considered by the Central Advisory Water Committee and their report, **The future management of water in England and Wales,** was published in April 1971. It analysed the present system of organisation at some length and found major weaknesses. Its principal conclusions are summarised in paras 15-17 below.

THE BACKGROUND

9. The responsibility for water services at present lies with over 1400 separate bodies. These include 22 river authorities whose areas lie wholly in England and another 3 which straddle the Anglo-Welsh border, 160 water undertakers, and over 1200 sewerage authorities (mainly county borough and county district councils). There is also a network of canals and river navigations, amounting to almost 2000 miles, separately administered by the British Waterways Board.

10. The present pattern of sewerage authorities largely dates back to the nineteenth century. The present pattern of water undertakers emerged in the mid-sixties but is the end-product of a process of gradual regrouping extending over more than two decades, and represents no more than the partial fulfilment of a policy adopted as long ago as 1944, in the White Paper 'A National Water Policy'.[4]

11. Because it was thought that the rising demand for water would require action over a wider front than the 1944 White Paper had envisaged, a Sub-Committee on the Growing Demand for Water was set up by the Central Advisory Water Committee in 1955. The final report of this Sub-Committee (the Proudman Report)[5] concluded that it should no longer be left to individual water undertakers and other users to develop the country's water resources according to their separate needs, but that the situation called for new authorities to review the various requirements and to plan the ordered development of resources to meet them. It therefore recommended

4 Cmd. 6515.

5 Central Advisory Water Committee, Sub-Committee on the Growing Demand for Water. Final Report. HMSO, 1962.

the creation of 'river authorities' to manage the water resources of river basins as a whole, together with a central authority to promote an active policy for the conservation and proper use of water resources. The river authorities would take over the functions of the river boards established under the River Boards Act 1948 (namely, land drainage and sea defence, fisheries and pollution control) and would also be given extensive new powers in relation to water conservation.[6]

12. The recommendations of the Sub-Committee were to a considerable extent accepted by the Government of the day in the White Paper of April 1962, 'Water Conservation: England and Wales" and implemented in the Water Resources Act 1963. The Water Resources Board was established as the central body, and the new river authorities took up their duties on 1 April 1965.

13. The constitution of the river authorities is not that recommended by the majority of the Proudman Committee, that is to say a membership of 10-15 with some full-time members. They were given a constitution similar to that of the river boards, a wholly part-time membership in the range 20-40 with a bare majority of the members appointed by local authorities and the remainder appointed by Ministers to represent prescribed interests. The members are unpaid, except that the Chairman (who is elected by the members) may receive a small salary.

THE CAWC REPORT

14. The Central Advisory Water Committee were asked in September 1969:

> To consider in the light of the Report of the Royal Commission on Local Government in England[7] and of technological and other developments how the functions relating to water conservation, management of water resources, water supply, sewerage, sewage disposal and the prevention of pollution now exercised by river authorities, public water undertakings, and sewerage and sewage disposal authorities can best be organised; and to make recommendations.

15. There was widespread agreement in the evidence submitted to the Committee that there should be changes in the present system of organisation. The Committee's finding was that there are increasing conflicts of interest between the various authorities responsible for providing water services and inadequate mechanisms for resolving them, apart from intervention by central government. They identified as the most important areas and causes of conflict (i) inflexibility in the use of existing resources, (ii) the division of responsibility for new sources between river authorities and water undertakers, (iii) the promotion of joint or national schemes, and (iv)

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6 'Water conservation' is defined in the 1962 White Paper as 'the preservation, control and development of water resources (both surface and ground) whether by storage, including natural ground storage, prevention of pollution, or other means, so as to ensure that adequate and reliable supplies of water are made available for all purposes in the most suitable and economical way whilst safeguarding legitimate interests'.

7 Cmnd. 1693.

8 Cmnd. 4040.

the treatment of water after use. They concluded that, in addition to detailed improvements in legislation and reductions in the number of operating units (which it is generally agreed are desirable), the relationship between the various authorities must be changed so that a comprehensive water management plan can be drawn up for every river basin, and so that the system of organisation and the financial arrangements will permit the implementation of such a plan.

16. The Committee's principal recommendation, which was unanimous, was that a small number of strong Regional Water Authorities should be established. These authorities would be responsible for the planning and co-ordination of all water services within their areas. They would draw up a long-term water plan for their areas within the framework of a national water plan and regional land-use policies. They would then be responsible for compiling 5-year action programmes based on this plan, and for securing their implementation.

17. The Committee differed among themselves however about the nature of these Regional Water Authorities. Some members thought they ought to be 'multi-purpose' bodies; others thought they should concentrate on planning and co-ordination, and that some or all of the existing types of authority should continue to exist alongside them.

II. THE GOVERNMENT'S CONCLUSIONS

THE NEED FOR INTEGRATION

18. The Government agree that the present system of organisation is inadequate and unlikely to achieve the objectives set out at the beginning of this memorandum. They believe the time has come to bring together, under all-purpose management structures, all aspects of the hydrological cycle, literally from the source to the tap. The government also agree with the CAWC that the solution must go beyond a mere reduction in the number of operating units, of the kind that might be brought about in the course of local government reorganisation. The basic principle of the 1963 Act, that water resources should be managed comprehensively on the basis of river basins, taking full account of all the relevant interests, needs to be carried further. In the six and a half years of their existence river authorities, which grew out of organisations catering for land drainage needs, have made a useful start in this direction. But while they have encountered no problems so far as land drainage and fisheries are concerned, insufficient progress has been made in overcoming the problems arising from the separation of responsibility for water supply, river management, water conservation, pollution control, sewerage and sewage disposal.

19. The central weakness of the present system for the provision of water services is that the interests of water undertakers and sewerage authorities, as at present constituted, often conflict with the best overall solution. Another weakness, which is of growing importance, is the division of responsibility for the control of industrial pollutants, where these are discharged to public sewers, between the sewerage authority and the river authority. These weaknesses too often produce a need for central intervention which the Government wishes to curtail. A reduction in the number of operating units will, by itself, do very little to cure these weaknesses. The Government are satisfied that the full integration of water services is now essential. In their view there is an urgent need for Regional Water Authorities with a clear sense of purpose, able to take a comprehensive and long-

term view of all the relevant aspects of water management, and at the same time capable of taking successful and cost-effective action to safeguard water supplies and protect the environment. This entails these authorities replacing virtually all the diverse public authorities at present responsible for water services. The Royal Commission on Environmental Pollution, after studying the CAWC's report, have informed the Government that this is also the solution they favour.

20. This solution will mean a radical change in organisation but it is no more than is demanded by the present situation and future needs. The alternative systems of organisation suggested by some members of the CAWC, and other possible compromise solutions that might be devised, would be more cumbersome and less economical in their use of resources, including resources of trained manpower. Moreover they would have one of two results. Either, and this seems more probable, the present tendency for conflicts of interest to arise between different types of authority would persist, and intervention by central government would still be required to resolve them. Or, if regional co-ordinating bodies were given overriding powers, the existing types of body would lose all real autonomy. To place bodies composed of elected members in such a position would be anomalous and unacceptable. Even if one of these alternative systems of organisation could be made to work for a few years it would be undesirable to undertake a second major reorganisation now, only to be faced with the need for a third reorganisation within a comparatively short time.

21. The Government have therefore decided to establish not more than 10 all-purpose Regional Water Authorities, which will be broadly similar to the 'multi-purpose' authorities described in the CAWC's report. The report suggested that authorities of this nature might take over from the British Waterways Board responsibility for the canals in their areas, and the Government think this is right. Their main functions are set out below, with an indication of those functions which will be the subject of further consultations. The Government's proposals for the areas of these authorities are given in part III of this memorandum, and the timetable proposed for reorganisation in part V.

ALL-PURPOSE REGIONAL WATER AUTHORITIES

22. The new Regional Water Authorities will take over the water conservation, water quality control, navigation and recreation functions of the present river authorities (including the Isle of Wight River and Water Authority, the Lee Conservancy Catchment Board and the Thames Conservancy) and the water supply and sewage disposal functions at present performed by local authorities. They will take over the responsibilities of the British Waterways Board for canals and river navigations. They will replace the existing joint water boards and joint sewerage boards. The statutory water companies will continue provided satisfactory arrangements can be made for them to act as agents of the appropriate Regional Water Authority (see paras. 29-30 below).

23. The Minister of Agriculture, Fisheries and Food is initiating consultations with the interested bodies about the future organisation of the land drainage and fisheries functions of the existing authorities, which lay outside the CAWC's terms of reference. However the present proposals for reorganisation do not require a review of the responsibilities of internal drainage boards.

24. Local authorities will continue to have local sewerage functions, other than those which the Regional Water Authorities need for the efficient discharge of their duties. The Regional Water Authorities however will be responsible for controlling the admission of trade effluents to public sewers, and the present division of responsibility in that respect (para. 19 above) will be resolved. Local authorities will also retain a responsibility for the independent testing of public water supplies. The Department of the Environment will carry out consultations about the functions remaining with local authorities.

25. The main activity of each Regional Water Authority will be the provision of water and the reclamation or disposal of used water. The statutory obligations at present placed on water undertakers and river authorities to provide water to meet legitimate needs will be preserved and consolidated. Like existing statutory undertakers, the Regional Water Authority will need to maintain close liaison with regional economic planning councils and county and district planning authorities over the location and timing of new development.

26. In its own planning and operations it will be required to take account of the needs of navigation and recreation, and also of land drainage and sea defence, fisheries and the conservation of amenity and wild life, consulting with other interested bodies where appropriate. It will be under a specific statutory obligation to maintain, and where possible improve, the quality of the rivers and canals in its area. It will be subject to land-use planning legislation in the same ways as the bodies it replaces.

27. A Regional Water Authority will have certain primarily regulatory functions, for example in relation to private discharges of effluent. Here and elsewhere, the present statutory safeguards for the rights of the individual will continue.

28. The Regional Water Authority will need accurate scientific information about the state of the rivers and canals under its control; the condition of the living systems they support; and the nature, origin and effects of any pollution. Scientific monitoring will be necessary to measure the effectiveness of sewage treatment and effluent control. Most river authorities and many local authorities already have laboratories of some kind, but the reorganisation will make possible the creation of larger centres or networks, better equipped to measure the very large number of substances on which a watch must be kept.

STATUTORY WATER COMPANIES

29. The CAWC envisaged that all-purpose Regional Water Authorities would acquire the 31 statutory water companies (29 in England, and 2 partly in England and partly in Wales) which at present account for about 22 per cent of the total water supplied by statutory water undertakers. In the Government's view, however, consideration of the desirable form of organisation within the public sector must be distinguished from proposals for a further increase in the size of the public sector. There must be a strong presumption against any such proposal. The company undertakings are in general viable and efficient and the Government see a continuing role for them as agents of the Regional Water Authorities in the field of water supply.

30. The Department of the Environment will carry out consultations about the relationship between the companies and the Regional Water Authorities. It is envisaged that companies will continue broadly on the present basis except that, following reorganisation, they will operate under agency agreements with the Regional Water Authorities. Any dispute about the terms and conditions of such agreements will be determined by the Secretary of State for the Environment and where necessary the Secretary of State for Wales. It seems appropriate to transfer to the Regional Water Authorities (with appropriate modifications and safeguards) certain powers which the Secretaries of State at present exercise in relation to statutory water companies under the Water Acts. In other contexts however the companies will retain the right of direct access to the Secretaries of State.

INLAND NAVIGATION AND RECREATION

31. Except for a few short lengths, the network of canals and river navigations administered by the British Waterways Board no longer fulfills a major transport function. On the other hand these waterways are extensively used for other purposes such as, increasingly, the supply and carriage of water supplies to water undertakers. They are of growing value for recreation and amenity, a function which the Government wishes to encourage. For these reasons, the inland waterways need to be more closely integrated into the system of river management and water supply. This can best be done at the regional level. The canals today are mainly of local and regional significance. It is unnecessary and inappropriate that they should continue to be adminstered by a nationalised transport industry.

32. The responsibilities of the British Waterways Board for these waterways will therefore be transferred to the new Regional Water Authorities and the Board wound up. Decisions about the future of individual waterways can then be taken locally by the Regional Water Authorities in consultation with the various bodies interested in use of the waterways including the Countryside Commission, regional Sports Councils and local authorities. Where a canal crosses Regional Water Authority boundaries, arrangements will need to be made for determining responsibility as between one Regional Water Authority and another. Through navigations will be safeguarded as appropriate. The Government intend that the Regional Water Authorities should retain the British Waterways Board's existing duties as regards maintenance of the waterways with suitable statutory provision for modification of these duties if they consider it unavoidable that the costly maintenance of a waterway for navigation should be discontinued or, alternatively, if funds become available for the restoration of a waterway to navigation. Special arrangements will be made for the future control of the Board's canals in Scotland.

33. The Regional Water Authorities will inherit from the Thames Conservancy responsibility for navigation on the Thames above Teddington, and statutory responsibilities exercised by other river authorities for navigation on a total of about 500 miles of river and canal. They will also inherit the powers of the present river authorities and statutory water undertakers in relation to recreation under the Water Resources Act 1963 and the Countryside Act 1968. They will be placed under an obligation, when constructing

major works, to develop amenities and assist the provision of facilities for any communities affected. They will co-ordinate their plans for recreational facilities with the overall plans of the local planning authorities, and will consult as necessary with the Countryside Commission and the Sports Councils.

FINANCING OF WATER SERVICES

34. The CAWC envisaged that in a system of all-purpose authorities the cost of sewage disposal might be transferred from the rating system to a system of charges, analogous to that already used for the supply of water, and they assumed that at the same time the existing charges for trade effluent disposal would be placed on a more rational basis, as recommended by the Jeger Committee. They suggested that the individual consumer should be presented with a single bill reflecting all the costs imposed by the use of water, both the cost of obtaining it and supplying it and the cost of dealing with it after use.

35. The Government agree in principle that, apart from Exchequer grants for specific purposes, the revenues to enable the new authorities to discharge their main functions should come from charges for the services they provide. They also consider that the idea of a combined charge to cover all the functions carried out by the Regional Water Authorities deserves to be explored further. The Department of the Environment will carry out consultations on the manner in which progress can best be made towards these objectives. It will be necessary to take account of the financing of the new authorities in the discussions on the future financing of local government.

36. Consideration of the financing of land drainage and fisheries administration must await the outcome of the consultations to be undertaken on the location of these functions.

37. The administrative costs of pollution control, at present met from a precept levied on local authorities, will in future be treated as part of the overall cost of providing and reclaiming water. The charges levied under the Water Resources Act 1963 on abstractors of water from surface and underground sources will be retained alongside the charges for piped water. Those categories of abstractor who are exempt from charge under the 1963 Act will continue to be exempt.

38. As regards the inland waterways to be taken over from the British Waterways Board, the Government intend that the costs necessitated by the basic water functions should be apportioned between those functions and then financed by the Regional Water Authority in the appropriate way. To meet the extra costs of navigation or recreational or amenity use, the Regional Water Authority would (after a fixed transitional period in which tapering Exchequer grants would be made) look to tolls, or contributions from local authorities, national park authorities, the Sports Council, or other bodies interested in such uses of the waterways.

39. It is intended that there should be statutory safeguards to ensure that the costs of a Regional Water Authority's operations are distributed equitably between different categories of water user. The Government do not however think it appropriate that Ministers should concern themselves with the detailed levels of charges.

40. The requirement to obtain loan sanction for particular works will be abolished. The Regional Water Authorities will be enabled to raise money from government sources to meet their future requirements for outside capital. Ministers will however retain control over matters of major policy such as pricing policy and the extent of self-financing, and over investment programmes, in order to ensure that the objectives set out in para. 7 above are attained. Control over investment programmes will be exercised through the approval of 7-year rolling programmes. The detailed arrangements will be discussed with the new authorities when they are established. Meanwhile, the Department of the Environment will collaborate with the existing bodies in drawing up short-term capital investment programmes in order to prevent any hiatus occurring during the period when reorganisation is taking place.

41. The Regional Water Authorities will assume the obligation of servicing the outstanding debt of the bodies they replace. Where borrowing by local authorities has related partly to water services and partly to other services the local authority concerned will continue to meet the loan charges but an appropriate proportion of them will be reimbursed by the Regional Water Authority.

III. CONSTITUTION AND AREAS OF REGIONAL WATER AUTHORITIES

CONSTITUTION

42. The Government agree with the CAWC that the boundaries of Regional Water Authorities must be determined by hydrological considerations and follow natural watersheds, and thus would normally follow the boundary of a river authority area. This means that their boundaries cannot be made to coincide with boundaries used for other purposes, for example local government boundaries. The Government propose that the authorities should be composed of a substantial proportion of members appointed by local government, together with members appointed by Ministers. They will be obtaining opinions about the proportion between the two, and about the method of appointment of the local government members. The local government members will have an important role to play in forging close links between the Regional Water Authorities and the new and stronger local authorities. It is essential however, if the Regional Water Authorities are to be fully capable of discharging the complex responsibilities which will be laid on them, that the total membership of each authority should be considerably smaller than in the case of the present river authorities, and that the Chairman should be appointed by Ministers.

43. It is proposed that within the area of each Regional Water Authority there should be one or more consumer councils reflecting the various interests involved, including local authorities, major users such as industry and farming, and amenity and recreation interests. It is envisaged that the Regional Water Authority will be required to report annually to the consumer council on its plans; and to consider, and reply to, comments by the council on these plans and on other matters affecting consumers' interests. If the council is dissatisfied with the reply it will have direct access to Ministers. There will be consultations about the constitution of these consumer councils.

AREAS

44. The Government consider that what are needed are authorities covering extensive areas which will be reasonably self-sufficient in water resources, and able to make effective use (either alone or in collaboration) of the very large projects now under consideration, including large-scale storage in estuaries. They also consider it desirable that the control over pollution in major estuaries should wherever practicable be unified in the hands of a single authority.

45. The schedule at the end of this memorandum contains a scheme for establishing 10 Regional Water Authorities, together with a Welsh National Water Development Authority.

46. The areas of the present Northumbrian and Yorkshire River Authorities are of a size and nature to warrant the establishment of a separate Regional Water Authority for each, subject to some adjustment of the boundary between them. In the North-West it is proposed that there should be a single authority covering the areas of the present Cumberland, Lancashire, and Mersey and Weaver River Authorities. This recognises the strong hydrological linkages within the region. To the South there are close links between the Severn and Trent basins, the watershed between which bisects the West Midlands conurbation and several important water distribution networks. It is proposed that there should be a single authority to administer these two basins, and that its area should also include the catchments in the northern part of the Lincolnshire River Authority's area. The latter will obtain at least some of their additional supplies of water from the Trent, and their inclusion in this authority reduces the number of authorities concerned with pollution in the Humber.

47. The Water Resources Board's Report on South-East England identified a Central Deficiency Zone spread across 5 river authority areas. It is proposed that this zone should be divided between 2 Regional Water Authorities. The first groups together the Great Ouse, and Welland and Nene, areas and the greater part of the Essex area, together with the southern part of the Lincolnshire River Authority's area (which has close links with the Welland and Nene area) and the East Suffolk and Norfolk area. The second covers the Thames and Lee basins and those catchments to the east of London (in the Essex and Kent River Authority areas) which drain to the Thames and rely on supplies (either in bulk or in detail) from the Metropolitan Water Board. The remainder of the Kent River Authority's area is grouped with the other river authority areas on the South coast, which forms a distinct region for water management purposes. In the South-West some joining together of the present river authority areas is again necessary to create viable regions and it is proposed that there should be 2 authorities.

48. The historical trend, under the pressure of circumstances, has been for developments in the organisation of water services, including the development towards comprehensive river basin management, to proceed faster in London and the Thames and Lee basins than elsewhere. Largely for this reason, the provision of water services in these areas is in certain respects governed at present by separate legislation. The Government are at one with the CAWC, however, in believing that, for the future, the same principles must govern the organisation of water services throughout the country.

49. The Secretary of State for Wales has announced his intention of establishing a Welsh National Water Development Authority. In addition to its other functions this will act as the Regional Water Authority for the 4 exclusively Welsh river authority areas and the areas of the Wye, and Dee and Clwyd river authorities (including those parts which lie in England). In the remainder of Wales, that is to say the upper Severn basin, the Severn-Trent authority will act as the Regional Water Authority in consultation with the Welsh National Water Development Authority. At ministerial level the Secretaries of State for the Environment and for Wales will be jointly responsible for water services in the 3 Anglo-Welsh river basins (the Dee, Severn and Wye). Before taking decisions on water services the Secretary of State for Wales will have ascertained, and will take into consideration, the views of the Welsh National Water Development Authority. Appropriate arrangements will be made for the representation of that part of the Severn basin lying in Wales and those parts of the Dee and Wye basins lying in England: it is envisaged for example that they will have separate consumer councils. Consideration of the constitution of the Welsh National Water Development Authority will be deferred however until the report of the Commission on the Constitution has been received.

50. As the boundaries proposed for Regional Water Authorities are based on watersheds they do not, on the whole, coincide exactly with the boundaries of the present statutory water undertakers and sewerage authorities. However, this should not give rise to significant practical difficulties with the boundaries now proposed. Where necessary one Regional Water Authority will be empowered to supply water, or (much more rarely) provide trunk sewers, within the area of another. The Department of the Environment will carry out consultations on the provision to be made for mutual arrangements between Regional Water Authorities.

IV. ORGANISATION AT THE NATIONAL LEVEL

51. Arrangements at national level were outside the terms of reference of the CAWC. They recorded, however, that they envisaged a National Water Authority performing the functions at present performed by the Water Resources Board though over a field which would include water quality as well as quantity, and with reserve power to execute works.

52. The Government fully agree that there must be a national strategy for the development of water resources, prepared with the help of the regional studies carried out by the Water Resources Board and revised from time to time. This strategy will reflect Government policy in such matters as regional planning and the use of land. They do not think, however, that this makes it necessary to interpose a national body between Ministers and the small number of strong Regional Water Authorities they propose. The Water Resources Board has done indispensable work, of great value to the country, but the need for it arose from there being 29 river authorities. The new authorities will largely be self-sufficient in water; and where water does need to be moved from one region to another the regional authorities involved should have no difficulty in settling matters between themselves. They will also be fully capable of carrying out the largest works. It will fall to them to revise the national strategy from time to time in close consultation with the Government. Direct communication between them and the Government will be an advantage to both sides.

53. There is, however, a need for a body to speak for the industry as a whole, and to provide central services for its benefit. The Government propose that there should be a statutory Water Council to perform these functions. The Council would consist of a Chairman appointed by Ministers, together with the Chairmen of the Regional Water Authorities, and additional members chosen by Ministers as having special knowledge of industrial, agricultural, amenity, recreational and other matters. It would be specifically charged with the duty of promoting efficiency in the industry by comparing practices and performance in the different authorities and helping authorities to profit from each other's ideas and experience.

54. It will be necessary for the Secretaries of State to have power to give general directives to the regional authorities on matters of policy, and a power to resolve any disagreements that may arise between them. The last would be a reserve power: the Government regard its use as unlikely.

V. TIMETABLE FOR REORGANISATION

55. Some of the bodies at present responsible for the provision of water services are directly affected by the reorganisation of local government in England and Wales. Others are affected only indirectly, or not at all. The Government consider that on balance the transition will be easier if the Regional Water Authorities are in a position to take up their duties at the same time as the new local authorities. Their aim is to introduce legislation which will make this possible. Pending the consideration by Parliament of further legislation, however, and as a contingency measure, the necessary provision has been included in the Local Government Bill now before Parliament for the continuance of the existing functions on what is, effectually, the present basis after 1 April 1974.

56. The Government propose that the Bill for the reorganisation of water services should be confined to matters immediately relevant to reorganisation. Changes in other aspects of the legislation governing water services and the rationalisation of the various powers inherited by the new authorities will be effected, as need be, by subsequent legislation, which will be able to take advantage of the practical experience gained in the operation of all-purpose authorities.

57. The Department of the Environment is proposing to the associations concerned that meetings should be held at the regional level for the purpose of setting up working parties, in advance of legislation, to make preparations for the transition. If this proposal meets with general agreement steps can be taken to implement it while consultations on other matters are still proceeding.

58. The aim must be to complete consultations on the other principal matters outstanding by the late spring of 1972, so as to leave adequate time for the drafting of legislation.

59. There will be full consultations about the transfer of employees to the new authorities and the arrangements for the protection of their interests.

SCHEDULE OF AREAS PROPOSED FOR REGIONAL WATER AUTHORITIES (PARAS. 44-50)

Regional Water Authority	Comprising the following river authority areas
1	Cumberland Lancashire Mersey and Weaver
2	Northumbrian together with the catchments of the river Esk and those rivers entering the sea to the North of it in the Yorkshire River Authority area (corresponding approximately to Whitby UD and RD)
3*	Severn Trent together with the Ancholme and Great Eau groups of catchments in the Lincolnshire River Authority area (corresponding approximately to the areas of supply of the North Lindsey and North East Lincolnshire Water Boards plus the northern half of the area of supply of the East Lincolnshire Water Board)
4	Yorkshire (minus the area in RWA 2)
5	East Suffolk and Norfolk Essex (minus the area in RWA 6) Great Ouse Lincolnshire (minus the area in RWA 3) Welland and Nene
6	Lee Conservancy Thames Conservancy together with: the London Excluded Area; the catchments of the rivers Darent and Cray (in the Kent River Authority area); that part of the Essex River Authority area which drains to the Thames upstream of Canvey Island (the Roding and Ingrebourne group of catchments). This authority will also assume the pollution control functions at present exercised by the Port of London Authority and the Greater London Council.
7	Hampshire Isle of Wight Kent (minus the area in RWA 6) Sussex

Regional Water Authority	Comprising the following river authority areas
8	Avon and Dorset Bristol Avon Somerset
9	Cornwall Devon
10. Welsh National Water* Development Authority	Dee and Clwyd Glamorgan Gwynedd South West Wales Usk Wye

*The special arrangements proposed for the 3 Anglo-Welsh river basins (Dee, Severn, Wye) are summarised in para 49. In addition special membership provisions will be made so that the Welsh National Water Development Authority, when acting in its capacity as a Regional Water Authority, will be able to take account of the interests of those parts of Cheshire and Herefordshire in which it will provide water services. It is envisaged that at least one member of the Welsh National Water Development Authority will also be a member of RWA 3. There will be separate consumer councils for the areas in England in which water services are provided by the Welsh National Water Development Authority, and for the area in Wales in which they are provided by RWA 3.

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STATUTORY INSTRUMENTS

1973 No. 1288

WATER, ENGLAND AND WALES

The Northumbrian Water Authority Constitution Order 1973

Made - - - -	25*th July* 1973
Coming into Operation	26*th July* 1973

The Secretary of State for the Environment and the Minister of Agriculture, Fisheries and Food, acting jointly in exercise of the powers conferred on them by sections 2(4) and (6) and 3(1) and (6) of the Water Act 1973(a) and of all other powers enabling them in that behalf, hereby order as follows:—

Citation and commencement

1. This order may be cited as the Northumbrian Water Authority Constitution Order 1973 and shall come into operation on 26th July 1973.

Interpretation

2.—(1) In this order, unless the context otherwise requires—

"the Act" means the Water Act 1973;

"the 1945 Act" means the Water Act 1945(b);

"the 1972 Act" means the Local Government Act 1972(c);

"county", "district", "county council" and "district council" mean respectively a county, district, county council, and district council established by the 1972 Act;

"existing statutory water undertakers" means statutory water undertakers within the meaning of the 1945 Act who are in existence at the date of the making of this order;

"the Minister" means the Minister of Agriculture, Fisheries and Food;

"the water authority" means the Northumbrian Water Authority.

(2) An article or schedule referred to only by number in this order means the article or schedule so numbered in this order.

(3) The Interpretation Act 1889(d) shall apply for the interpretation of this order as it applies for the interpretation of an Act of Parliament.

(a) 1973 c. 37.
(b) 1945 c. 42.
(c) 1972 c. 70.
(d) 1889 c. 63.

[DOE 12330]

Establishment and general area of Northumbrian Water Authority

3.—(1) There shall be established a regional water authority, which shall come into existence on the date on which this order comes into operation, and which shall be known as the Northumbrian Water Authority, for the area asssigned to the water authority by virtue of section 2(2) of, and Schedule 1 to. the Act, that is to say the area of the Northumbrian River Authority, and in this article "the general water authority area" means the area so assigned.

(2) For the purposes of this order, and without prejudice to paragraphs 2 to 5 of Schedule 2 to the Act, the seaward boundaries of the Northumbrian River Authority shall be taken as being the seaward boundaries having effect by virtue of the Northumbrian River Authority (Seaward Boundaries of Area) Order 1964(a).

(3) Where the water authority perform any of their functions in any area which lies outside the general water authority area and within the area assigned to another regional water authority by virtue of section 2(2) of, and Schedule 1 to, the Act, they shall perform those functions in consultation with that authority.

(4) The provisions of this order shall be without prejudice to the provisions of section 126 (which relates to certain border rivers) of the Water Resources Act 1963(b).

Members of water authority

4.—(1) The water authority shall consist of nineteen members.

(2) The number of members specified for the purposes of paragraph (*b*) of section 3(1) of the Act as the number to be appointed by the Minister is two.

(3) The number of members specified for the purposes of paragraph (*c*) of section 3(1) of the Act as the number to be appointed by the Secretary of State is six.

(4) (*a*) The number of members to be appointed by each of the councils of counties specified in column (1) of Schedule 1, or by the councils of each group of districts so specified, shall be the number specified in relation to that county or to that group in column (2) of that Schedule.

(*b*) Where in the said schedule the number to be appointed is specified in relation to a group of districts, the councils of the districts comprised in the group shall between them appoint that number.

(*c*) The year specified for the purposes of paragraph 4 of Schedule 3 to the Act (which provides that the first members to whom that paragraph applies shall hold office until the end of May in such year as may be specified for the purposes of that paragraph) is the year 1975 in the case of a member appointed by the councils of a group of districts, and the year 1977 in the case of a member appointed by the council of a county.

Water supply area

5. The area within which it shall be the duty of the water authority to supply water under Part II of the Act shall be the area comprising the limits of supply of the existing statutory water undertakers named in Schedule 2.

(a) S.I. 1964/1493. (b) 1963 c. 38.

SCHEDULE 1

Article 4

NUMBERS OF MEMBERS TO BE APPOINTED BY LOCAL AUTHORITIES

(1)	(2)
Metropolitan County	*Number of Members*
Tyne and Wear	Two
Non-Metropolitan County	
Cleveland	One
Durham	One
Northumberland	One
Metropolitan District	
Gateshead, Newcastle upon Tyne, North Tyneside, South Tyneside, Sunderland	Two between them
Non-Metropolitan District	
Hartlepool, Langbaurgh, Middlesbrough, Stockton-on-Tees	One between them
Chester-le-Street, Darlington, Derwentside, Durham, Easington, Sedgefield, Teesdale, Wear Valley	One between them
Alnwick, Berwick-upon-Tweed, Blyth Valley, Castle Morpeth, Tynedale, Wansbeck	One between them

SCHEDULE 2

Article 5

EXISTING STATUTORY WATER UNDERTAKERS

Darlington Corporation
Tynemouth Corporation

Durham County Water Board
Tees Valley and Cleveland Water Board

Hartlepools Water Company
Newcastle and Gateshead Water Company
Sunderland and South Shields Water Company

Signed by Authority
of the Secretary of State.
25th July 1973.

R. Graham Page,
Minister for Local Government
and Development
Department of the Environment.

In Witness whereof the Official Seal of the Minister of Agriculture, Fisheries and Food is hereunto affixed on 20th July 1973.

(L.S.)

Joseph Godber,
Minister of Agriculture, Fisheries and Food.

EXPLANATORY NOTE

(This Note is not part of the Order.)

The Water Act 1973 requires the Secretary of State and the Minister of Agriculture, Fisheries and Food by order to establish regional water authorities for the areas specified in the Act. This order accordingly establishes the Northumbrian Water Authority. The authority will consist of nineteen members appointed as follows:—

(*a*) a chairman appointed by the Secretary of State;

(*b*) two members appointed by the Minister of Agriculture, Fisheries and Food;

(*c*) six members appointed by the Secretary of State;

(*d*) five members appointed by the county councils specified in article 4 of the order; and

(*e*) five members appointed by the councils of the groups of district councils specified in article 4 of the order.

The first members to be appointed by district councils will hold office until the end of May 1975, and those appointed by county councils until May 1977; otherwise the terms of office of the chairman and members will be governed by paragraphs 3 and 4 of Schedule 3 to the Act.

The Northumbrian Water Authority will come into existence on the day on which the order comes into operation.

Except in so far as article 5 (relating to water supply) specifies a particular area for the exercise of particular functions of the authority, the Act requires the authority (subject to the general provisions of the Act) to exercise their functions as respects the area specified as their area in Schedule 1 to the Act, namely the area of the Northumbrian River Authority.

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STATUTORY INSTRUMENTS

1973 No. 1359

WATER, ENGLAND AND WALES

The Anglian Water Authority Constitution Order 1973

Made - - - -	31*st July* 1973
Coming into Operation	1*st August* 1973

The Secretary of State for the Environment and the Minister of Agriculture, Fisheries and Food, acting jointly in exercise of the powers conferred on them by sections 2(4) and (6) and 3(1) and (6) of the Water Act 1973(**a**) and of all other powers enabling them in that behalf, hereby order as follows:—

Citation and commencement

1. This order may be cited as the Anglian Water Authority Constitution Order 1973 and shall come into operation on 1st August 1973.

Interpretation

2.—(1) In this order, unless the context otherwise requires—

"the Act" means the Water Act 1973;

"the 1945 Act" means the Water Act 1945(**b**);

"the 1972 Act" means the Local Government Act 1972(**c**);

"county", "district", "county council" and "district council" means respectively a county, district, county council, and district council established by the 1972 Act;

"existing statutory water undertakers" means statutory water undertakers within the meaning of the 1945 Act who are in existence at the date of the making of this order;

"the general water authority area" has the meaning assigned to it in article 3(1);

"the map" means the map, prepared in duplicate, signed by an Under Secretary in the Department of the Environment and an Under Secretary in the Ministry of Agriculture, Fisheries and Food, and marked "Map referred to in the Anglian Water Authority Constitution Order 1973", of which one duplicate has been deposited and is available for inspection at the offices of the Secretary of State for the Environment and the other at the offices of the Minister of Agriculture, Fisheries and Food;

"the Minister" means the Minister of Agriculture, Fisheries and Food;

"the water authority" means the Anglian Water Authority.

(2) An article or schedule referred to only by number in this order means the article or schedule so numbered in this order.

(**a**) 1973 c. 37. (**b**) 1945 c. 42. (**c**) 1972 c. 70.

[DOE 12328]

(3) The Interpretation Act 1889(a) shall apply for the interpretation of this order as it applies for the interpretation of an Act of Parliament.

Establishment and general area of Anglian Water Authority

3.—(1) There shall be established a regional water authority, which shall come into existence on the date on which this order comes into operation, and which shall be known as the Anglian Water Authority, for the area assigned to the water authority by virtue of Section 2(2) of, and Schedule 1 to, the Act, that is to say the area comprising—

(*a*) the areas of the East Suffolk and Norfolk, Great Ouse, Lincolnshire, and Welland and Nene River Authorities; and

(*b*) the area of the Essex River Authority except the part of the area of that authority the drainage of which is directed to the Thames above the point where the western boundary of the catchment area of the Mar Dyke meets the Thames, which part is shown hatched black on the map,

and in this order "the general water authority area" means the area so assigned, as it is more particularly described in this paragraph.

(2) For the purposes of this order, and without prejudice to paragraphs 2 to 5 of Schedule 2 to the Act, the seaward boundaries of the area of any river authority named in column (1) of Part 1 of Schedule 1 to this order shall be taken as being the seaward boundaries having effect by virtue of the instrument or instruments specified in relation to that authority in column (2) of the said Part 1, and no part of the waters specified in Part 2 of that schedule shall be taken as being included in the general water authority area.

(3) Where the water authority perform any of their functions in any area which lies outside the general water authority area and within the area assigned to another regional water authority by virtue of section 2(2) of, and Schedule 1 to, the Act, they shall perform those functions in consultation with that authority.

Members of water authority

4.—(1) The water authority shall consist of thirty-five members.

(2) The number of members specified for the purposes of paragraph (*b*) of section 3(1) of the Act as the number to be appointed by the Minister is four.

(3) The number of members specified for the purposes of paragraph (*c*) of section 3(1) of the Act as the number to be appointed by the Secretary of State is twelve.

(4) (*a*) The number of members to be appointed by each of the councils of counties specified in column (1) of Schedule 2, or by the councils of each group of districts so specified, shall be the number specified in relation to that county or to that group in column (2) of that schedule.

(*b*) Where in the said schedule the number to be appointed is specified in relation to a group of districts, the councils of the districts comprised in the group shall between them appoint that number.

(a) 1889 c. 63.

(c) The year specified for the purposes of paragraph 4 of Schedule 3 to the Act (which provides that the first members to whom that paragraph applies shall hold office until the end of May in such year as may be specified for the purposes of that paragraph) is the year 1975 in the case of a member appointed by the councils of a group of districts, and the year 1977 in the case of a member appointed by the council of a county.

Water supply area

5. The area within which it shall be the duty of the water authority to supply water under Part II of the Act shall be the area comprising the limits of supply of the existing statutory water undertakers named in Schedule 3.

Area for river pollution functions

6. The area of the water authority for the purposes of their functions relating to the restoration and maintenance of the wholesomeness of rivers and other waters shall include the waters required to be included by virtue of paragraph 5 of Schedule 2 to the Act, subject to the exclusion of any part of the waters specified in Part 3 of Schedule 1 to this order which, but for the provisions of this article, would be so included.

Fisheries area

7. The area of the water authority for the purposes of their functions relating to fisheries shall include the waters required to be included by virtue of paragraph 4 of Schedule 2 to the Act, subject to the exclusion of any part of the waters specified in Part 4 of Schedule 1 to this order which, but for the provisions of this article, would be so included.

Sewerage and sewage disposal area

8. The area of the water authority for the purposes of their functions relating to sewerage and sewage disposal shall be the general water authority area subject to—

(*a*) the exclusion of the areas specified in Part 1 of Schedule 4; and

(*b*) the inclusion of the areas specified in Part 2 of that schedule.

SCHEDULE 1 — Articles 3, 6 and 7

SEAWARD BOUNDARIES

In this schedule—

"the area of the Southern Water Authority" and "the area of the Thames Water Authority" means respectively the area assigned to the Southern Water Authority and the area assigned to the Thames Water Authority by virtue of section 2(2) of, and Schedule 1 to, the Act;

"the Thames area" and "the *Yantlet line*" have the same meaning as in the Port of London Act 1968(a).

(a) 1968 c. xxxii.

PART 1

Instruments Designating Tidal Waters for Inclusion in River Authority Areas

(1) *River Authority*	(2) *Instrument*
East Suffolk and Norfolk River Authority	The East Suffolk and Norfolk River Authority (Seaward Boundaries of Area) Order (1964)(a)
Essex River Authority	The Essex River Authority (Seaward Boundaries of Area) Order 1964(b)
Great Ouse River Authority	The Great Ouse River Authority (Seaward Boundaries of Area) Order 1964(c)
Lincolnshire River Authority	The Lincolnshire River Authority (Witham) (Seaward Boundaries of Area) Order 1964(d)
	The Humber (Seaward Boundaries of River Authority Areas) Order 1964(e)
Welland and Nene River Authority	The Welland and Nene River Authority (Seaward Boundaries of Area) Order 1964(f)

PART 2

Waters Excluded from the General Water Authority Area

The tidal waters within the following line, that is to say—

a line drawn due north from the point at which the boundary on land between the area of the Thames Water Authority and the area of the Southern Water Authority meets the Thames to the boundary in the Thames between the counties of Kent and Essex, and thence in a generally westward direction along the boundary between the said counties, and thence along the boundary in the Thames between Greater London and the county of Essex to the point on that boundary due south of the point at which the boundary on land between the area of the Thames Water Authority and the general water authority area meets the Thames, and thence due north to the last-mentioned point.

PART 3

Waters Excluded from the Area for River Pollution Purposes

The tidal waters and parts of the sea within the Thames area.

PART 4

Waters Excluded from the Fisheries Area

The tidal waters and parts of the sea within so much of the Thames area as lies within the Yantlet line.

(a) S.I. 1964/1503.
(b) S.I. 1964/1504.
(c) S.I. 1964/1506.
(d) S.I. 1964/1491.
(e) S.I. 1964/1509.
(f) S.I. 1964/1499.

SCHEDULE 2 Article 4

NUMBERS OF MEMBERS TO BE APPOINTED BY LOCAL AUTHORITIES

(1) *County*	(2) *Number of Members*
Bedfordshire	One
Buckinghamshire	One
Cambridgeshire	One
Essex	One
Humberside	One
Lincolnshire	One
Norfolk	One
Northamptonshire	One
Suffolk	One
District	
Bedford, Luton, Mid Bedfordshire, South Bedfordshire	One between them
Aylesbury Vale, Beaconsfield, Chiltern, Milton Keynes, Wycombe	One between them
Cambridge, East Cambridgeshire, Fenland, Huntingdon, Peterborough, South Cambridgeshire	One between them
Basildon, Braintree, Brentwood, Castle Point, Chelmsford, Colchester, Epping Forest, Harlow, Maldon, Rochford, Southend-on-Sea, Tendring, Thurrock, Uttlesford	One between them
Beverley, Boothferry, Cleethorpes, Glanford, Grimsby, Holderness, Kingston upon Hull, North Wolds, Scunthorpe	One between them
Boston, East Lindsey, Lincoln, North Kesteven, South Holland, South Kesteven, West Lindsey	One between them
Breckland, Broadland, Great Yarmouth, Norwich, Pastonacres, South Norfolk, West Norfolk	One between them
Corby, Daventry, East Northamptonshire, Kettering, Northampton, South Northamptonsire, Wellingborough	One between them
Babergh, Forest Heath, Ipswich, Mid Suffolk, St. Edmundsbury, Suffolk Coastal, Waveney	One between them

SCHEDULE 3 Article 5

EXISTING STATUTORY WATER UNDERTAKERS

Ipswich Corporation
Buckingham Corporation
Norwich Corporation

Bedfordshire Water Board
Bucks Water Board
Colchester and District Water Board
East Lincolnshire Water Board
Ely, Mildenhall and Newmarket Water Board
Higham Ferrers and Rushden Water Board
Kesteven Water Board
Lincoln and District Water Board
Mid-Northamptonshire Water Board
Nene and Ouse Water Board
North East Lincolnshire Water Board
North Lindsey Water Board
North West Norfolk Water Board
South Lincolnshire Water Board
South Norfolk Water Board
West Suffolk Water Board
Wisbech and District Water Board

Cambridge Water Company
East Anglian Water Company
Essex Water Company
Tendring Hundred Waterworks Company

SCHEDULE 4 Article 8

SEWERAGE AND SEWAGE DISPOSAL AREA

PART 1

AREAS WITHIN THE GENERAL WATER AUTHORITY AREA IN WHICH THE WATER AUTHORITY ARE NOT TO EXERCISE SEWERAGE AND SEWAGE DISPOSAL FUNCTIONS

So much of--

(*a*) the urban district of Gainsborough, and

(*b*) the parish of Kirton in Lindsey, in the rural district of Glanford Brigg,

as lies within the general water authority area.

PART 2

AREAS OUTSIDE THE GENERAL WATER AUTHORITY AREA IN WHICH THE WATER AUTHORITY ARE TO EXERCISE SEWERAGE AND SEWAGE DISPOSAL FUNCTIONS

So much of—

(*a*) the borough of Dunstable,

(*b*) the urban district of Thurrock, and

(*c*) the parish of Houghton Regis, in the rural district of Luton,

as lies outside the general water authority area.

Signed by authority of
the Secretary of State.
31st July 1973.

R. Graham Page,
Minister for Local
Government and Development
Department of the Environment.

In Witness whereof the Official Seal of the Minister of Agriculture, Fisheries and Food is hereunto affixed on 26th July 1973.

(L.S.)

Joseph Godber,
Minister of Agriculture, Fisheries and Food.

EXPLANATORY NOTE

(*This Note is not part of the Order.*)

The Water Act 1973 requires the Secretary of State and the Minister of Agriculture, Fisheries and Food by order to establish regional water authorities for the areas specified in the Act. This order accordingly establishes the Anglian Water Authority. The authority will consist of thirty-five members, appointed as follows:—

(*a*) a chairman appointed by the Secretary of State;

(*b*) four members appointed by the Minister of Agriculture, Fisheries and Food;

(*c*) twelve members appointed by the Secretary of State;

(*d*) nine members appointed by the county councils specified in article 4 of the order; and

(*e*) nine members appointed by the councils of the groups of district councils specified in article 4 of the order.

The first members to be appointed by district councils will hold office until the end of May 1975, and those appointed by county councils until May 1977; otherwise the terms of office of the chairman and members will be governed by paragraphs 3 and 4 of Schedule 3 to the Act.

SCHEDULE 3 Article 5

EXISTING STATUTORY WATER UNDERTAKERS

Ipswich Corporation
Buckingham Corporation
Norwich Corporation

Bedfordshire Water Board
Bucks Water Board
Colchester and District Water Board
East Lincolnshire Water Board
Ely, Mildenhall and Newmarket Water Board
Higham Ferrers and Rushden Water Board
Kesteven Water Board
Lincoln and District Water Board
Mid-Northamptonshire Water Board
Nene and Ouse Water Board
North East Lincolnshire Water Board
North Lindsey Water Board
North West Norfolk Water Board
South Lincolnshire Water Board
South Norfolk Water Board
West Suffolk Water Board
Wisbech and District Water Board

Cambridge Water Company
East Anglian Water Company
Essex Water Company
Tendring Hundred Waterworks Company

SCHEDULE 4 Article 8

SEWERAGE AND SEWAGE DISPOSAL AREA

PART 1

AREAS WITHIN THE GENERAL WATER AUTHORITY AREA IN WHICH THE WATER AUTHORITY ARE NOT TO EXERCISE SEWERAGE AND SEWAGE DISPOSAL FUNCTIONS

So much of---

(*a*) the urban district of Gainsborough, and

(*b*) the parish of Kirton in Lindsey, in the rural district of Glanford Brigg,

as lies within the general water authority area.

WATER AUTHORITIES

WATER ACT 1973, SECTION 15

MODEL ARRANGEMENTS BETWEEN A WATER AUTHORITY AND A RELEVANT AUTHORITY FOR THE DISCHARGE OF SEWERAGE FUNCTIONS

THE Water Authority ("the Authority") and the Council ("the Council") (a) hereby enter into the following arrangements, pursuant to section 15 of the Water Act 1973:-

1. In these arrangements, unless the context otherwise requires -

"the Act" means the Water Act 1973, and a section or schedule referred to only by number in these arrangements means the section or schedule so numbered in the Act;

"the 1936 Act" means the Public Health Act 1936;

"the area of the Authority" means the area of the Authority for the purposes of their functions relating to sewerage and sewage disposal as defined in article of the Water Authority Constitution Order 1973, subject to any amendment of that area effected by any order made under section 2(5);

"the area of the Council" means so much of the area of the Council as lies within the area of the Authority;

"enactment" includes any Act of Parliament or statutory order and any provision in an Act of Parliament or statutory order;

"the relevant functions" means the functions of the Authority under Part II of the 1936 Act, other than any of their functions relating to -

(a) sewage disposal or

(b) the maintenance or operation of any sewer which immediately before 1st April 1974 was vested in a joint sewerage board or the Greater London Council;

"sewers" includes foul, surface water, and combined sewers, storm overflows, overflow pipes and outfalls except outfalls from sewage disposal works, storm water balancing stations (other than storm water tanks within the curtilage of sewage treatment works); pumps and pumping stations belonging to any sewer (including emergency outflows therefrom) and rising mains not discharging directly to sewage treatment works; and "sewerage system" and "works of sewerage" shall be construed accordingly.

(a) Where the relevant authority are the development corporation of a new town, they may be described as "the Development Corporation ('the Corporation')".

2.-(1) On or before 197 , and on or before in each year thereafter, or at such other date as the Authority may determine, the Council shall prepare and submit to the Authority a statement of the works of sewerage which appear to them to be necessary at that date for effectually draining the area of the Council.

(2) In preparing any such statement the Council shall have regard to any relevant structure plan and local plan, and to any development taking place, or expected to take place, in or near their area.

(3) The Authority shall have regard to any such statement received by them when they formulate any policies or proposals for the purpose of carrying out their functions under the Act.

3. On or before 197 , the Authority shall furnish to the Council a statement of the policies, priorities and proposals of the Authority relating to the maintenance and development of sewerage systems in the area of the Authority, and on or before in each year thereafter or at such other date as the Authority may determine the Authority shall furnish to the Council a statement supplementing, amending or superseding the statements previously furnished under this paragraph.

4.-(1) On or before 197 , and on or before in each year thereafter or at such other date as the Authority may determine the Council shall submit to the Authority for their approval a programme of capital works of sewerage ("a capital works programme") considered to be required to be executed during the period of five years /commencing on 1 April next following that date/ (or such longer period as the Authority may specify to the Council) for the purpose of effectually draining the area of the Council.

(2) Without prejudice to the generality of sub-paragraph (1) above, a capital works programme shall include the following matters -

(a) particulars of land (including buildings) and of equipment which it is considered necessary to acquire;

(b) estimates of the capital cost of the programme and of any associated costs;

(c) particulars, so far as these can be estimated, of any contingent payments which may have to be made by way of compensation to any person.

(3) In preparing any capital works programme the Council shall take into account any information or guidance contained in any statement furnished to them by the Authority under paragraph 3 above and the programme shall be in such form as the Authority may determine.

5.-(1) On or before 197 , and on or before in each year thereafter or at such other date as the Authority may determine, the Council shall submit to the Authority for their approval a programme in such form as the Authority may require of expenditure chargeable to revenue account ("a revenue expenditure programme") which the Council expect to incur during the period of five years /commencing on 1 April next following that date/ (or such longer period as the Authority may specify to the Council) in respect of the sewerage systems within the area of the Council, including the maintenance and running costs of ancillary land and buildings.

(2) In preparing any revenue expenditure programme the Council shall take into account any information or guidance contained in any statement furnished to them by the Authority under paragraph 3 above and any advice received by them from the Authority as to the items which may properly be charged to revenue account.

6. Where the Authority have approved any capital works programme or any revenue expenditure programme, the Council shall carry out that programme in the form in which it is so approved and within the limits of expenditure contained in the programme, except that, in relation to any item of expenditure upon works, expenditure exceeding the approved limits relating to that item by not more than 10 per cent. may be incurred by the Council at their discretion without the express approval of the Authority.

7.-(1) Subject to the provisions of these arrangements, the Authority shall reimburse the Council all expenses incurred by the Council in the discharge of the relevant functions, in such manner, and on such conditions, as the Authority and the Council may agree between them.

(2) Subject to the arrangements in subsection (1) above, the Council may include as part of their expenses such amounts in respect of establishment and administrative charges as may be agreed by the Authority.

(3) The Council shall submit to the Authority in such form and at such times as the Authority may require, such accounts, returns of their expenditure, audit checks, certificates of payments and other information as the Authority may require for the purposes of sub-paragraph (1).

(4) Reimbursement under (1) above shall be subject to the Authority being satisfied with the discharge of the relevant functions but such reimbursement shall not be unreasonably withheld.

8. The Authority, at any reasonable time and after giving reasonable notice, may, through any person authorised by them, visit and inspect any work which is being carried out, or which has been carried out, by or on behalf of the Council for the purposes of any of the relevant functions.

9.-(1) In any case where it appears necessary to the Council for reasons of emergency, that they should carry out works which are not included in any approved programme, they may carry out those works without the prior approval of the Authority.

(2) The Council shall report the carrying out of any such works to the Authority as soon as may be after they have been carried out, and the Authority, if they approve the works, shall reimburse the Council the cost of them. The approval of the Authority under this paragraph shall not be unreasonably withheld.

10.-(1) The Authority may at any time by notice in writing request the Council to carry out any works of sewerage specified in the notice in addition to, or in substitution for, works included in an approved programme.

(2) If the Council carry out the works specified in the notice, the Authority shall reimburse them the cost thereof.

(3) If the Council inform the Authority that they do not consider it reasonably practicable for the Council to carry out the works, the Authority may carry them out.

11.-(1) The Council shall provide such vehicles and equipment as may be necessary for maintaining the sewers which it is their function to maintain under these arrangements.

(2) The Council shall maintain detailed records of the times of and the purposes of the use of such vehicles and equipment that they may provide under sub-paragraph (1) above.

(3) The Authority shall pay to the Council, as reimbursement of all or part of the cost of any such provision, such amounts as the Authority and the Council may agree between them, at such intervals as may be so agreed.

12.-(1) Without prejudice to the generality of these arrangements the Council shall exercise within their area on behalf of the Authority the functions of the Authority under the provisions of Part II of the 1936 Act specified below and as exercisable by the Authority either by virtue of section 14(2) of the Act or under any local statutory provision as applied to the Authority by Part II of Schedule 6 to the Act.

Function	Provision of 1936 Act
Power to construct a public sewer	Section 15(1)(i)(a) and (b) Section 15(2) and (3)

Function (cont'd)	Provision of 1936 Act (cont'd)
Power to acquire by agreement any sewer, or the right to use any sewer	Section 15(1)(iii)
Power to declare any sewer to be vested in the Authority	Section 17
Power to agree to adopt any sewer or drain on behalf of the Authority, at a future date	Section 18
Power to require a proposed sewer or drain to be so constructed as to form part of the general sewerage system within the area of the Council	Section 19
Power to enter into an agreement with the county council or the Greater London Council for the use of highway drains and sewers for sanitary purposes, or to allow public sewers to be used for the drainage of highways	Section 21
Power to alter or close any public sewer	Section 22
Duty to maintain, cleanse and empty public sewers	Section 23
Power to recover on behalf of the Authority the cost of maintaining certain lengths of public sewers	Section 24
Power to enforce prohibition against certain matters being passed into public sewers	Section 27
Power to refuse consent for communication with a public sewer and to make such a communication	Sections 34 and 36
Power to require remedial work in relation to soil pipes and ventilating shafts	Section 40
Power to alter the drainage system of premises	Section 42
Power to examine and test drains and other apparatus believed to be defective	Section 48
General	So much of Part XII as relates to the above-mentioned sections

(2) The Council shall upon request by the Authority furnish them as soon as may be with estimates of the cost of and the period required for the construction of any sewer with respect to which such information is required for the purposes of section 16 of the Act and upon further such request construct any sewer which the Authority are under duty to construct in pursuance of that section.

(3) Where the Council propose to carry out any such construction by direct labour or to invite tenders they shall, unless the Authority otherwise direct, afford to the owners of the premises concerned an opportunity to submit a tender therefor.

(4) The Council shall pay to the Authority the amount of any expenses or penalties incurred by them under section 16(9) of the Act in any case where the Council has failed to complete the construction of a sewer within the period agreed between the parties and the Council under that section or determined in accordance with section 16(10).

13. The Authority shall furnish to the Council from time to time (and at any time when the Council so request) sufficient information as to the source, nature, composition, volume and rate and times of discharge of trade effluent in the area of the Council as may be required by the Council to enable them to ensure the safe operation of the works of sewerage maintained by the Council and to secure the safety of their employees and of the public.

14. The Council shall comply with any direction issued to them by the Authority concerning the basis of design, form of construction and the mode of operation of any sewer operated by the Council under these arrangements, or the direction in which sewage is required to flow within any such sewer, in any case where that mode of operation or direction of flow is likely to affect -

(a) the operation of any sewage treatment works, or

(b) the condition of any inland or coastal waters

to which the sewer discharges.

15. The Council are authorised to initiate or defend on behalf of the Authority any legal proceedings which relate to any relevant function, and the Authority shall give them any assistance or information which they may require for the conduct of any such proceedings.

16.-(1) If in any particular case it appears to the Authority that the Council have failed to do anything which they are required to do by or under these arrangements, they may give notice in writing to the Council specifying the nature of the failure, the action which they require the Council to take in order to rectify it and the time within which the action is to be taken.

(2) If at the end of that time it appears to the Authority that the Council have not taken the required action, the Authority may take the action themselves.

(3) The provisions of this paragraph shall be without prejudice to the provisions of section 15(7) of the Act, but no action taken by the Authority or the Council under this paragraph shall constitute the variation or termination of these arrangements under that enactment.

17. Any dispute arising under any provision of these arrangements shall be determined by an arbitrator to be appointed in default of agreement by the President of the Institution of Civil Engineers.

18.-(1) The Authority shall pay to any officer of the Council who suffers loss as a result of any variation or the ending of these arrangements such reasonable compensation as may be agreed between them or in default of agreement determined by arbitration as provided by paragraph 17 of these arrangements.

(2) If these arrangements are ended at any time and are not replaced by new arrangements to the like effect, the Authority shall accept into their employment any officer of the Council who at that time was employed wholly or mainly on work related to the relevant functions, on terms not less favourable than those specified in section 255(3) of the Local Government Act 1972.

WATER ACT 1973, SECTION 12

MODEL ARRANGEMENTS BETWEEN A WATER AUTHORITY AND A STATUTORY WATER COMPANY

The Water Authority and the Company hereby enter into the following arrangements, pursuant to section 12 of the Water Act 1973:-

1. In these arrangements -

"the Act" means the Water Act 1973, and a section referred to only by number means the section so numbered in the Act:

"the 1945 Act" means the Water Act 1945;

"the Authority" means the Water Authority;

"the Company" means the Company;

"the Company's limits of supply" means the limits within which the Company are authorised by their enactments to supply water immediately before 1st April 1974, or, in a case where those limits are varied on or after that date under section 10 of the 1945 Act, the limits as so varied;

"enactment" includes any Act of Parliament or statutory order and any provision in an Act of Parliament or statutory order.

2. Within the Company's limits of supply, the Company undertake to discharge, on behalf of the Authority, all duties imposed on the Authority by or under section 11 (Water supply) or any other provision of the Act relating to the supply of water within those limits, other than section 12, and so to exercise their powers and functions under any enactment as to secure the effective discharge of those duties.

3. - (1) Without prejudice to subsection (2) of Section 24 (Periodical reviews, plans and programmes) the Company shall submit to the Authority not later than the last day of August in each year a programme showing -

(a) the works which the Company propose to undertake in the period of 5 years beginning on 1st April of the following year for any of the following purposes, namely -

(i) the construction of source works, or the alteration or extention of existing source works designed for the purpose of materially affecting the yield of those works;

(ii) the construction of treatment works, or the alteration or extension of existing treatment works designed for the purpose of materially affecting the capacity of those works; or

(iii) the construction of a trunk main for the purposes of transporting water to or from a place outside the Company's limits of supply, or the construction of any works intended materially to increase the carrying capacity of a trunk main for that purpose.

(b) Any action of the following nature which the Company propose to undertake in the said period of 5 years, namely -

(i) any material change in the methods adopted by the Company for treating water for potable supply; or

(ii) any material change in the provision of facilities for recreation.

Any such programme shall include, as a separate item, particulars of any such operations proposed to be undertaken by a joint water board or joint water committee on which the Company are represented but the Authority are not represented.

(2) Where the Authority have received a programme submitted to them by the Company in pursuance of sub-paragraph (1) of this paragraph, and the Authority are of the opinion that any works proposed in the programme are not adequate to ensure that the statutory duties of the Authority with respect to the supply of water within the Company's limits of supply will be satisfactorily discharged, the Authority may require the Company by notice in writing to submit proposals for such additional or alternative works as they may specify in the notice for any of the purposes listed in the said sub-paragraph (1), and the Company, if so required, shall submit those proposals within six months after the date on which they receive the notice; and this sub-paragraph shall apply to any such proposals, after they have been submitted, as if they had been contained in the programme as originally submitted.

(3) Where the Authority submit any programme to the Secretary of State in pursuance of section 24(6), they shall include in that programme, as being works proposed to be carried out by the Company, or by a joint water board or joint water committee as aforesaid, only such works as have been included in a programme submitted by the Company to the Authority under sub-paragraph (1) of this paragraph or in proposals submitted under sub-paragraph (2) thereof.

(4) Where any proposals submitted by the Company under this paragraph have been approved -

(a) by the Authority, and

(b) Where the proposals are proposals of a nature which the Secretary of State has directed the Authority to submit to him as part of a programme under section 24(6), by the Secretary of State,

and the Company shall use their best endeavours to obtain all necessary consents, licenses and authorisations (including authorisations by orders under Section 23 of the 1945 Act) and, subject to the obtaining of these, shall carry out any project which has been so approved unless the Authority and the Company and, where the project has been approved by the Secretary of State, the Secretary of State otherwise agree.

4. - (1) In this paragraph, unless the context otherwise requires - "grant" means -

(a) a contribution payable by the Secretary of State under the Rural Water Supplies and Sewerage Acts 1944 to 1965 and the Rural Water Supplies and Sewerage Act 1971, or

(b) any grant or other contribution payable by the Secretary of State or the Minister of Agriculture, Fisheries and Food under any other enactment, in respect of works relating to the supply of water; and

"the appropriate Minister", in relation to any grant, means the Minister by whom that grant is payable.

(2) The following provisions of this paragraph shall have effect in any case where the Company propose to carry out works in respect of which a grant ("the relevant grant") may become payable to the Authority.

(3) Where the Authority propose to submit an application for the relevant grant to the appropriate Minister, they may require the Company to furnish them with such particulars of the proposed works as the Authority consider necessary for the purposes of the application, and the Company shall comply with that requirement.

(4) Where the Authority receive payment of the relevant grant, they shall pay it over to the Company.

(5) The Authority may authorise the Company to submit the application for the relevant grant to the appropriate Minister, and in any such case the Company shall furnish the Authority with a copy of the application at the time when they submit it to the appropriate Minister.

(6) In any particular case the Authority may authorise the Company to receive the relevant grant from the appropriate Minister.

(7) In any case where the relevant grant is received by the Company, and the

works to which it relates are works in respect of which a local authority have given an undertaking to make annual payments to the Company under section 36 of the 1945 Act, the cost of those works, for the purpose of the calculation of any such annual payment, shall be taken as being the actual cost of the works less the amount of the relevant grant.

5. - (1) The Authority shall keep the Company informed of the principles and criteria by reference to which the Authority propose from time to time to fix their charges in pursuance of section 30 (Water charges).

(2) The Company, in fixing their own charges, shall have regard to the principles and criteria adopted by the Authority, and shall keep the Authority informed of the principles and criteria by reference to which the Company propose from time to time to fix their charges for the supply of water.

6. - (1) Where any person institutes proceedings against the Authority in respect of any alleged breach of any statutory duty of the Authority in relation to water supply, being a breach alleged to have occurred as a result of any failure by the Company -

(a) the Authority shall give to the Company reasonable notice of the alleged breach, and no settlement or compromise of the action shall be made without the prior consent in writing of the Company;

(b) the Company shall give to the Authority such information and other assistance as the Authority may require for the purpose of defending the action, and shall indemnify the Authority against any penalty or expenses incurred by them in respect of such a breach unless the breach arose from some act or default of the Authority;

(c) if it is agreed by the Authority and the Company that the defence of the action shall be conducted by the Company in place of the Authority, the Authority shall give to the Company such information and other assistance as the Company may require for the purpose of defending the action.

7. Where the Company are preparing to make any byelaws under section 17 or section 18 of the 1945 Act, they shall furnish particulars of the proposed byelaws to the Authority, and before they make the byelaws they shall take into account any views expressed by the Authority concerning them.

8. - (1) As from 1st April 1974, the Company shall supply water to the Authority in accordance with the provisions of each of the agreements and instruments specified in column (1) of Table A below* as if the agreement or instrument were expressed to operate for the benefit of the Authority instead of the benefit of the person specified in column (2) of the Table (being statutory water undertakers whose undertaking is to be transferred to the Authority on 1st April 1974).

TABLE A

(1) Agreement or Instrument	(2) Person receiving supply of water from the Company

(2) As from 1st April 1974, the Authority shall supply water to the Company in accordance with the provisions of each of the agreements and instruments specified in column (1) of Table B below* as if the agreement or instrument were expressed to require the supply of water by the Authority and not by the person specified in column (2) of the Table (being statutory water undertakers whose undertaking is to be transferred to the Authority on 1st April 1974).

TABLE B

(1) Agreement or Instrument	(2) Person required to supply water to the Company

(3) The provisions of this paragraph are subject to the provisions of section 12 of the 1945 Act.

9. - (1) Where immediately before 1st April 1974 there is in operation one of the orders specified in column (1) of Table C below authorising certain statutory water undertakers ("the authorised undertakers") under section 11 of the 1945 Act to supply water outside their limits of supply in an area specified in column (2) of the Table, that supply shall continue to be given on and after that date -

(a) where the authorised undertakers are the Company, by the Company; and

(b) where the authorised undertakers are a body whose functions then become exercisable by the Authority by virtue of the Act, by the Authority.

* Paragraph 8 is intended to serve as a recital of existing bulk supply agreements

TABLE C

(1) Order made under section 11 of the 1945 Act	(2) Area of supply under the order

(2) In relation to each area specified in column (2) of Table C this paragraph shall have effect as if it constituted an agreement made between the Authority and the Company under section 13 of the Act and embodying the provisions of the relevant order, subject to any necessary modifications, and where the authorised undertakers are the Company, the provisions of these arrangements shall have effect in relation to such an area as they have effect in relation to the Company's limits of supply.

DEPARTMENT OF THE ENVIRONMENT

10 September 1973

SOVIET SYSTEM OF WATER LAW

by O.S. Kolbasov*

Part I

SOURCES AND SPHERE OF INFLUENCE OF THE SOVIET WATER LAW

The Soviet Water Law is a complex of legal regulations established or authorized by the Soviet State to provide for the rational utilization and conservation of water in the USSR. The numerous sources - statutes, decrees, regulations, instructions and so on contain rules of the Soviet Water Law.

The USSR Constitution proclaims general principles for the Soviet Law as a whole.

On December 10th, 1970 the Suprime Soviet of the USSR approved the basic water law--Fundamentals of Water legislation of the USSR and the Union Republics (see Appendix) which were put in force since September 1, 1971 ("Vedomosty" of the Suprime Soviet of the USSR, 1970, No. 50, p. 566). This law involves the most general and basic principles of regulations governing the utilization and protection of rivers, lakes, seas, reservoirs, other surface and underground water bodies within the territory of the Soviet Union. The said principles are compulsory for all ministries, departments, state agencies, enterprises, institutions, organizations and citizens.

As compared to other laws, Governmental decrees, regulations, principles, instructions and some legal acts that regulate the relations concerning water utilization and conservation, the Fundamental of Water Legislation have the highest legal force. All legislative regulations involved in water relations should be in accordance with the Fundamentals. Any new acts of the water legislation should be worked out also in absolute impliance with the Fundamentals.

In elaboration of Fundamentals of water legislation 15 Water Codes have been adopted in all Union Republics (see Appendix).

Besides, for more comprehensive regulation of water relations at all levels, i.e. all-union, republican and local, subsidiary normative acts such as statutes decrees, regulations, instructions are being adopted. The problems of the water law are also being solved in resolutions and decrees dealing with environment protection, for example, in the Decree of the CPSU Central Committee and the USSR Council of Ministers "On Strengthening the Environmental Protection and Betterment of the Utilization of Natural Resources" of December 29, 1972 (Collected Decrees of the USSR, 1973, No. 2, p. 6) attached hereinafter.

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The water law is one of the branches of the Soviet Law. Historically it formed an independent branch because of the increased importance of utilization and conservation of water resources and water relations, being quite specific, required separate and thorough legal regulation.

The Soviet Water Law regulates relations of State Agencies, State and public enterprises, organizations and individual citizens in connection with water ownership, management, utilization of water resources, water conservation and control of its harmful effect.

The main peculiarity is that these relations refer only to the natural water resources available as separate water bodies, i.e. seas, rivers, lakes, reservoirs, underground water and glaciers. If the water is also no longer a part of environment (for example, obtained by man), the relations with its utilization are not regulated by the Water Law, they are regulated by other branches of the Soviet Law, i.e. economic and civil ones.

The sphere of influence of the Soviet Water Law convers the entire territory of the Soviet Union. Sometimes it is in force beyond the USSR boundaries but within the national jurisdiction of the Soviet State and in connection with realization of its sovereign rights. The regime of the Soviet boundary water utilization in the part in which it is not regulated by the international agreements with the Soviet participation, shall be effected in conformity with USSR and Union Republics legislation.

POLICIES OF THE SOVIET STATE, OBJECTIVES AND PRINCIPLES IN THE FIELD OF UTILIZATION AND CONSERVATION OF WATER RESOURCES

Nearly 3 mill. rivers and springs (from 5 km and more in the length) flow on the territory of the USSR, their annual runoff makes up 4.7 thousand cu. km. which is equal to 12% of the world's total river runoff. The USSR has about 3 million lakes, over 5 thousand glaciers and a number of inland seas. Large areas are covered by territorial waters. The rechargeable underground water resources (annual flow) exceed 1000 cu. km.

Water resources are more intensively used to meet various demands of population for water and the needs of national economy.

For example, for the forty-year period (1928-1968) water supply for domestic purposes increased 25 times. At present water mains of our country supply about 50 million cu. km. of pure water a year. The utilization of water resources in industry and agriculture has significantly increased. In 1921 the area irrigated lands in the USSR covered 2.2 million ha. In 1965 it reached 9.8 million ha. As a result of successful fulfillment of the Five-year National Economy Development Plan the area of irrigated lands increased by 3 million ha. and even more. The Directives of the XXIVth Congress of the Communist Party of the Soviet Union for the Five Year National Economy Development Plan (1971-1975) envisage putting into practice 3 million ha. of new irrigated lands during this five-year period.

The growth of water withdrawal and consumption from surface and underground water resources will result in noticeable growth of sewage discharge and other wastes disposal into these sources.

Under such condition our country is faced with very important tasks: to ensure economical and most rational utilization of water resources, to eliminate adverse effects resulted from their utilization, to preserve and in some cases to improve and maintain in good condition water bodies and water sources on the territory of our country so as the present and future generations of people could meet their demand for water to its full effect.

In accordance with the resolutions of the XXIVth Congress of the Communist Party of the Soviet Union the rational utilization and conservation of water resources is considered in the USSR as part of wide-scale task of achieving stable harmony between the developing society and the satisfactory condition of natural environment. The rational utilization, preservation and reproduction of natural resources, care of nature constitute an integral part of the program of communism construction in the USSR. The Communist Party and the Soviet State attach great importance to nature protection and rational utilization of nature resources.

The Decree of the Suprime Soviet of the USSR "On Measures for Further Improving Nature Protection and Rational Utilization of Natural Resources" of September 20, 1972 declares: "An indefatigable concern for protection of nature and the better utilization of natural resources, the strict observance of the legislation of the conservation of land and its riches, forests and waters, plant and animal life and atmospheric air, shall be considered as one of the most vital tasks of the state, bearing in mind that scientific and technical progress must be combined with a regard for nature and its resources and must contribute to the creation of the most favorable conditions for the life, health, work, and leisure of the working people," "Vedomosty" of the Suprime Soviet of the USSR, 1972, No. 39, p. 346).

The principle juridical concepts, requirements, principles and constructions that follow from the political lines of the Communist Party and the Soviet State are fixed in the Law, in all its branches to fit the peculiarities of regulated public relations.

The Soviet Water Law also involves and suggests a number of principles, including: exclusive state ownership of water resources in the USSR; rational, comprehensive utilization of water resources, priority of water supply for drinking and domestic purposes; prohibition of putting into operation new or reconstructed economic projects if they are not provided with adequate facilities to prevent water pollution; improvement of all types of technology for the purpose of water conservation; constant observation over water resources, registration and control of all forms of water use; basin principle in the field of regulation of water utilization and conservation; active participation of population in all projects designed to ensure rational utilization and conservation of water resources, and other measures.

EXCLUSIVE STATE OWNERSHIP OF WATER RESOURCES IN THE USSR. INTEGRATED STATE WATER RESOURCES. CLASSIFICATION OF WATER RESOURCES.

From the very first days of the Soviet Power in our country there exists quite a new system of relations concerning the use of land, entrails, water resources and forests. This system is based on the law of exclusive State ownership of these natural resources, adopted as a result of socialist nationalization. Theoretically and practically the exclusiveness of State ownership is determined as an immutable right of the State to possess these or those objects, inadmissibility of appropriation of these objects by other subjects of law, except the Soviet State.

The right of exclusive State ownership of water resources is proclaimed in Article 3 of the Fundamentals of Water Legislation of the USSR and the Union Republics.

It is characteristic, that the law declares State ownership of water resources but not water. The Fundamentals of water Legislation draw a distinction between the notions of "water" and "water resources" which is very important for proper understanding of the law.

Water, as a mineral, is a kind of substance which is in continuous motion, circulation, and therefore it cannot be an exclusive State property. Water may become a property of individuals and organizations as a result of lawful activities (for example, drinking water of municipal water supply systems).

Water resources are natural water reserves which constitute separate material wealth. At the present level of development of productive forces in the society the use of this wealth is subject to purposeful regulation. The natural water resources involve seas, lakes, rivers, reservoirs, canals, sources or basins of underground waters, mountains and polar glaciers as well as other surface and underground water bodies and sources.

Unlike land, which, being an object of right of exclusive State ownership, is a homogeneous category, water resources are characterized by great diversity. To avoid enumeration of types of water resources when resulting water relations in each particular case, there has been introduced a unitary notion, e.g., a water body. The water body is a river, lake, sea, glacier, aquifer, etc. The whole complex of the said water bodies within the territory of the USSR, constitutes integrated State water resources.

It should be noted that State water resources are determined by the Legislation as being integrated. Our Legislation does not envisage water resources of the Union and Autonomous Republics nor all national-state formations and administrative units of the USSR. It follows from the above-said, that the subject of the right of exclusive State ownership of water resources is only one in our country, i.e. the Union of Soviet Socialist Republics.

The Soviet Water Law is based on the definite historically established classification of water resources according to the physical,

economic and political features. This classification, which has assumed a legal character, stipulates three main categories of waters: surface waters, underground waters and glaciers. In turn, these categories have their own subdivisions.

The surface water resources involve seas, lakes, rivers, reservoirs, other water bodies and water sources.

The category of seas includes inland seas, other inland sea waters (bays, inlets, etc.) as well as territorial waters (territorial sea) of the USSR. Lakes, rivers, reservoirs and other bodies may be inland and boundary.

Among inland water bodies one may distinguish drainless and drainage ones which are in exclusive use of definite enterprises and organizations, or in joint (collective) use of an indefinite number of subjects, i.e., interprises, institutions, organizations and citizens.

Underground water resources are subdivided into fresh and saline, cold and hot (thermal). All underground waters are considered to be inland.

Glaciers have not got any legal classification so far.

The given categories of water resources and their internal subdivisions have different legal regime and are taken into account when regulating the relations connected with the utilization and conservation of water resources.

THE RIGHT TO USE WATER RESOURCES; GENERAL CHARACTERISTICS, FORMS, SUBJECT, OBJECTS, RIGHTS AND OBLIGATIONS OF WATER USERS.

The fundamentals of Water Legislation pay much attention to the regulation of the relations associated with water use. For the first time in the Soviet Legislation there have been determined general principles of water use: subjects, objects, forms, grounds for establishing and revoking the right to use water, procedure and conditions of water users (Article 12-19). The Legislation established the procedure for compensation of damages arising from water development undertakings or changes in terms governing water use (Article 20). There have been determined main requirements imposed upon the utilization of water bodies for drinking, domestic and other needs of population; for purposes of therapy, health resorts and recreation; for the purposes of farming, industry, hydropower generation, water transport and timber rafting, air transport, fishery, game breeding and hunting, wildlife preserves for disposal of waters and other purposes (Article 21-32). A separate article is devoted to the exploitation of water reservoirs (Article 33).

The Fundamentals also solve such specific problems as regulations of use of water bodies situated within the territories of several Union Republics (Article 34) and water use from water bodies lying on the USSR State Frontier (Article 36). One of the articles (Article 35) shows procedure for settling disputes on water use.

Thus, 25 out of 46 articles of the Fundamentals of water Legislation deal with regulation of relations connected with water use.

Water use has its own classification. First of all, it is possible to distinguish forms of water use depending on economic objectives of utilization of water bodies. Various objectives condition main differences in legal requirements and assessment of economic importance of these or those forms of water use.

Water bodies shall be made available for use, provided the requirements and terms of the law are met. They must satisfy the needs of the population in drinking water, in water for domestic, therapeutic, health resort, recreation and other purposes as well as water needs of agriculture, industry, fishery, transport, including other State and public water needs. The use of water bodies for disposal of sewage may be allowed, but only in some cases and on condition that special requirements and terms are met. With regard for this, the Fundamentals have special articles which deal with regulation of use of water bodies for each of the said economic purposes.

Furthermore, there are two forms of water use: general water use which is affected without utilization of structures and technical installations affecting the condition of water, and special water use which is effected with the help of such structures or installations. The distinction of these forms of water use is also of great practical importance.

The special water use greatly affects the state of seas, lakes, rivers and other water bodies and may result in deterioration of conditions for comprehensive utilization of water resources, it may cause damage either to the State or to individual water users. Therefore, the special water use requires, as a rule, the implementation of research and project studies, preliminary correlation of conditions of water use, preliminary and contuitous control by State agencies. Unlike the special water use, the general one does not effect, to such an extent, the state of water bodies and hence it does not require detailed legal regulation and continous control.

Proceding from these circumstances, the Fundamentals provide for the general water use without any permission made by the State agencies but according to the regulations established by legislations of the Union Republics.

The typical examples of the general use of water are as follows: withdrawal of water by individuals with the help of simpliest household implements, swimming, watering of livestock directly from water bodies, game fishing, etc.

The special use is affected on the basis of permission granted by the agencies responsible for regulation of utilization and conservation of water resources and in the same cases on the basis of permission granted by executive committees of local Soviets of working People's Deputies; such permission is granted with the agreement of agencies

responsible for State sanitary inspection protection of fish resources, as well as other agencies concerned. The procedure for agreement and issue of permission for special water use is established by the USSR Council of Ministers.

Water bodies may be available for joint and exclusive water use.

Under joint use the water body is utilized jointly by two and more water users having independent rights. In this case each water user has the right (provided legal requirements are met) to utilize the water body without asking any permission from other water users but not infringing upon their legal rights and interests.

The joint water use is very widely spread. Practically it is observed in all cases when the water body is large enough.

Water use should be considered to be exclusive when a concrete water body, i.e. a lake, a pond, a part of a drainless water reservoir, a river stretch, etc., is made available for use by one water user and meant exclusively or mainly for meeting the needs of this water use. For example, the exclusive water use is observed when river stretches are made available for use by water transport facilities (creeks, ports, moorages, timber rafting harbours, etc.) or when drainless water bodies are made available for use by collective farms, fish breeding farms, etc.

Exclusive water users may not only use a water body available for them to meet their own requirements but may allow other enterprises, institutions, organizations or citizens to use water of this water body. In the latter case secondary (dependent) water use relations get established.

Water users in the USSR may be state cooperative and public enterprises, organizations, institutions and citizens of the USSR. In cases specified in the legislation of the USSR, other organizations and persons may also be water users.

The Legislation provides for great diversity of rights and obligations of water users depending on the forms of water use, subjects and objects of law ensuring water use.

As a rule, water use in the USSR is free of charge. According to the law the USSR Government is created with the right to charge water use in certain cases.

In compliance with the legislation definite terms of water use are stipulated in plans, project documents or in special permissions.

Water bodies may be made available either for permanent or temporary use. The permanent water use is the use without term specified in advance. The temporary water use may be either short-term, i.e., to a period of three years, or long-term, from three to twenty-five years. If necessary the terms of water use may be extended for a period not exceeding the initial short or long-term use, respectively. The general water use is not limited by any term.

Rational utilization of water resources is obligatory for all water users (Article 17). The requirements of the rational water use have been established with regard for the forms of water use. At the same time some articles of the Fundamentals of water legislation underline particular importance of the principle of comprehensive utilization of water resources. The preamble of the Fundamentals reads: "State ownership of water resourcers forms... favorable conditions for comprehensive utilization of waters along planned lines and with maximum economic effect."

The comprehensive water use involves economically justified employment of all useful properties of this or that body to meet various demands of all water users concerned, i.e. population and national economy; The comprehensive water use is observed when one water body is utilized by several water users or by one water user but for a number of purposes. For example, a water body may be available for use by one collective farm is used as a source of irrigation, water supply and for fishery, etc.

The comprehensive water use does not mean equal satisfaction of all demands for water. In most cases under comprehensive water use some forms of water use are given priority in conformity with local economic and natural conditions. The requirements of population in drinking water are met first of all.

PRIORITY OF DRINKING WATER SUPPLY FOR POPULATION. THE RIGHT TO DISCHARGE SEWAGE.

A man needs not less than two litres of drinking water daily. Large quantities of water are consumed by population for domestic purposes. The higher living standards of population, from the point of view of culture and hygiene, the higher level of water consumption.

The existing Legislation determines the general procedure of water use for drinking and domestic purposes of population, provides for measures of sanitary protection of water supply sources, prohibits the operation of enterprises polluting these sources, places special requirements to utilization of underground waters and so on. To estimate the quality of water supplied through centralized water mains for drinking and domestic purposes of population, the use is made of the State standard "Drinking water." The standard involves hygienic requirements based on the results of special medical and biological research studies. The suitability of a water body for use as a water supply source is also estimated according to the State standard.

The legal regulation of water use for drinking and domestic purposes of population in the USSR is based on two main principles; firstly, the natural water resources are available for general use by all citizens to meet their own requirements to the full effect; secondly, provision is made for all necessary health protection measures associated with water use.

The State principles responsible for regulation of water resources utilization have put into practice a rule of distinctive priority of drinking and domestic water supply for population as compared to other

forms of water use. It means that when a water source is used to meet various needs, the water use for drinking and domestic purposes of population is not liable to any limitations in favor of other forms of water use. On the contrary, if the water use for industrial, agricultural and transport needs interferes with the use of natural water resources for drinking and domestic purposes of population, the former may be limited.

This rule is proclaimed in the Fundamentals and is of the new provisions of the Soviet Water Legislation. The demands of population for drinking water are met best of all through utilization of underground waters. Therefore the Fundamentals have proclaimed that the utilization of underground waters of drinking quality to meet the needs other than drinking and domestic ones is not admissible as a rule.

It is for the first time that the water legislation has established an important rule prohibiting the deterioration of conditions of drinking and domestic water use of population.

According to article 24, in the event of a calamity, breakdown, or some other extraordinary circumstances and in the event of excessive water consumption by an enterprise from the water supply system, executive committees of local Soviets of Wroking People's Deputies have the right to prohibit or limit the utilization of drinking water for industrial needs to benefit of meeting the demands of population for drinking and domestic water supply.

Unlike drinking water supply of population, the right to discharge sewage does not have any priority, moreover, it is rather strictly limited in the interests of water resources conservation.

The Law does not prohibit the discharge of sewage into water bodies because such prohibition would be an unreal step. At present and in visible future there are no adequate technical means to stop the discharge of not only industrial but, mainly, storm drainage (agricultural) and other kinds of wastewaters. Besides, it would be irrational to prohibit the return of wastewaters into water bodies under ever-growing rate of water withdrawal from bodies as the non-returnable water withdrawal will result in noticeable disturbance of the hydraulic regime in water bodies. Taking into account this circumstance, the law regulates the discharge of wastewaters as a form of water use and imposes a number of requirements upon their discharge. These requirements are aimed at eliminating (preventing) the pollution of water bodies as a result of wastewater discharge.

According to the Legislation water users are obliged to take measures to reduce water consumption and to stop the discharge of wastewaters through modification of producing technology and schemes of water supply (the utilization of air cooling, water recycling systems and other technical means).

Much importance is attached to the regulation of the procedure of sewage discharge.

In compliance with Article 31 of the Fundamentals the use of water bodies for discharge of industrial, municipal, drainage and other wastewaters may be effected only with the permission of agencies responsible for regulation of utilization and conservation of water resources upon agreement with the State sanitary inspection authority, fish protection and other agencies concerned.

It means that in every particular case of sewage discharge into a river, lake and sea there must be a permission of the agency responsible for regulation of the utilization and conservation of water resources, the permission being made according to the adopted form. This permission is a document specifying the right of this or that enterprise to discharge sewage. The permission specifies the name of an enterprise, the water body, the outfall location and the amount of sewage allowed to be discharged, as well as the kind of wastewaters, their composition, temperature, the degree of treatment, possible fluctuations of the amount of sewage discharge in time and some other conditions.

The unwarrant deviation from the specified procedure of sewage discharge is considered as a violation of the Water Legislation. In such cases the discharge of sewage should be restricted, suspended or prohibited by the above-mentioned agencies, even if it results in the stoppage of work of separate installations, workshops, enterprises, organizations and institutions.

The discharge of sewage is permitted only if it does not increase the concentration of pollutants in a water body above the permissible level. The USSR Ministry of Health has approved permissible concentrations of noxious substances in water of water bodies meant for sanitary domestic water use. These standards are in use now. Besides, there are General Requirements to the composition and characteristics of water in water bodies at points of drinking, domestic and recreational water use, as well as the General Requirements to the composition and characteristics of water in water bodies used for fishing. Permissible concentrations of radioactive substances in water of water bodies and sources of water supply are rated separately. All these standards taken together permit proper solution of the problem of possibility and terms of sewage discharge.

Thus, the Fundamentals of water Legislation, considering the discharge of sewage as a form of water use, establish such procedure of sewage discharge which provides the protection of water bodies and their comprehensive utilization.

PROTECTION OF WATER RESOURCES FROM POLLUTION, LITTERING AND DEPLETION. PREVENTIVE MEASURES ON PROTECTION OF WATER RESOURCES AND OTHER ELEMENTS OF ENVIRONMENT. CONTROL OF HARMFUL EFFECT OF WATERS.

As stipulated by the Fundamentals of Water Legislation, all waters should be protected from pollution, littering and depletion. Enterprises, organizations and institutions whose activities affect the state of water resources are obliged to carry out various developments, including technological and forest-improvements, agrotechnical, hydrotechnical and other ensuring the protection of water resources, improvement of their conditions and regime.

To ensure the protection of water resources used for drinking and domestic water supply as well as for therapeutic, health resort and recreational needs of the population, there have been established special sanitary protection districts and zones.

Preventive measures play a significant role in protection of water resources. The Legislation envisages that their implementation is the most important duty of ministries and agencies responsible for siting, designing, construction and putting into operation production and other facilities, units and installations. The Fundamentals have prohibited to put into operation new and reconstructed enterprises if they are not provided with adequate facilities preventing the pollution and littering of water resources of their harmful effects. In such a way there has been set a limit on pollution growth in water bodies for the future. This growth is associated with further development of industry, agriculture, etc.

Prevention and elimination of harmful effects of waters constitutes an important task of the State. Article 40 of the Fundamentals envisages that enterprizes, organizations and institutions are bound to take actions to prevent or eliminate: floods, inundations and water instrusions; destruction of banks, levels and other structures; bedding and salinization of lands; soil erosion, ravine formation, landslides, mudflows and other harmful phenomena. It is recognized that such measures must be stipulated in State plans of the national economy development.

RESPONSIBILITY FOR INFRINGEMENT OF THE WATER LEGISLATION

From the point of view of legal aspects of rational utilization and conservation of water resources in the USSR, to a certain extent, provision is made for the necessity of State enforcement of some individuals of groups to meet jurisdicial terms and requirements stipulated in the Water Legislation. Such inforcement is effected through bearing various measures of responsibility: criminal, administrative, disciplinary, civil and special water-legislation.

The criminal responsibility is envisaged in criminal code of the Union Republics and in some laws of the USSR. The criminal responsibility is beared in most cases, as a result of offences that come from infringement of rules of water use and cause the pollution of water bodies. The following penalities are provided for: imprisonment for a period of time lasting up to five years, corrective labor for a period of up to one year or a fine in the amount not more than 300 roubles.

In accordance with the Decree of the Presidium of the Suprime Soviet of the USSR dated February 26, 1974, the actions associated with the pollution of inland sea and territorial waters of the USSR as a result of unlawful discharge from vessels or other floating means of substances harmful for people and marine living beings or mixtures containing these noxious substances in the amount exceeding the permissible concentrations or neglect of necessary measures to prevent the discharge, as well as the pollution of the open sea waters as a result of discharge from Soviet vessels or other floating means of the above-mentioned substances

and mixtures or neglect of necessary measures to prevent the discharge thus violating the terms of the international agreements where the USSR is one of the parties, shall be punished by imprisonment for a period of up to two years, or by corrective labor for a period of up to one year, or by a fine of up to 10.000 roubles.

The same actions that may cause considerable damage to people or marine living beings shall be punished by imprisonment for a period up to five years or by a fine of up to 20.000 roubles, ("Vedomosty" of the Suprime Soviet of the USSR, 1974, No. 10, p. 161).

According to the Decrees of the councils of Ministers of the Union Republics, in case if infringement of the Water Legislation that causes the pollution and littering of surface and underground waters by non-treated sewage and waters as a result of neglect of rules of conservation and utilization of water resources, those who are guilty of this action shall be fined in the abount of up to 10 roubles (citizens) or up to 50 roubles (officials) by administrative order.

The material civil-legal responsibility, i.e., compensation of damage, has not been so far practiced when solving the legal aspects of rational utilization and conservation of water resources in the USSR. Now the compensation of damage caused by the infringement of water Legislation is provided for.

The penalty for said action is the forced revoking of the right to use water by enterprises, institutions, organizations and citizens if they violate the rules of water use and conservation, the right to use water for drinking being not liable to revoking.

LEGAL REGULATION OF RELATIONS CONNECTED WITH UTILIZATION AND CONSERVATION OF BOUNDARY WATER RESOURCES

In the relations with neighboring countries pertaining to the utilization of boundary waters the Soviet Union adheres to the policy of peaceful and friendly cooperation, supports universally recognized principles of the International Law and contributes to the establishment and development of new most progressive legal forms and principles of international cooperation.

Following the principle of integrity of water basin, the Soviet Union, however, firmly adheres to the basic clause of the International Law saying that each country within its boundaries has a sovereign right on any international water body. But this right should be effected in such a way that one country would not affect the sovereign rights of the other countries.

The USSR has concluded agreements with all neighboring countries. With different degrees of comprehension, these agreements determine the terms and requirements of joint utilization and conservation of boundary waters.

The most comprehensive ones are the Agreement between the USSR and the Finnish Republic on Boundary Water Systems of April 24, 1964 and the Agreement between the USSR and the Polish People's Republic on Water Management in Boundary Waters of July 24, 1964. Some agreements stipulate the procedure of joint utilization and conservation of the rivers of Tizsa, Prut, Araks, Amudarya, etc.

Taking into account the important role and ever-growing significance of the international cooperation in the field of utilization and conservation of water resources, the law envisages that the water use in the boundary waters of the USSR should be effected on the basis of international agreements.

If water use in the Soviet portion of boundary waters, to a certain extent has not been regulated by international agreements with the participation of the USSR, it will be effected in the accordance with the Legislation of the USSR and the Union Republics to this extent.

The procedure of the water use in the boundary waters of the USSR shall be established by competent agencies on agreement with headquarters of frontier troops.

Part II

STATE ADMINISTRATION IN THE FIELD OF UTILIZATION AND CONSERVATION OF WATER RESOURCES. SYSTEM AND COMPETENCE OF AGENCIES OF STATE WATER MANAGEMENT. BASIN PRINCIPLE OF MANAGEMENT.

The problem of State administration in the field of utilization and conservation of water resources constitutes a part of the problem of State management of the USSR national economy and is being solved in accordance with resolutions of the Communist Party and the Soviet Government aimed at further improvement of management of economy.

The State administration in the field of utilization and conservation of water resources is affected by the USSR Council of Ministers, the Councils of Ministers of the Union Republics, the Councils of Ministers of the Autonomous Republics, executive committees of local Soviets of Wroking People's Deputies as well as by specially authorized State agencies responsible for regulating the utilization and conservation of water resources directly or through basin (territorial) authorities, and other State agencies in compliance with Legislation of the USSR and the Union Republics.

The administration agencies responsible for the utilization and conservation of water resources are subdivided into three categories:

- Agencies of general State administration, i.e., the USSR Council of Ministers, the Councils of Ministers of the Union and Autonomous Republics, executive committees of the territorial, regional, district, urban and rural Soviets of the Working Peoples Deputies. This category also involves the agencies responsible for planning, registration,

coordination of science, etc. They regulate the utilization and conservation of water resources as an integral part of general management of the country's economy;

-Agencies of special State administration, i.e., the Ministery of Reclamation and Water Management, Health, Geology, the State Urban Technical Inspection of the USSR and its local board entrusted with the right to regulate the conditions of water use and conservation and to perform regular control over the observance of the Water legislation. Specialized State inspections are available at different levels of the system of these agencies;

-Agencies of branch administration, i.e. all ministers and departments managing the branches of the national economy that employ water resources. Within the jurisdiction of the branches of the national economy the above agencies are responsible for meeting the requirements of the water Legislation.

Such agencies as the procurator's office, court, arbitration, people's control hold special position. They are responsible for ensuring the observance of the law in the country.

They apply specific methods inherent in their practice such as general supervision, institution of criminal proceedings against anybody, settlement of disputes, etc.

Among new clauses of the Water Legislation, mention should be made of the basin-wide principle as a basis of the structure of the system of agencies of special State administration in the field of regulation of the utilization and conservation of water resources.

Water resources within large river, lake or sea basins form a definite physical and economical unity. As most river and other water basins cover the territories of several republics, regions and districts, the agencies of each of the national or territorial formation concerned are not able to solve any problem of water use within the same basin reasoning from local conditions and interests. Many years of practice of the Board for Interrepublic Amudarya Irrigation Canals and establishment of the Caspian Sea Protection Board prove that the basin-wide principle of management contributes to more successful solution of problems related to utilization and conservation of water resources.

The system of basin administrations, however, does not exclude but stipulates obligatory participation of local Soviets of Working People's Deputies and their executive committees in solving the problems of water bodies utilization infringing upon economic interests of a territory, region, district, or city.

STATE REGISTRATION AND PLANNING THE UTILIZATION AND CONSERVATION OF WATER RESOURCES.

The Water Legislation envisages three main kinds of measures on registration and planning the utilization and conservation of water

resources: water cadastre, schemes of comprehensive utilization and conservation of water resources and Water Budget calculations. Moreover, a calculation of water consumption and derivation provided by the State agencies.

The USSR Water Cadastre was prepared in 1933-1940, it was the first water cadastre in the world. The principal information on surface and underground water resources of the entire territory of the country was compiled, generalized and published in this document. This through generalization was of extremely great importance for planning the development of industry, agriculture, power, transport and other branches of the national economy.

The Water Cadastre has undergone specification and improvement during the ensuing years. Currently, the Water Cadastre is keeping a regular activity which involves the State quantitative and qualitative assessment of water resources, records of water consumption and registration of utilization of water resources.

The schemes of comprehensive utilization and conservation of water resources constitute the main form of long-term water management planning. These schemes can be general, regional and basin-wide. The schemes provide for the coordinated and scientifically grounded recommendations specifying what kind of measures on rational utilization and conservation of water resources should be carried out in future for the purpose of economic development and meeting all requirements in water with due regard for environmental protection. The schemes of comprehensive utilization and conservation of water resources supply basic data for drawing up five-year and annual plans of the national economy development.

The general Scheme of Comprehensive Utilization and Conservation of water resources for the period up to 1980 is in force now. At the same time similar scheme for the period up to 2000 is being developed.

To ensure the running operative regulation of utilization and conservation of water resources the use is made of water budget calculations. As a rule, they are performed annually for the main water basins with regard for the existing hydrometeorological conditions.

The water use practice often reveals conflicts of interests of different branches of the national economy. Besides, the volume of spring flow in a basin changes from year to year. Sometimes floods or extremely low-flow periods occur. That is why, water budget calculations prepared properly a year in advance makes it possible to avoid big economic miscalculations and damages.

The agencies of hydrometeorological service and water economy are responsible for keeping the Water Cadastre, preparing the schemes of comprehensive utilization and conservation of water resources and making the water budget calculations.

STATE CONTROL OVER UTILIZATION AND CONSERVATION OF WATER RESOURCES.

In the Fundamentals of Water Legislation a special article (Article 8)

is devoted to the State control. The main task of the State control is to ensure the observance of the established rules of water use, fulfillment of obligations related to water conservation, prevention and elimination of harmful effects of water as well as the observance of other rules laid down by the Water Legislation.

The control is exercised by numerous agencies of State administration but the USSR Ministry of Reclamation and Water Management bears the main responsibility in this field. Within the jurisdiction of this ministry there are 105 basins (regional) administrations and inspections involved in utilization and conservation of water resources. They carry on daily observations over the state of water bodies, water distribution, sewage, discharge, etc. For example, all industrial and other enterprizes consuming over 100 cu.m. of water per day and discharging sewage have taken under the control of the said agencies.

The basin administrations and inspections responsible for utilization and conservation of water resources carry on large-scale preventive work. Their representatives participate in the State acceptance commissions meant to test newly constructed or reconstructed enterprises, workshops, units, structures and other economic facilities before putting them into operation. If an enterprise is not provided with all technical means necessary to guarantee the satisfaction of requirements to the rational utilization and conservation of water resources, it is not accepted for putting into operation until it is supplied with supplementary equipment.

If testing reveals certain infringement of the law, criminal, administrative or disciplinary proceedings are instituted against those who are guilty.

If necessary, the agencies of the procurator's office investigate the case. Courts study criminal cases, settle conflicts associated with compensation of damages (if one of the conflicting parties is a citizen or a collective farm) and study complaints of officials and citizens about resolutions of administrative agencies imposing a fine. The arbitration agencies settle property conflicts of State enterprises, institutions and organizations. The committee of the people's control and its agencies examine the work of some State agencies, institutions and organizations. If necessary, they institute proceedings against managers and other officials.

The water Legislation envisages the participation of public organizations and citizens in the system of measures on rational utilization and conservation of water resources. Trade unions, youth organizations, societies of nature protection and other public organizations as well as citizens contribute to conservation of water resources, prevention and elimination of their harmful effect control over the observance of the Water Legislation.

The All-Russian Society of Nature Protection and similar societies of other Union Republics whose members number over 40 million carry on large-scale work in the field of water resources conservation. In the recent years public technical committees have been established at many enterprises

on the initiative of these societies. They exercise control over the observance of the requirements to water resources conservation, render assistance to the administration of enterprises to achieve satisfactory results in this field.

In the final analysis, effective State and public control constitues a rather important part of the Soviet system of the Water Law and establishes organizational safeguards for meeting the requirements to rational utilization and conservation of water resources.

The measures on improvement of the Soviet Water Law carried out lately have already their positive effect. However, the work in this field is still going on. In the near future it is planned to improve the procedure of granting permissions for water use, to solve some problems of managing multipurpose utilization of reservoirs, to achieve better coordination in solving the problems of conservation of water resources and other elements of the natural environment. The main emphasis is being put on organizational and practical measures meant to ensure the observance of the existing laws. All this makes it possible to hope for further improvements in the field of rational utilization and conservation of water resources in the USSR.

FUNDAMENTALS OF WATER LEGISLATION OF THE USSR AND THE UNION REPUBLICS

As a result of the triumphant Great October Socialist Revolution the waters and the other natural resources of the country, have been nationalised and have become property of the people.

State ownership of water resources forms the foundation for water relations in the USSR, creating favourable conditions for comprehensive utilisation of waters along planned lines and with maximum economic effect. State ownership of waters helps ensure the best conditions for labour, home life, recreation and protection of the health of Soviet people.

Development of social production and urban construction, higher living and cultural standards of the people have extended the various needs in water and raised the importance of rational utilisation and protection of water resources.

Soviet legislation on water is designed to ensure the most efficient utilisation of water resources on scientific principles and protect them against pollution, littering and depletion.

S E C T I O N I

G e n e r a l

Article 1. Purposes of Soviet Legislation on Water

The purposes of Soviet legislation on water are regulation of water relations to ensure rational utilisation of water resources for the needs of the people and the national economy, to protect the waters against pollution, littering and depletion, to prevent and eliminate the harmful effect of waters, to improve the state of water sources, to protect the rights of enterprises, organisations, establishments and citizens and to uphold legality in the field of water relations.

Article 2. Water Legislation of the USSR and the Union Republics

Water relations in the USSR shall be governed by the present Fundamentals and other acts of USSR water legislation, water codes and other acts of water legislation of the Union Republics issued in keeping with these Fundamentals.

Land, forest and mountain relations shall be regulated by pertinent legislation of the USSR and the Union Republics.

Article 3. State Ownership of Water Resources in the USSR

In conformity with the USSR Constitution the waters in the Union of Soviet Socialist Republics are owned by the state, i.e. they are national property.

Waters in the USSR are the exclusive property of the state and are made available only for use. Actions violating directly or covertly the right of state ownership of waters are prohibited by law.

Article 4. Integrated State Water Resources

All waters (water sources) in the USSR make up the integrated state water resources.

The integrated state water resources include:

1) rivers, lakes, reservoirs and other surface water repositories and sources, including canals and ponds;

2) subterranean waters and glaciers;

3) inland seas and other internal sea waters of the USSR;

4) territorial waters (territorial sea) of the USSR.

Article 5. Competence of the USSR in the Regulation of Water Relations

USSR jurisdiction in regulation of water relations covers:

1) Management of the integrated state water resources within the sphere essential for the execution of the USSR's powers under the USSR Constitution;

2) formulation of the basic regulations governing the use of waters, protection of waters against pollution, littering and depletion, prevention and elimination of harmful effect of water;

3) establishment of All-Union standards for use of water, quality of water and methods for evaluation thereof;

4) establishment of unified USSR systems for state registration of water resources, use of water, registration of water tenure and State Water Register;

5) approval of schemes for comprehensive use of waters and protection thereof, as well as of water balance for economic purposes on a USSR scale;

6) planning of All-Union measures for the use and protection of waters; protection and elimination of harmful effect of water;

7) exercising state control over the use and protection of waters and establishment of procedures for execution of this control;

8) earmarking of water objects whose use shall be governed by USSR bodies.

Article 6. Competence of the Union Republics in the Regulation of Water Relations

Union Republic jurisdiction in the regulation of water relations outside USSR competence covers: management of the integrated state water resources on the territory of the given Union Republic; formulation of rules governing use of waters, protection thereof against pollution, littering and depletion, prevention and elimination of harmful effect of water; planning of measures for the use of waters, protection thereof, prevention and elimination of harmful effect of water; approval of schemes for comprehensive use of waters and protection thereof, as well as of water balance for economic purposes; exercising state control over the use of waters and protection thereof and regulation of water relations with respect to other matters, unless they refer to USSR competence.

Article 7. State Administration in the Use and Protection of Waters

State administration in the use and protection of water resources shall be exercised by the USSR Council of Ministers, the Councils of Ministers of the Union Republics, the Councils of Ministers of the Autonomous Republics, executive committees of the local Soviets of working people's deputies and by specially authorised state bodies for regulation of the use and protection of waters directly or through basin (local) departments, as well as by other state bodies in keeping with the legislation of the USSR and Union Republics.

Article 8. State Control Over the Use and Protection of Water Resources

State control over the use and protection of water resources is designed to ensure the observance by all ministries, departments, state-owned, cooperative and public enterprises, organisations, institutions, and citizens of the established rules for the use of waters, execution of duties with respect to protection of waters, prevention and elimination of harmful effect of water, rules on registration of waters and other rules laid down by legislation on water.

State control over the use and protection of water resources shall be exercised by the Soviets of working people's deputies, their executive and administrative bodies and by specially authorised state bodies in keeping with procedures established by USSR legislation.

Article 9. Participation of Public Organisations and Citizens in Measures for Rational Use and Protection of Water Resources

Public organisations, such as trade unions, youth organisations, societies for protection of nature and scientific associations, and citizens shall assist state bodies in the execution of measures for rational use and protection of water resources.

Public organisations shall take part in work designed to ensure rational use and protection of water resources in keeping with their rules (statutes) and USSR and Union Republic legislation.

Article 10. Distribution, Designing, Construction and Commissioning of Enterprises, Structures and Other Projects Affecting the State of Water Resources

In locating, designing, building and commissioning newly-built or reconstructed enterprises, structures and other projects and in introducing new production techniques which may affect the state of waters it is essential to ensure rational use (consumption) of water, giving higher priority to meeting the demand of the population for drinking water and water for household purposes. In this case it is important to make provision for measures for recording the quantity of water taken from the sources and the quantity returned to them, protecting waters against pollution, littering and depletion, preventing harmful effect of water, flood control of lands, protecting land against salinisation, bogging up or drying up and preserving favourable natural conditions and attractive landscapes.

In locating, designing, building and commissioning of newly-built or reconstructed enterprises, structures and other projects on fish farm reservoirs it is essential, in addition to the above, to execute timely measures for protection of fish and other water animals and plants and for their reproduction.

Sites for the construction of enterprises, structures and other projects affecting the state of water shall be earmarked in agreement with bodies responsible for regulating the use and protection of water resources, executive committees of the local Soviets of working people's deputies, bodies exercising state sanitary inspection, responsible for the protection of fish stocks and other bodies in keeping with USSR and Union Republic

legislation. The designs of such enterprises, structures and other projects shall be agreed with bodies responsible for the regulation of use and protection of water resources and other bodies in cases provided for by USSR legislation and in keeping with procedure envisaged by this legislation.

It is prohibited to put into operation:

newly-built and reconstructed enterprises, factory departments, units, municipal and other projects that have not been outfitted with pollution and litter control devices and means for prevention of harmful effect of water;

irrigation and water supply systems, reservoirs and canals before measures provided in the designs for prevention of flooding, bogging up, salinisation and erosion of soil have been realised;

drainage systems before water receivers and other structures have been completed in keeping with the approved designs;

water collecting structures without fish protecting devices in keeping with the approved designs;

hydraulic engineering projects before the devices for passage of spring waters and fish have been completed in keeping with the approved designs;

water boreholes before they have been outfitted with water control devices and before sanitary zones have been established for them as required by the law.

It is prohibited by the law to fill up reservoirs with water before the bed has been duly treated as required by the designs.

Article II. Procedure for Works on Water Objects and in Coastal Zones

Construction and channel deepening works, blasting operations, extraction of minerals and taking of water plants, laying of cables, pipelines and other communications, tree felling, drilling, farming and other operations on water objects or in coastal zones which may affect the state of water shall be performed in agreement with bodies responsible for the regulation of use and protection of water resources, executive committees of the local Soviets of working people's deputies and other bodies in conformity with USSR and Union Republic legislation.

S E C T I O N II

Water Use

Article I2. Water Users

In the USSR state-owned, cooperative and public enterprises, organisations and institutions and Soviet citizens may be listed as water users.

In cases provided by USSR legislation other organisations and persons may also be listed as water users.

Article I3. Objects of Water Use

The water objects listed in Article 4 of the present Fundamentals may be made available for use.

The use of water objects of special importance to the state, or of special scientific or cultural value may be prohibited in part or in whole in conformity with the rules laid down by the USSR Council of Ministers or the Councils of Ministers of the Union Republics.

Article I4. Forms of Water Uses

Water objects shall be made available for use, provided the requirements and terms of the law are met. They shall be made available for satisfying the needs of the population in drinking water, in water for household, therapeutic, health resort, recreation and other purposes. These objects shall also be made available for meeting the needs in water of farms, industries, power stations, transport, fish farms, and other state and public organisations and agencies. Use of water objects for disposal of sewage may be permitted, only if the special requirements and terms of USSR and Union Republic legislation are observed.

There are two different forms of water uses: general--which is effected without structures and other technical devices affecting the state of water, and special--which is effected with the help of such structures and devices. In separate cases use of water objects which is effected without structures and other technical devices but which affect the state of water may be regarded as a special form of water use.

Special forms of water uses shall be listed by bodies responsible for the regulation of the use and protection of water resources.

Water objects may be made available for joint or exclusive use.

Enterprises, organisations and agencies to which water objects have been made available for exclusive use are known as primary users. In conformity with USSR and Union Republic legislation the primary user may permit other enterprises, organisations, agencies and citizens secondary use of water in agreement with bodies responsible for regulation of the use and protection of water resources.

Article 15. Procedure and Conditions for Making Water Objects Available for Use

Water objects shall be made available for use above all for meeting the needs of the population in drinking water and in water for household purposes.

Water objects shall be granted for exclusive use in whole or in part by decision of the Council of Ministers of the given Union Republic or the Council of Ministers of the given Autonomous Republic, by decision of the executive committee of the Soviet of working people's deputies concerned or other authorised state agency in conformity with USSR or Union Republic legislation.

Special use of water shall be effected on permission issued by bodies responsible for regulation of the use and protection of water resources and in cases provided by USSR and Union Republic legislation--on permission granted by the executive committees of local Soviets of working people's deputies. Such permission shall be granted with the agreement of bodies responsible for state sanitary inspection, protection of fish stocks and other agencies concerned. The procedure for securing agreement and issue of permission for special use of water has been established by the USSR Council of Ministers.

General use of water is effected without permission in conformity with Union Republic legislation. Primary users to whom water objects have been made available for exclusive use shall permit general use of water at these objects on terms laid down by him in agreement with bodies responsible for regulation of use and protection of water resources. However, if necessary general use of water may be prohibited.

Use of water is gratis. Special use of water, however, may incur charges in cases provided by the USSR Council of Ministers in keeping with a procedure established by the Council.

Article I6. Term of Water Use

Water objects may be made available either for permanent or temporary use.

Permanent use is use without term specified in advance.

Temporary use is either short term--up to a period of three years, or long term--from three to twenty-five years. If necessary the term may be extended for a period not exceeding the initial short or long term period respectively.

General use of water is not limited by any term.

Article I7. Rights and Obligations of Water Users

Users of water may use water objects only for purposes stipulated by the terms on which they have been made available.

In cases provided by USSR and Union Republic legislation the rights of the user may be restricted to meet state interests or the interests of other users. However, the terms of use of water for meeting the needs of the population in drinking water and in water for household purposes shall not be infringed upon.

Users of water are obliged:

to make rational use of water objects, display concern for economical consumption of water, replenishment of water reserves and improvement of the quality of water;

to seek to stop completely disposal of sewage with pollutants into the water objects;

to preclude infringement of rights granted to other users of water and to prevent damage to economic objects and natural resources, such as lands, forests, animal kingdom, and minerals, etc;

to maintain in good working order the pollution control, purifying installations and other water supply and disposal installations and technical devices, to improve their operational efficiency and in specified cases to register water consumption.

Article I8. Grounds for Revoking Rights of Water Users

The right of an enterprise, organisation, agency or citizen to use water shall be revoked in the following cases:

1) termination of the need in use of water or renunciation of the right by the user;

2) expiration of the term of water use;

3) elimination of the enterprise, organisation or agency concerned;

4) transfer of water installations to other users;

5) emergence of the need to withdraw water objects from exclusive use.

The right of an enterprise, organisation, agency or citizen to use water (with the exception of the right to use water for drinking and for household purposes) may be revoked also in case the party concerned has broken the rules governing the use and protection of water resources or has used the water object for purposes other than specified by the terms on which it has been made available.

Union Republic legislation may also provide for other grounds for revoking the right to the use of water by enterprises, organisations, agencies and citizens.

Article 19. Procedure for Revoking the Right to Use Water

The right to use of water may be revoked by:
cancellation of permission to special and secondary use of water;
withdrawal of water objects from exclusive use.
The right to special use of water shall be revoked by decision of the body that has issued this right.

Secondary use of water may be discontinued by decision of the primary user in agreement with the body responsible for regulation of use and protection of water resources.

Water objects shall be withdrawn from exclusive use in keeping with the procedure established by USSR and Union Republic legislation.

Water objects shall be withdrawn from exclusive use by enterprises, organisations and agencies subordinated to Union-level authority in agreement with the user concerned and the ministry or department to which he is subordinated.

Article 20. Compensation of Damages Arising from Water Supply Undertakings, Discontinuation of Terms Governing Use of Water or Changes in These Terms

Damages incurred on enterprises, organisations, agencies and citizens as a result of water supply undertakings, such as works on hydraulic engineering projects, etc., discontinuation of terms governing the use of water or changes in these terms shall be compensated in cases stipulated by the USSR Council of Ministers and in keeping with the procedure established by the Council.

Article 21. Use of Water Objects to Meet the Needs of the Population in Drinking Water and in Water for Household and Other Purposes

To meet the needs of the population in drinking water and in water for household and other purposes water objects shall be made available for use in which the quality of the water meets the established sanitary requirements.

The use of subterranean waters fit for drinking for purposes other than drinking and household needs shall, as a rule, be forbidden. In areas without the necessary surface water sources, though with adequate subterranean water reserves fit for use as drinking water, the bodies responsible for regulation of use and protection of water resources may permit the use of such water for purposes other than drinking and household needs.

Article 22. Use of Water Objects for Purposes of Therapy, Health Resorts and Recreation

Water objects listed as therapeutic waters in keeping with the established procedure shall above all be used for therapeutic purposes and health resort facilities. In exceptional cases bodies responsible for regulation of use and protection of water resources may permit the use of water objects listed as therapeutic sources for purposes other than the above; this may be done only with the agreement of the public health authorities and health resort administration concerned.

Disposal of sewage into water objects listed as therapeutic is prohibited.

The use of waters for purposes of recreation and acquatic sports is governed by USSR and Union Republic legislation.

Article 23. Use of Water Objects for Farming

Use of water objects for needs of farming shall be effected both in terms of general and special uses.

In the case of special use the user may employ irrigation, watering, drainage and other water supply facilities and devices belonging to state organisations, collective farms, state farms and other agencies.

Collective farms, state farms and other enterprises, organisations, agencies and citizens using water objects for needs of farming shall observe the approved plans, rules,

standards and conditions of water consumption; they shall take measures to cut down waste of water resulting from filtration and evaporation in watering systems, to prevent unjustified loss of water from them, to prevent penetration of fish into watering systems from fish farm ponds and to create the most favourable conditions for moisture in the fields.

Irrigation of fields and other farm land with sewage water shall be permitted by bodies responsible for regulation of use and protection of water resources in agreement with the state sanitary and veterinary inspection authorities.

The provisions of the present Article shall also cover irrigation and drainage of lands under forests, afforestation belts and forest nurseries.

Article 24. Use of Water Objects for Industrial Purposes

Users of water employing water objects for industrial purposes shall observe the approved plans, technological standards and rules governing use of water. They shall also take measures to cut down water consumption and to stop disposal of sewage through improvement of production techniques and water supply patterns (introduction of water-free techniques, air cooling, recycling of water supply and other technical methods).

In the event of an elemental calamity, breakdown or some other exceptional circumstances, in the event of excessive consumption by an enterprise of water from the water supply system the executive committee of a local Soviet of working people's deputies may cut down or cut off the consumption of drinking water for industrial needs from municipal water supply; it may also temporarily impose a limit on water consumption from departmental drinking water supply systems above all to meet the needs of the population in drinking water and in water for household purposes.

Subterranean waters (fresh, mineral and thermal) not listed as drinking or therapeutic waters may be used for technical purposes in keeping with the established rules, they may be used for extraction of chemical elements from them, obtaining of heat and other industrial needs in conformity with the requirements of rational use and protection of water resources.

Article 25. Use of Water Objects for Power Generation

Water objects shall be used for power generation with account of the needs of other economic sectors. In this case the requirements arising from the use of waters in complex shall be observed unless other measures have been provided by a decision

of the USSR Council of Ministers, decisions of the Union Republic Councils of Ministers or in pertinent cases by a decision of the body responsible for regulation of use and protection of water resources.

Article 26. Use of Water Objects for Water Transport and Timber Floating

Rivers, lakes, reservoirs, canals, inland seas and other internal sea waters of the USSR, as well as the territorial waters (territorial sea) of the USSR are waterways of general use with the exception of cases when their use for these purposes is prohibited in whole or in part or when they have been made available for exclusive use.

The procedure for listing waterways as navigational and timber floating and the rules governing the operation of waterways are determined by USSR and Union Republic legislation.

Timber floating and timber rafting in ties and bundles without towing is forbidden:

1) on navigational routes;

2) on water objects enumerated in a list approved by the USSR Council of Ministers or Union Republic Councils of Ministers with account of their special value as fisheries, sources of water supply or other economic purposes.

Other water objects may be used for the above forms of timber floating on permission issued by bodies responsible for regulation of use and protection of water resources with the agreement of bodies responsible for the protection of fish stocks.

It is binding on the timber floating agency regularly to clear the floating routes of sunken timber.

Article 27. Use of Water Objects for Air Transport

Regulations governing the use of water objects for stationing, take-off and landing of aircraft and for other needs of air transport are laid down by USSR legislation.

Article 28. Use of Water Objects for Fishing

The rights of users may be restricted in the interests of the fishing industry on fish breeding reservoirs or separate zones thereof which are of special importance for the preservation and reproduction of fish species and other commercial water denizens of high value. These reservoirs or zones thereof are listed and water

use restrictions are specified by bodies responsible for regulation of use and protection of water resources on recommendation of fish protection bodies.

In operation of hydraulic engineering and other installations on fish breeding reservoirs it is essential to execute in due course measures ensuring the protection of fish stocks and conditions for their reproduction.

Regulations governing the use of water objects for fishing and fish breeding are laid down by USSR and Union Republic legislation.

Article 29. Use of Water Objects for Game Breeding and Hunting

Bodies responsible for regulation of use and protection of water resources may grant preferential rights to water use to enterprises and organisations engaged in game breeding and hunting on rivers, lakes and other water objects inhabited by wild water fowl and valuable fur bearing beasts, such as the beaver, musk rat, desman, nutria, etc., these rights being granted with account of requirements for use of waters in complex.

Regulations governing the use of water objects for game breeding and hunting are stipulated by USSR and Union Republic legislation.

Article 30. Use of Water Objects for Reservations

Water objects of special scientific or cultural value are declared reservations in keeping with a procedure established by USSR and Union Republic legislation. These objects shall be made available for permanent and exclusive use to the reservation authority for protection of nature and research.

Procedure for the use of reservation waters shall be determined by the statutes on reservations.

Water objects can be withdrawn from the use of the reservation authority only in case of special need by decision of the Council of Ministers of the given Union Republic.

Article 31. Use of Water Objects for Disposal of Sewage

Use of water objects for disposal of industrial, municipal service, drainage and other sewage water may be effected only with the permission of bodies responsible for regulation of use and protection of water resources with the agreement of the state sanitary inspection authority, fish protection body and other agencies concerned.

Disposal of sewage shall be permitted only it is does not increase the concentration of pollutants in the water objects above the permissible level and if the user purifies the sewage water to a degree established by the body responsible for regulation of use and protection of water resources.

If the above requirement is not met the disposal of sewage shall be restricted, suspended or altogether forbidden by the body responsible for regulation of use and protection of water resources, even if this step results in stoppage of work of separate industrial installations, factory departments, enterprises, organisations and agencies. In the event of a threat to public health the state sanitary inspection authority shall be entitled to suspend sewage disposal even if this step entails stoppage of operation of industrial and other objects. In this case the state sanitary inspection authority shall notify the body responsible for regulation of use and protection of water resources about this action.

The procedure and terms for use of water objects for sewage disposal are stipulated by USSR and Union Republic legislation.

Article 32. Use of Water Objects for Fire Fighting, Other State and Public Needs

It is permitted to take water for fire fighting from any water objects.

The procedure for use of water objects for fire fighting, other state and public needs shall be established by USSR and Union Republic legislation.

Article 33. Exploitation of Water Reservoirs

It is binding on enterprises, organisations and agencies using backwater, water-passage or water reception installations on reservoirs to observe the conditions of accumulation and consumption characteristic of the reservoir with account of the interests of the water users and land users in the zones affected by these reservoirs.

Exploitation of reservoirs shall be governed by rules approved by bodies responsible for regulation of use and protection of water resources for each separate reservoir, cascade or system of reservoirs in agreement with the state sanitary inspection authority, fish protection body and other agencies concerned.

The bodies responsible for regulation of use and protection of water resources shall organise and coordinate measures for adequate technical condition and improvement of the reservoirs as well as for control over the observance of rules governing the exploitation of these reservoirs. These measures shall be executed in keeping with a procedure established by USSR and Union Republic legislation.

The provisions of the present Article shall also cover the exploitation of lakes and other water bodies used as reservoirs.

Article 34. Regulation of Use of Water Objects Situated on Territories of Several Union Republics

Regulation of use of water objects situated on the territories of two or more Union Republics, inasmuch as they are of concern to these Republics, shall be effected in agreement between the relevant bodies of the said Republics with the exception of water objects whose use shall be regulated by the USSR authority.

Article 35. Procedure for Settlement of Disputes in Use of Water

Disputes on water use shall be settled by the Councils of Ministers of the Union Republics, the Councils of Ministers of Autonomous Republics, executive committees of local Soviets of working people's deputies, bodies responsible for regulation of use and protection of water resources and other authorised state bodies in keeping with USSR and Union Republic legislation.

Disputes between users of water of one Union Republic and those of another Union Republic on the use of waters shall be investigated by a commission formed on a parity basis of representatives of the Union Republics concerned. If the commission has failed to agree on a decision the dispute shall be considered in keeping with a procedure established by the USSR Council of Ministers.

Property disputes arising from water relations shall be settled in keeping with a procedure stipulated by USSR and Union Republic legislation.

Article 36. Use of Water on Objects Situated on the USSR's State Frontier

Use of water on objects situated on the USSR's state frontier shall be effected on the basis of international agreements.

Inasmuch as use of water in the Soviet part of state frontier waters has not been covered by international agreements with Soviet participation, it shall be effected in conformity with USSR and Union Republics legislation.

The regulations governing use of water in USSR state frontier waters shall be laid down by competent bodies in agreement with the command of frontier guard troops.

S E C T I O N III

Protection of Water Resources and Prevention of Harmful Effect of Water

Article 37. Protection of Water Resources

All waters (water objects) shall be protected against pollution, littering and depletion since this may harmfully affect public health, cause depletion of fish stocks, damage water supply conditions and bring about other unfavourable phenomena arising from a change in the physical, chemical and biological properties of the waters, lower capacity for natural purification and violation of hydrological and hydrogeological conditions of the waters.

It is binding on enterprises, organisations and agencies whose activity may affect the state of waters to carry out various measures, including technological and forest improvements, agrotechnical, hydrotechnical and sanitary measures, designed to protect waters against pollution, littering and depletion and to improve the state of waters and the water conditions. These measures shall be executed in agreement with bodies responsible for regulation of use and protection of water resources, executive committees of local Soviets of working people's deputies, the state sanitary inspection authority, fish protection bodies and other state agencies concerned or in keeping with instructions issued by specially authorised state bodies.

Water protection measures shall be covered by state economic development plans.

Article 38. Protection of Water Against Pollution and Littering

Disposal into water objects of industrial, household and other waste is forbidden. Disposal of sewage shall be permitted only if the requirements of Article 31 of the present Fundamentals are met.

Owners of water transport facilities, pipelines, floating means and other installations on water objects, timber floating agencies and other enterprises, organisations and agencies must prevent pollution and littering of waters as a result of losses of oil, timber, chemical, oil and other products.

It is binding on enterprises, organisations and agencies to prevent pollution and littering of the surface of water collection units, ice cover of reservoirs and surface of glaciers by industrial, household and other waste, by oil and chemical products which if washed off will adversely affect the quality of surface and subterranean waters.

The boards charged with the management of state water systems, collective farms, state farms and other enterprises, organisations and agencies must preclude pollution of waters by fertilizers, weed and pest killers.

To ensure protection of waters used for drinking, for household needs of the population, for therapeutic purposes, for health resorts and recreation facilities USSR and Union Republic legislation has established sanitary protection districts and zones.

Article 39. Protection of Water Resources Against Depletion

To maintain favourable water conditions in rivers, lakes, reservoirs, of subterranean waters and in other water objects, to prevent soil erosion by water, silting of reservoirs, deterioration of conditions of habitation for water animals and to control the fluctuation in the flow, water protection zones of forests shall be established, forest improvements, anti-erosion, hydrotechnical and other measures shall be carried out in keeping with USSR and Union Republic legislation.

In reaching agreement on location and construction of enterprises, structures and other objects affecting the state of waters and in issuing permission for special use of water the bodies responsible for regulation of use and protection of water resources shall be guided by schemes of comprehensive use and protection of water resources and water balance which take into account the interests of both the water users and land users.

If drilling and other mining work conducted with the purpose of exploration, prospecting and exploitation of resources of natural gas, oil, coal and other minerals have led to the discovery of underground water levels the agencies carrying out these operations shall report their findings without delay to the bodies responsible for regulation of use and protection of water resources and take measures to protect the subterranean waters in keeping with the established procedure.

Spontaneous water gushers shall be equipped with control devices, conserved or closed up in keeping with the rules established by USSR and Union Republic legislation.

Article 40. Prevention and Elimination of Harmful Effect of Water

It is binding on enterprises, organisations and agencies to conduct measures for prevention and elimination of harmful effect of water in agreement with bodies responsible for regulation of use and protection of water resources, executive committees of local Soviets of working people's deputies and other state bodies concerned or in pursuit of instructions issued by specially authorised state agencies, such as:

inundations, floods or water encroachments;

destruction of banks, dykes and other structures;

bogging up and salinisation of land;

soil erosion, ravine formation, landslides, mud streams and other harmful phenomena.

Execution of emergency measures for prevention of elemental calamities or elimination of consequences thereof arising from the harmful effect of water is stipulated by USSR and Union Republic legislation.

State economic development plans shall provide measures for prevention and elimination of harmful effect of water.

S E C T I O N IV

State Registration and Planning of Use of Water Resources

Article 41. Purposes of State Registration and Planning of Use of Water Resources

The purpose of state registration of water resources and use thereof is to establish the quantity and quality of water available and data on the use of water resources for the needs of the population and the national economy.

Use of water resources along planned lines is designed to ensure distribution of water between users on a sound scientific basis, priority being given to meeting the needs of the population in drinking water and water for household purposes, protecting water resources and preventing harmful effect of water. In planning use of water resources it is necessary to take account of the data given in the State Water Register, economic water balance and schemes for comprehensive use and protection of water resources.

Article 42. State Water Register

The State Water Register carries information on the quantitative and qualitative indicators of water resources available, records of water users and data on water consumption.

Article 43. Economic Water Balance

Economic water balance sheets estimating the availability of water resources and the extent of their use shall be drawn up for each basin, economic area, Union Republic and the USSR as a whole.

Article 44. Schemes for Comprehensive Use and Protection of Water Resources

The general and basin (local) schemes for comprehensive use and protection of water resources shall lay down the basic economic and other measures to be executed to meet the long term needs of the population and the national economy in water and to protect the water resources and to prevent harmful effect of water.

Article 45. Procedure for State Registration of Water Resources and Use Thereof, Keeping the State Water Register, Drawing Up Economic Water Balance Sheets and Developing Schemes for Comprehensive Use and Protection of Water Resources

Work on state registration of water resources and use thereof, keeping the State Water Register, drawing up economic water balance sheets and developing schemes for comprehensive use and protection of water resources shall be conducted at the expense of the state in conformity with a unified system for the USSR.

The procedure for state registration of water resources and use thereof, keeping the State Water Register, drawing up economic water balance sheets, developing and approving schemes for comprehensive use and protection of water resources shall be established by the USSR Council of Ministers.

SECTION V

Responsibility for Infringement of Water Legislation

Article 46. Responsibility for Infringement of Water Legislation

Passing over of rights to use of water and other transactions violating directly or covertly the right to state ownership of water are invalid.

Persons found guilty of such transactions as well as of:
unauthorised seizure of water objects or unauthorised water use;
use of water violating plans for use of water;
pollution and littering of waters;
commissioning of enterprises, municipal and other objects before they have been outfitted with structures and devices preventing the pollution and littering of water, or harmful effect thereof;
wasteful use of water (extracted or delivered from water objects);
violation of water protection conditions on water receivers which has caused pollution thereof, water soil erosion and other harmful effects;
unauthorised hydraulic engineering work;
damage to water installations and devices;
violation of the rules of operation of water installations and devices---
shall be held responsible under criminal law or administrative measures in keeping with USSR and Union Republic legislation.

Union Republic legislation may establish responsibility for other infringements of water legislation.

Water objects seized without authorisation shall be returned to the rightful users without compensation of expenses borne during unauthorised use of objects.

Enterprises, organisations, agencies and citizens shall compensate damages incurred by violation of water legislation to the sum established by USSR and Union Republic legislation and in keeping therewith. Officials and other workers who have caused enterprises, organisations and agencies to bear expenses for compensation of damages shall be held financially responsible in conformity with the established procedure.

(Pravda, December 12, 1970. In full)

THE END

Decree of the Central Committee of the CPSU
and the USSR Council of Ministers

6. On Strengthening the Environmental Protection and the Betterment of the Utilization of Natural Resources. 1/

The CC CPSU and the USSR Council of Ministers note that measures are being implemented in the country in the matters of environmental protection and the rational utilization of natural resources: irrigation of lands has received a wide development, erosion of soils is being countered, large hydro-electric power stations have been built, regulation and redistribution of the river flow are being pushed, steps are being taken to improve the conduct of the fishing and hunting economy, to renew the afforestation of large areas; there is a wide inculcation of central heating systems in cities and industrial centers and also of gasification which leads to substantial lessening of the pollution of water basins; construction is going forward of enterprises and in cities to erect structures for the purification of sewage waters and industrial wastes that otherwise would poison the atmosphere.

The Foundations of the Land Legislation of the USSR and the union republics, the Foundations of the Water Legislation of the USSR and the union republics, the Foundations of legislation of the USSR and the union republics on health protection, all adopted by the USSR Supreme Soviet, and also decisions adopted by the Party and the Government on problems linked with a rational utilization of natural resources and protection of the environment from pollution, have created a climate for the most effective and scientifically grounded utilization of these resources and the strengthening of environmental protection.

At the same time, the CC CPSU and the USSR Council of Ministers call attention to the fact that a number of ministries, agencies, enterprises and organizations have not yet concentrated in the proper manner on the questions of the protection of the environmental natural medium from pollution and of securing of the rational utilization of natural resources.

Ministries, agencies and scientific institutions do not devote due attention to the elaboration of technical processes that exclude or would materially lower the extent of pollution of the soil, atmosphere and sewage waters, do not conduct needed research for perfecting methods and technique of purification of sewage water and gases and neglect other urgent problems of environmental protection and renewal of natural wealth.

1/ No supplements are attached.

Ministries, agencies, enterprises and organizations do not pursue, in full measure, a rational, overall utilization of the bowels of the earth and permit great losses in the quarrying and processing of useful minerals. Very often only the basic metals get extracted from the ores and a substantial portion of valuable side recovery is thrown on the dumps; serious losses to the State ensue from this practice.

In a number of enterprises, in cities and other populated places, necessary installations for the purification of sewage are lacking, and even when these are present, they are often operated most inadequately. Designing and construction of waterstoring and water-purifying installations trail behind the tempos of industrial and housing construction.

The machinebuilding industries are paying scant attention to production of modern equipment and devices for purifying installations.

Many incidents occur of irrational utilization of reservoirs and of agricultural and forested landed properties.

In the process of building reservoirs, the dimensions of the possible mechanical and biological processes in the reservoirs are not always fully taken into account /destruction of the banks, overgrowing of the shallow waters, the growth of water plants, deterioration of the conditions of the reproduction of fish, and other processes/; the necessary steps for forestalling their noxious effects are not taken, and national economy is damaged as a result.

The USSR Ministry of Fish Economy, the USSR Ministry of Power and Electrification and the USSR Ministry of Irrigation and Water Resources do not devote sufficient attention to an elaboration of methods of a biological improvement of reservoirs and, in particular, the utilization for these purposes of herbivorous fish.

The local Party and Soviet organs allot insufficient attention to environmental issues, display little concern about the preservation of agricultural and forested valuable land resources, purity of reservoirs and the air basin cover, about the preservation and enrichment of the flora and fauna.

There are also shortcomings in the area of the propaganda of the cause of the protection of nature. Due attention is not devoted in the schools, technikums and the higher educational institutions to this problem.

To the end of strengthening environmental protection and the betterment of the utilization of natural resources, the Central Committee of the CPSU and the USSR Council of Ministers decree.

1. The CCs of the Communist Parties and the Councils of Ministers of the union republics, the Kraykoms and Obkoms of the Party, the Councils of Ministers of the autonomous republic, the Kraysispolkoms and oblispolkoms, ministria and agencies of the USSR must intensify their attention to the problems of environmental protection and the securing of a rational utilization of natural resources by means of establishing systematic control over the conduct of work to lessen the soil erosion, over the rational utilization by kulkhozas, enterprises and organizations of lands, waters, bowels of earth and other natural riches, over their observance of extant regulations and norms for the recultivation of lands, for the prevention of pollution and salinization of soils, surface and subterranean waters, for the preservation of water-protective and preserving functions of the forests, the water-regulating role of peat deposits, for the preservation and reproduction of animal and vegetable world, for the prevention of pollution of the atmospheric air, and for intensifying the struggle against noise stemming from production and every-day life.

The ministries, departments, enterprises and organizations must be urged to effect a complex and fuller utilization of not only basic but also incidental useful minerals in the course of mining and processing the useful minerals.

2. To establish that

a) The USSR Ministry of Agriculture:

is implementing a State control over the observance of the land legislation and the priorities in the utilization of lands by ministries, departments, State, cooperative and social organizations and institutions, as well as private citizens;

bears responsibility for the organization of protection and a rational utilization of lands used by Kolkhozes, Sovkhozes and other agricultural enterprises and organizations that are an integral part of the Ministry, correct application of pesticides in agriculture, for the development and wide application of biologic agents in the struggle with ailments and pests afflicting agricultural cultures and plantings, for the organization of an economical use of water in the processes of land irrigation, and exercises control over the recultivation of lands;

organizes the implementation of the entire complex of anti-erosion measures including work in the area of protective afforestation;

enforces State control over implementation of measures by ministries, departments and private citizens for combatting plant pests and maladies and for observing the prescribed regulations, for the use of pesticides to the end of not permitting the fallout of noxious substances into agricultural products and their accumulation in the soil and reservoirs;

enforces control over a rational conduct of hunting economy and over observance of the laws in force for the safeguarding and enriching useful flora and fauna and those pertaining to natural preserves and reservations.

b) The USSR Ministry of Irrigation and Water Resources:

bears responsibility for the organization of rational use of water in the national economy and for their protection from pollution, contamination and depletion, for preserving the technical level and the raising of efficiency of land-reclamation systems, for carrying out measures for the desalization of saltridden lands;

implements in the prescribed order the State control over the rational utilization of waters, over the carrying out of measures to forestall the pollution, contamination and depletion of reservoirs as well as over the work of purifying installations and dumping of sewage waters /industrial, drainage, those resulting from public utility and every-day activities, agricultural, particularly those ensuing from large-scale stock-raising complexes, and so forth/;

organizes the exploitation of large inter-branch water-resources objects and systems;

elaborates and submits to the USSR Gosplan drafts of long-term and annual plans for the development of the water economy of the USSR, schemes of an overall utilization and protection of waters, drafts of water economic balances that have an all-union significance, as well as plans for allocating waters among water-users along river basins that have inter-republican significance;

elaborates schemes for the protection of waters of small streams and of the upper reaches of mountain rivers;

c) the State Committee on Forestry of the USSR Council of Ministers:

exercises the State surveillance of the condition of forests and secures a rational utilization of forest resources in the country, bears the responsibility for reproduction and the raising of the productivity of forests, organization of protection of forests from fires and rapid liquidation of those fires, the protection of forests from noxious insects and maladies, organization of the protection of forests from illegal cutting of timber and other acts that result in damage to forest lands;

exercises control over the protection of the lands of the State Forest Fund and their utilization by forestry enterprises and organizations and forest-users in accordance with special-purpose designation of these lands and over observance of forest-using regulation on the territory of the State Forest Fund;

d) The USSR Ministry of Fish Economy secures the protection and the reproduction of fish reserves, regulation of fisheries, as well as the protection of the natural resources of the country's continental shelf;

e) The Main Administration of Hydrometeorological Service of the USSR Council of Ministers bears the responsibility for the organization of services of observation and control of the pollution level of external media of nature and issues special bulletins on sharp changes of the levels of pollution of waters and the atmosphere;

f) The USSR Ministry of Power and Electrification, as well as other ministries having electric power stations within their area of authority, bear responsibility for observance by the electric power stations subordinate to them of the rules of exploitation of the reservoirs, as well as dumping of waters into the reservoirs and of smoky gases into the atmosphere by thermal electric power stations;

g) The USSR Ministry of Health exercises the State control over the execution of measures actually of the liquidation and forestalling of the pollution of external natural medium, including measures for the liquidation and prevention of the pollution of surface and subterranean waters utilized for meeting the drinking, everyday needs, sanitation and other needs of the population;

h) The USSR Ministry of Internal Affairs:

exercises jointly with the USSR Ministry of Health surveillance of the observance of sanitary regulations for the maintenance of streets, courtyards and other centers of populated places, as well as of suburban recreation facilities for toilers and beaches;

renders aid to appropriate organs in implementation of measures for protection of natural riches and prevention of their pollution and for combatting poaching and violation of rules governing hunting and fishing;

i) The USSR Ministry of Geology exercises control over protection of subterranean waters from depletion and pollution;

j) The State Committee for Surveillance of Safe Conduct of Work in Industry and Mining Surveillance of the USSR Council of Ministers exercises control over protection of the bowels of the earth, the correct exploitation of the deposits of useful minerals and hydromineral resources.

Responsibility for securing the implementation of measures designed to protect the atmospheric air in cities and other populated places from pollution, is vested in the Councils of Ministers of union and autonomous republics, oblispulkows, krayispolkoms and gorispolkoms.

The Councils of Ministers of the union and autonomous republics and the ispolkoms of local Soviets of Workers Deputies should strengthen their control of the implementation by all enterprises and organizations, irrespective of their jurisdictional chain of command, of measures for the protection of nature and betterment of the utilization of natural resources, as well as strict observance by all citizens of the prescribed rules for the protection of the ambient natural medium.

The USSR Ministry of Irrigation and Water Economy, the USSR Ministry of Agriculture, the State Committee on Forestry of the USSR Council of Ministers, the USSR Ministry of Fish Economy, the Main Administration of Hydrometeorological Services of the USSR Council of Ministers, the USSR Ministry of Health, the USSR Ministry of Geology, the USSR Ministry of Internal Affairs, the State Committee on Surveillance of Safe Conduct of Work in Industry and Mining Surveillance of the USSR Council of Ministers and the Councils of Ministers of union republics are obligated to analyze the problem about defining more precisely the function and duties of organizations subordinate to them and of agencies that implement control over rational utilization and protection of natural resources and introduce needed change in the sanctioned plans, as well as into the statutes on these organizations and agencies.

3. To obligate the USSR ministries and agencies and the Councils of Ministers of union republics:

to secure, starting with year 1974, the elaboration of drafts of long-range and annual plans of the implementation of measures for environmental protection and for a rational utilization of natural resources, and for the submission of these to the USSR Gosplan simultaneously with the drafts of plans for the development of the national economy.

The above-mentioned drafts of plans should specify measures for environmental protection which would be subject to implementation by enterprises and organizations.

The Councils of Ministers of the union republics should also secure, starting in 1974, elaboration of drafts of summary long-range and annual plans of environmental protection on the territories of autonomous republics, krays, oblasts, large industrial centers and on territories of union republics as a whole; these plans should provide plans for environmental protection subject to implementation by enterprises and organizations of all-union and union-republican ministries and departments of the USSR as well as by enterprise and organizations within the jurisdiction of the ministries and departments of the union republic;

the designs for construction of enterprises should provide special sections for measures for protecting reservoirs, soils and atmospheric air from pollution by sewage and industrial wastes;

necessary measures should be taken for accelerating and improving projects linked with recultivation of lands and timely transfer of restored lands to kolkhoses, sorkhozes and other land-users must be secured;

strict control must be secured over the design construction and use in enterprises within the respective jurisdiction of structures for purifying sewage waters and of structures for purifying gases and collecting dust;

withdrawal from cities, in a prescribed order, of specific enterprises or change in their method of operation must be arranged in cases where it proves impossible to substantially lessen the most noxious wastes of these enterprises;

the elaboration and ratification in 1973 must be secured for enterprises and organizations within the respective jurisdictions of measures intended to create new and improve the existing technical processes looking toward lessening the volume of sewage, the dumping of noxious waste into the atmosphere and lessening the content of their contamination;

a survey of the state of canalization and purification of sewage in enterprises and organizations within the respective jurisdictions should be carried out by July 1, 1973; this step should aim at the realization of the necessary construction of new or reconstruction of the existing purifying installations and the basic guideline must be the maximal increase in circular water-supply and the need of accelerating the construction of installation for the purifying of sewage.

The Councils of Ministers of the union republics jointly with the USSR Ministry of Irrigation and Water Resources, the USSR Ministry of Health, the USSR Ministry of Fish Economy and other concerned ministries and departments should elaborate measures securing full cessation of dumping into reservoirs of unpurified or insufficiently purified or rendered harmless sewage; top priority must be given to basins of rivers

where large pollution contamination of waters has been observed or a tenseness of water balance is expected, and appropriate proposals must be submitted in 1973 to the USSR Gosplan.

4. The USSR Ministry of Ferrous Metallurgy, the USSR Ministry of Nonferrous Metallurgy, the Ministry of Chemical Industry, the USSR Ministry of Petroleum-Refining and Petrochemical Industry, the USSR Ministry of Construction Materials Industry and the USSR Ministry of Power and Electrification are obligated to implement in the course of 1973-1975 at enterprises within their jurisdictions measures for lessening the ejection of noxious wastes into the atmosphere in accordance with Supplement No 1.

5. The Councils of Ministers of the union republics jointly with the USSR ministries and agencies are assigned the task of elaborating and implementing within the period 1973-1977 measures for reconstruction and building of gas-purifying and dust-absorbing installations at the sites of existing enterprises for the elimination of heightened pollution of atmospheric air in the cities in accordance with Supplement No 2.

The USSR ministries and agencies are obligated to allocate the necessary capital investments for the implementation of indicated measures.

6. The USSR Gosplan is charged with:

an elaboration of systematic methodical instructions and a list of indices and forms for setting up State Plans for rational utilization of natural resources and for environmental protection bearing in mind that beginning with 1974 such plans should be an integral part of long-range and annual plans of the development of national economy;

examination of proposals submitted by USSR ministries and agencies and by Councils of Ministers of union republics for a rational utilization of natural resources and for environmental protection;

ratification of schemes of complex overall utilization and protection of waters as well as of water resources balances having an all-union significance;

submission to the USSR Council of Ministers of proposals coordinated with the Councils of Ministers of union republics on determining the water objects, the regulation of whose use is held advisable to be left to the organs of the USSR;

the securing of the working out within the system of general schemes of development and allocation of productive forces of the country's economic rayons of special measures for environmental protection.

In this content, the USSR Gosplan is called upon to organize within the system of the central apparatus the Department of Environmental Protection.

7. The State Committee on Science and Technology of the USSR Council of Ministers is charged with:

an elaboration jointly with appropriate ministries and agencies and the ratification of plans of exploration on scientific grounds of the rational utilization of natural resources and environmental protection. In the elaboration of such plans, special attention should be paid to the securing of the transition to qualitatively new technological processes which result in a potential of utilizing natural resources more rationally and lessening negative effects on the environmental medium;

coordination of the activities of scientific institutions in elaborating the most important problems of a rational utilization of natural resources and environmental protection;

securing of financing of the most significant scientific and research works, provided for in the plans, and dealing with a rational utilization of natural resources and protection of the ambient natural medium, as well as the control of their implementation;

elaboration of prognoses dealing with problems of rational utilization of natural resources and protection of the ambient environmental natural medium.

8. For the purpose of improving the organization and coordination of scientific-research and designing-planning works for resolving weighty scientific and technical problems in the area of a rational utilization of natural resources and protection of the ambient natural medium:

a) to obligate the State Committee on Science and Technology of the USSR Council of Ministers, the USSR Academy of Sciences, the USSR Gosplan, the USSR Gosstroy /the USSR State Committee for Construction/, the USSR Ministry of Health, the USSR Ministry of Agriculture and the Main Administration of Hydrometeorological Services of the USSR Council of Ministers with the participation of concerned ministries and agencies of the USSR and the Councils of Ministers of the union republics to elaborate within the 1973-1974 period a scientific-technical prognosis of potential changes in the biosphere as a result of the development of various branches of the national economy for the prospective 20-30 years; this prognosis should include measures for an optimal forestalling of the negative effect of business activities on the environmental natural medium as well as measures for the development of scientific studies tending to secure the resolution of the weightiest problems of the protection of the ambient natural medium and a rational utilization of natural resources.

The USSR Academy of Sciences jointly with scientific and research organizations of the concerned ministries and agencies are called upon to elaborate in 1973 methods of economic evaluation of the utilization of the most significant kinds of natural resources;

b) to establish that

the tasks for the solution of the weightiest scientific and technical problems in the area of protection of the ambient natural media, a rational utilization and protection of natural resources are singled out in the State Five-Year Plan of scientific and research works and the utilization of the achievements of science and technology within the national economy into a special section /programme/ entitled: "Complex Problems of the Protection of the Ambient Natural Medium and the Rational Utilization of Natural Resources";

appropriations allotted for the carrying out of scientific-research and designing-planning works for the solution of the most significant scientific and technical problems in the area of a rational utilization of natural resources and the protection of the ambient natural medium cannot be used for other projects without authorization by the State Committee on Science and Technology of the USSR Council of Ministers;

c) The State Committee on Science and Technology of the USSR Council of Ministers jointly with the USSR Academy of Sciences has to organize as a part of the Committee on Interjurisdictional Scientific and Technical Council dealing with overall problems of protection of the ambient natural medium and rational utilization of natural resources.

The indicated Interjurisdictional Scientific and Technical Council is to be charged with:

an analysis of the contemporary state of protection of the ambient natural medium and a rational utilization of natural resources in the USSR and abroad;

the elaboration with participation of the ministries and agencies of the USSR and the Councils of Ministers of the union republics of proposals aiming at an improvement of the utilization of natural resources, the protection and reproduction of renewable natural resources and the protection of the ambient natural medium;

consideration of the questions of control and surveillance in the area of protection of the ambient natural medium and a rational utilization of natural resources and an elaboration of proposals for their improvement,

consideration of proposals for setting up standards and regulations for rational use and reproduction of natural resources, protection of the ambient surrounding natural media and for control of the levels of its pollution;

the defining of the basic scientific and technical problems in the area of protection of the ambient natural medium and a rational use of natural resources, an elaboration, jointly with ministries, agencies and other concerned organizations of coordinated plans of efforts for their resolution as well as examination of the annual plans of research projects and the volumes of financing of these efforts;

systematic guidance of efforts implemented by the ministries and agencies of the USSR in the area of setting new technological processes that will permit an elimination or sharp lowering of the emission of noxious wastes into the reservoirs, the atmosphere and the soils.

The State Committee on Science and Technology of the USSR Council of Ministers and the USSR Academy of Sciences are charged with ratifying within a three-month period the statute on the mentioned Interjurisdictional Scientific and Technical Council and for setting in accordance with the appropriate ministries and agencies its personnel and staff;

d) the ministries and agencies of the USSR are obligated to secure:

the allocations of material and financial resources needed for the fulfillment of the tasks provided for by the coordinated plans, for the resolution of basic scientific and technical problems in the area of a rational utilization and protection of lands, waters and timber resources, the improvement of protection of atmospheric air from pollution by noxious industrial wastes and exhaust gases of automobile engines, and of soils from erosion and salination, the raising of fishery yields of inland reservoirs, the creation and mastering of the production of new chemical preparations that are safe for humans and animals, the creation of technology capable of forestalling the pollution of the outer media, barring of the pollution of the seas as a result of navigation, the elimination of the consequences of substantial oil spills in the seas ensuing from accidents and for the solution of other basic scientific and technical problems in the area of protection of the ambient natural medium and a rational use of natural resources;

systematic control of the implementation of these measures.

9. To establish that the functions of the organs charged with regulating the use and protection of waters, provided for by the Foundations of Water Legislation of the Union of SSR and the union republics, are impelmented conformably by the USSR Ministry of Irrigation and Water Resources, the corresponding ministries and other union-republican organs of irrigation and water resources of union republics, basin /territorial/ bureaus and inspections charged with regulating the use and protection of waters which are subordinate to the above, as well as other local organs of the System of the USSR Ministry of Irrigation and Water Resources.

The USSR Gosplan and the USSR Gossnab must in the process of preparing national economic plans envisage earmarking the necessary auto transport facilities, mobile laboratories, swimming equipment, materials and other equipment to the USSR Ministry of Irrigation and Water Resources and the Councils of Ministers of the union republics for the basin /territorial/ offices and inspection boards charged with regulating the use and protection of waters, to the Main Administration of Hydrometeorological Services of the USSR Council of Ministers for observation services of the pollution level of the ambient natural media, to the USSR Ministry of Health for sanitary and epidemiological services and to the USSR Ministry of Agriculture for the organizations and departments of the State Veterinary Service.

10. The Main Administration of Hydrometeorological Services of the USSR Council of Ministers is obligated:

to organize all-state service of observations and controls of the levels of pollution of the atmosphere, soils and water objects as shown by physical, chemical and hydrobiologic /in case of water objects/ indices and special emergency bulletins about drastic sharp changes in the levels of pollution of the atmosphere, soil and waters;

to provide the concerned organizations and agencies with systematic information and prognoses on the levels of pollution of the atmosphere, soil, and water objects and on the possibility of their changes under the pressure of business activities and hydrometeorological conditions.

The Main Administration of the Hydrometeorological Services of the USSR Council of Ministers is to set up as an integral part of the central apparatus an Office for the Study and Control of Pollution of External Media.

11. To introduce, effective July 1, 1973, a State census inventory of waters and of their use under a system unified for the entire Union of SSR.

The census inventory of waters and the conduct of the State water cadastre is to be entrusted to the Main Administration of the Hydrometeorological Services of the USSR Council of Ministers jointly with the USSR Ministry of Geology /its Department of Subterranean Waters/ and the USSR Ministry of Irrigation and Water Resources /in matters pertaining to inventoring the consumption and distribution of water/.

12. The ministries and agencies of the USSR and the Councils of Ministers of the union republics are obligated, in the process of setting up assignments for designing enterprises and installations, to foresee in them requirements for elaborating measures that exclude the possibility of a negative impact on the ambient natural medium by the enterprise or installation being designed; in setting up assignments for designing new technological processes to foresee requirements for a drastic curtailment or complete elimination of contamination of atmosphere, reservoirs and soil by noxious wastes and sewage; in ratifying of technical /techno-working/ projects for the construction of new and reconstruction of operating enterprises and installations to secure the observance of these requirements.

The USSR Gosstroy, the ministries and agencies of the USSR, the Councils of Ministers of the union republics while rendering expert consultations on projects of constructing new and recontracting of operating enterprises and installations have to secure that the requirements for the protection of the ambient natural medium are duly observed.

13. The Councils of Ministers of the union republics are charged with:

establishing within the 1973-1974 years the boundaries of green zones /with setting within them of forest and park territories and of areas of long-range and short-range rest and leisure of the populace/ for cities where such zones had not yet been established, as well as the boundaries of water-protecting forest zones and zones of sanitary protection of water sources;

securing for the 1973-1980 period the carrying out of expansion within the cities and suburban areas of green plantings /setting up of new parks, gardens, squares, boulevards, protective green zones and forest-park areas, particularly on recultivated lands/;

strictly limiting the allotting of land sectors in forests for the green zones of cities, in forest protective strips and in other forested areas of the first category for purposes not linked with the development of forestry;

preparing /plans/ at the suggestions of the State Committee on Civil Construction and Architecture of the USSR Gosstroy, the USSR Ministry of Health and the VTsSPS /All-Union Central Council of Trade Unions/ and ratifying the list and the boundaries of territories reserved for purposes of organizing therapeutic zones and zones of rest and tourism as well as rules and regulations governing the exploitation of these territories;

entrusting the protection of shelter, belts and other tree plantations that do not belong to the State Forest Fund to those enterprises, organizations and agencies on whose lands they are located;

undertaking necessary measures for the prevention of fires in forests and in peat deposits.

14. The USSR Ministry of Timber and Woodworking Industry, ministries and agencies conducting procurement and floating of timber as well as its processing, are obligated to adopt necessary measures for the improvement of deliveries and lessening the losses of timber, and the State Committee on Forestry of the USSR Council of Ministers is called on to strengthen the control of a rational felling of trees and the rational utilization of timber-procuring organizations and enterprises of their allotted wood-cutting fund.

15. For the purpose of diminishing of the losses of useful minerals in the course of their quarrying the processing, as well as forestalling of the pollution of the ambient medium by industrial wastes:

a) The USSR Ministry of Nonferrous Metallurgy, the USSR Ministry of Ferrous Metallurgy, the USSR Ministry of Coal Industry, the USSR Ministry of the Chemical Industry, the USSR Ministry of Construction Materials Industry, the Ministry of Petroleum Industry, the Ministry of Gas Industry and other ministries quarrying and processing useful minerals, are obligated to ratify in 1973 plans of measures for all their subordinate enterprises, that foresee:

inculcation of more efficient methods and systems of elaboration of deposits of useful minerals and of technical schemes for processing mineral raw materials to the end of securing the fullest, complex and economically expedient extraction from the bowels of the earth of reserves of basic useful minerals as well as of useful minerals located within the same deposits with the former, and also utilization of components having industrial significance, which are located in the former categories;

the construction or reconstruction of shops, factories, installations for an overall processing of raw materials, wastes, slags, allotment of capital investments for these purposes, setting of data of the completion of transfer of the above enterprises to work securing an overall utilization of useful minerals;

b) the Ministry of Chemical Industry, the USSR Ministry of Petroleum, Refining and Petrochemical Industry and the Ministry of Cellulose and Paper Industry and obligated to secure the

production and timely delivery to mining and quarrying enterprises of the necessary range of high-quality flotation reagents, sorbents, and extra agents, which would permit an optimal extraction of valuable components in the process of the concentration of mineral raw materials.

16. The Ministry of Chemical and Petroleum Machine-Building is charged with:

production and overall deliveries of gas-purifying and dust-absorbing equipment and apparatus to ministries and agencies;

securing of the organization of production of new and perfected equipment and apparatus for purifying wastes emitted into the atmosphere and resulting from noxious gases, dust, soot and other substances;

the carrying out of appropriate scientific studies and of experimental and designing work for the creation of more perfect equipment and apparatus for the protection of atmospheric air from pollution by industrial wastes;

realization in enterprises, organizations and agencies of the main assembly and adjusting of gas-purifying and dust-absorbing equipment and apparatus;

implementation of State control of the work of gas-purifying and dust-absorbing installations in industrial enterprises irrespective of their jurisdictional subordination.

In this context, the All-Union enterprise "Soyuzgazoochistka" /Union Association for the Purifying of Gases/ of the USSR Ministry of Petroleum-Refining and Petrochemical Industry with all its subordinate enterprises and organizations is to be transferred to the jurisdiction of the Ministry of Chemical and Petroleum Machine-Building. The transfer is to be effected on the basis of the statute of 1 July 1972 conformably to the order provided by the resolution of the USSR Council of Ministers of 12 October 1965, No 755.

To consider it necessary to set up within the Ministry of Chemical and Petroleum Machine-Building on the basis of the transferred All-Union association "Soyuzgazoochistka" a Main Office for the Working Out and Production of Gas Purifying and Dust-Absorbing Equipment /Glargazoochistka/ including the State Inspection of Control of the Work at Gas-Purifying and Dust-Absorbing Installations that is subordinate to it. The number of the personnel of the central apparatus of the Ministry of Chemical and Petroleum-Machine-Building is to be increased by 70 units at the expense of the personnel strength of the transferred All-Union Association "Soyuzgazoochistka."

To establish the fact that the organization of the "Glargazoochistka" within the Ministry of Chemical and Petroleum Machine-Building does not lower the responsibility of the ministries and agencies of the USSR and of the

Councils of Ministers of the union republics for the implementation of needed measures for the protection of the atmospheric air from the pollution by noxious substances.

The USSR Gosplan will consider the question on the measures of assistance to be rendered to the Ministry of Chemical and Petroleum Machine-Building in connection with the pending formation within its structure of the above Main Office.

17. The USSR Gosplan and the Ministry of Chemical and Petroleum Machine Building are to submit to the USSR Council of Ministers in accord with the USSR Gosstroy of the proposal on the transfer to the jurisdiction of the Ministry of Chemical and Petroleum Machine-Building of enterprises and organizations of the ministries and agencies of the USSR engaged in the production of gas-purifying and dust-absorbing equipment and apparatus as well as in scientific-research, planning-designing and starting-adjusting activities, linked with protection of atmospheric air from pollution.

18. The Ministry of Chemical and Petroleum Machine-Building, the USSR Ministry for the Construction of Enterprises of Heavy Industry, the USSR Ministry of Construction and the Council of Ministers of the Ukrainian SSR are to secure the construction of enterprises and other entities in accordance with Supplement No 3.

The USSR Gosplan is charged with providing in national economic Plans an allotment to the Ministry of Chemical and Petroleum Machine Building of capital investments needed for the construction of entities indicated in Supplement No 3, at the expense of capital investments provided for these years in the Five-Year Plan for the USSR Ministry of Petroleum-Refining and Petrochemical Industry.

19. The USSR Gosplan and the Ministry of Chemical and Petroleum Machine Building jointly with the USSR Ministry of Power and Electrification, the Ministry of Electrotechnical Industry, the Ministry of Instrument-Making, Automation Equipment, and Control Systems and other concerned ministries are charged with elaborating and implementation of measures for increasing the production of gas-purifying and dust-absorbing equipment and apparatus in line with up-to-date advances of science and technology to the end of fully satisfying, starting in 1976, the requirements of the national economy in these areas.

20. To prohibit the ministries and agencies of the USSR to initiate changes, without a former agreement with the Ministry of Chemical and Petroleum Machine-Building, in enterprises within their jurisdiction of the list of products and volume of production of equipment, articles, materials and spare parts for gas-purifying and dust-absorbing installations.

21. For the purpose of improving the organization of scientific-research and planning-designing work in the area of gas-purification and dust-absorption and for strengthening the coordination of these activities to entrust the functions of a head organization:

to the State Institute for Designing Gas-Purifying Installations of the Ministry of Chemical and Petroleum Machine-Building in the matter of elaborating the designs of gas-purifying installations;

to the State Scientific and Research Institute for Industrial and Sanitary Purification of Gases of the Ministry of Chemical and Petroleum Machine-Building in the matter of elaboration of problems of gas-purification and dust-absorption as well as the problem of the recovery of valuable products from industrial wastes;

to the Central Scientific Research and Designing Technical Laboratory of the Toxicity of Engines of the Ministry of Tractor and Agricultural Machine-Building in the matter of lowering of toxicity of exhaust gases of automobile and other engines of internal combustion;

to the Central Scientific-Research Motor Vehicle and Auto-Engine Institute of the Ministry of Motor Vehicle Industry in the matter of creating low-toxic automobile engines.

22. The Glavmosstroy /Main Administration for Construction in Moscow/ of the Mosgorispolkom is obligated to secure in 1974 the completion in the city of Moscow of the "Mossel'mask" /Moscow Agricultural Machinery Plant/ of the Ministry of Tractor and Agricultural Machine-Building of a laboratory-experimental and productive building with total area of 15 thousand square meters for the needs of the Central Scientific Research and Designing-Technical Laboratory of the Toxicity of Engines, of the above Ministry.

The Ministry of Tractor and Agricultural Machine-Building is charged with organizing, starting in 1935, in the above building a series output of devices for neutralizing noxious substances contained in exhaust gases of automobile engines.

23. The Ministry of Chemical Industry, the USSR Ministry of Ferrous Metallurgy, the USSR Ministry of Power and Electrification, the USSR Ministry of Building Materials Industry, the USSR Ministry of Petroleum-Refining and Petrochemical Industry and the USSR Ministry of Nonferrous Metallurgy are charged with elaborating in agreement with the USSR Ministry of Health and the Main Administration of Hydrometeorological Services of the USSR Council of Ministers and of implementing measures for lowering in operating industrial enterprise within their jurisdiction of the emission of noxious wastes into the atmosphere for forestalling dangerous concentrations of pollution of atmospheric air in the rayons of the location of enterprises in periods of unfavorable meteorological conditions.

The Main Administration of Hydrometeorological Services of the USSR Council of Ministers and the USSR Ministry of Health are charged with elaborating the procedures for warning the local organs of authority and the executives of industrial enterprises about possible rise of concentration of atmospheric pollution in connection with anticipated unfavorable meteorological conditions.

24. The Ministry of the Motor Vehicle Industry, the Ministry of Tractor and Agricultural Machine-Building and the RSFSR Ministry of Motor Transport in agreement with the USSR Ministry of Health are charged with elaborating within the period of 1973-1974 and submitting to the State Committee of Standards of the USSR Council of Ministers drafts of standards setting the maximum permissible norms of content of toxic components in exhaust gases for newly manufactured cars and cars in actual use.

The State Committee Standards of the USSR Council of Ministers is to examine and ratify the above standards.

25. The Ministry of Tractor and Agricultural Machine-Building jointly with the Ministry of the Motor Vehicle Industry is charged with elaborating, production and testing within 1974 of effective designs of devices, suitable for mass production, for neutralizing noxious substances contained in the exhaust gases of automobile engines and for organizing within 1975 a series production of such devices.

26. The Councils of Ministers of the union republics and the ministries and agencies of the USSR, in agreement with the USSR Ministry of Health are charged with preparation and implementation within the 1973-1975 period of measures for lowering the toxicity of the exhaust gases of automobile engines in actual use, and of bringing it down to the prescribed norms, guided in part, by the need of setting up in large cities and public resort cities a necessary network of controlling and regulatory stations.

27. The Ministry of Instrument-Making, Automation Equipment and Control Systems is charged with preparing the designs of measuring instruments for the control of the contents of carbon monoxide and other noxious substances in the exhaust gases of automobile engines and setting up, starting in 1974, of a series production of instruments for the control of the content of carbon dioxide in these gases in quantities conforming to the requirements of the Councils of Ministers of the union republics and the ministries and agencies of the USSR.

The Ministry of Motor Vehicle Industry and the Ministry of Tractor and Agricultural Machine-Building have until 1 April 1973 to submit to the Ministry of Instrument-Making, Automation Equipment and Control Systems the coordinated technical orders for the above-mentioned instruments.

28. For the purpose of wide breeding in reservoirs of herbivorous fish that allow the possibility of bettering the biological cleansing of reservoirs of algae and other plants damaging to the water stocks of the reservoirs and simultaneously utilizing the large quantity of biogenetic substances that are accumulating in storage lakes:

a) The USSR Ministry of Fish Economy, the RSFSR Council of Ministers, the Council of Ministers of the Ukrainian SSR, the Council of Ministers of the Uzbek SSR and the Council of Ministers of the Azerba YDZH an SSR are charged with:

adoption of measures for the breeding of herbivorous fish, and as top priority, in storage lakes of the Dniepr cascade of hydroelectric power stations, in the Volgograd, Kuybushev and Tsymlyansk storage lakes, and of an increase of breeding young silver carps in existing fish nurseries, and also provision for the breeding of silver carps in designing and building of zonal fish nurseries and spawning and raising fish farms;

determination jointly with the USSR Academy of Sciences, the USSR Ministry of Power and Electrification and the USSR Ministry of Irrigation and Water Resources of the need of building fishing nurseries of herbivorous fish for the purpose of biological improvement of the reservoirs and the effort for the prevention of overgrowing of irrigation systems and reservoirs-cooling facilities for thermal electric power stations and to submit proposals in this matter to the USSR Gosplan within the first half of 1973;

b) The USSR Ministry of Fish Economy, the USSR Ministry of Irrigation and Water Resources and the USSR Ministry of Power and Electrification are charged with securing within the 1973-1978 period the designing, construction and putting into operation of fish nurseries of herbivorous fish of total capacity of 383 million of young fish per year in accordance with Supplement No 4.

The USSR Gosplan is charged with providing in its plans of supplementary capital investments in the sums of 23 million rubles to the USSR Ministry of Fish Economy for the construction of fish nurseries enumerated in Supplement No 4 from the account of capital investments provided for in the Five-Year Plan for the USSR Ministry of Power and Electrification and the USSR Ministry of Irrigation and Water Resources;

c) The USSR Ministry of Power and Electrification, the USSR Ministry of Irrigation and Water Resources and other ministries and agencies of the USSR and the Councils of Ministries of the union republics are charged with implementing in the process of reconstructing and building the storage lakes of measures for securing a biological improvement of the reservoirs;

d) The USSR Ministry of Fish Economy is charged with preparing in 1973 in coordination with the USSR Ministry of Power and Electrification and with implementing before the end of 1974 the measures for setting up a specialized fish nursery, using warm waste waters of one of the electric power stations for the purpose of study and breeding of new types of fish, promising for the fishing economy and for an improvement of reservoirs, these types of fish are to be drawn from tropical and subtropical ichtyological fauna;

e) The USSR Ministry of Irrigation and Water Resources is charged with:

resolving the problem of utilizing the Kremenchug storage lake in the capacity of an experimental-industrial reservoir for studying the processes of biological improvement, with full awareness of the fact, that the exploitation of this storage lake and utilization of its water stocks should be implemented by ministries and agencies in full coordination with the USSR Ministry of Fish Economy;

building in the period of 1973-1974 in the rayon of the city of Ashkhabad a productive-irrigatory base for the carrying out of scientific and research studies for utilization of herbivorous fish for a purification of irrigation and drainage systems;

f) The USSR Ministry of Power and Electrification is to construct in the 1973-1974 period the Burstyn fish nursery of herbivorous fish as a compensatory measure for the loss sustained by the fishing industry as the result of the building of the Burshtyn GRES.

29. For the purpose of forestalling the pollution of the soil, reservoirs and other objects of the external medium by pesticides used to exterminate pests, plant diseases, weeds as well as noxious insects and rodents:

a) The USSR Ministry of Agriculture, the State Committee on Forestry of the USSR Council of Ministers, the USSR Ministry of Fish Economy, the USSR Ministry of Irrigation and Water Resources, the USSR Ministry of Health and the Councils of Ministers of the union republics are charged with securing strict observance by kolkhozes, sovkhozes and other enterprises, organizations and agencies as well as by citizens of the prescribed rules governing the application of pesticides.

The Main Administration of Hydrometeorological Services of the USSR Council of Ministers is charged with setting of observation of changes in the ambient natural medium caused by application of pesticides;

b) The USSR Ministry of Agriculture is called upon to elaborate jointly with concerned ministries and agencies and to ratify within 1973 recommendations for combatting basic pests and plant diseases;

c) to establish that the sale of pesticides to kolkhozes, sovkhoza, lyakhoze and other enterprises and organizations should proceed, starting in 1973, solely on the basis of findings by local organs of the plants protection services of the USSR Ministry of Agriculture or the State Committee on Forestry of the USSR Council of Ministers on the advisability of carrying out of the chemical treatment of sowings, plantings, reservoirs and forests;

d) to establish that in the process of developing new pesticides, scientific and research organizations of the appropriate ministries and agencies must elaborate the methods of defining the residual quantities of these media in the waters, atmospheric air, soil as well as in agricultural produce;

e) The USSR Ministry of Agriculture, the USSR Ministry of Fish Economy, the USSR Ministry of Health, the Main Administration of the Hydrometeorological Services of the USSR Council of Ministers, and the Councils of Ministers of the Union republics are called upon to organize, starting in 1973, using the staffs of scientific and research institutions under their jurisdiction, a systematic study of the impact of pests on water organisms and to determine the maximal permitted concentrations of these in fishing reservoirs.

30. For the purpose of improving the sanitary condition of cities, suburban zones, workers' settlements and rural populated places, the Councils of Ministers of the union republics are called upon:

to consider the state of construction of water mains, sewerage and purifying installations in cities and workers' settlements and to take necessary steps for their unconditional putting into operation within the prescribed time limits.

To establish that purifying installations of water mains and sewerage must be designed with full awareness of the prospects of development of cities and workers' settlements Construction and putting into operation of these installations should proceed by stages with the securing of the needed technical complex of the purifying services;

to secure implementation within the 1973-1974 period of necessary measures for bringing open, disorganized dumps for domestic and every-day

trash located near cities, industrial centers and health resort zones into line with sanitary regulations ratified by the USSR Ministry of Health;

to organize preparation of designing documentation for the construction of trash-processing and trash-burning plants and to secure, starting with 1974, construction of such plants in large cities and health resort zones;

to elaborate and implement, within the 1973-1975 period, measures concerned with centralized collection, removal and decontamination of industrial wastes in large cities and industrial centers, drawing toward the fulfillment of these measures the enterprises of the appropriate ministries and agencies of the USSR.

The Ministry of Construction, Road, and Communal Machine-Building, the Ministry of Heavy, Power, and Transport Machine-Building /in concordance with their branch specialization/ and the USSR Ministry of Power and Electrification are obligated to implement within the 1973-1975 period preparation and mastering of the series production of equipment for trash-processing and trash-burning plants, while taking into account of results of experimental operation of such plants in the cities of Moscow and Leningrad and in conformity with technical requirements of the RSFSR Ministry of Housing and Public Utility Services.

The Mosgovispolkom is charged with securing within 1973 the completion of construction on the territory of the experimental plant for the processing of every-day wastes /Varshavskoye Chaussée, G3 b/ of the Experimental Laboratory of the Academy of Communal Services imeni K.D. Pamfilov for Rendering Harmless and the Processing of Domestic and Every-Day Trash in the Volume of 13,500 cubic meters per year.

31. The USSR Gosstroy is charged with:

the strengthening of the methodological guidance of the elaboration and review of normative documentation for designing and building of cities and other populated entities and also for designing and constructing structures for water supply, sewerage, purification and rendering harmless sewage, and of structures for purifying noxious wastes emitted into the atmosphere, basing this work on advanced home and foreign experience in designing and construction and the need for maximum improvement of sanitary conditions of the ambient medium in cities and other populated entities and the need for lessening of the volume of sewage and the emission of industrial wastes into the atmosphere, accompanied by the simultaneous lowering of the costs of building purifying installations;

to elaborate with the participation of the concerned ministries and agencies of the USSR and the Councils of Ministers of the union republics and to ratify the program, the volume of work and the time periods of preparation and the ratification of the indicated standard documentation;

to strengthen the existing productive-technical base of branches of VNIIvodgeo /All-Union Scientific Research Institute of Water Supply, Sewer Systems, Hydraulic Engineering Structures and Engineering Hydrogeology/ in the union republics.

To permit the USSR Gosstroy to expand the experimental base of VNIIvodgeo in the Kuchino settlement of the Moscow oblast by building on its territory a laboratory building with a total area of up to seven thousand sq. meters and an experimental pavilion with an area of up to 3.6 thousand sq. meters.

32. To obligate the ministries and agencies of the USSR and the Councils of Ministers of the union republics to secure compliance with normative requirements relating to purification of waters and dumped industrial and domestic sewage, to protection of atmosphere from noxious industrial wastes, to utilization, neutralization and incineration of economic domestic and industrial wastes, and rational exploitation of useful minerals and recultivation of lands -- in appraisal and ratification of technical designs of the construction of enterprises and installations and designs for planning and building cities and other populated entities.

The USSR Gosstroy is to set up regular controls over the implementation of the outlined requirements.

33. To establish that in resolving disputes arising out of questions of water are linked with dumping of sewage into water objects and also out of emission of noxious substances into the atmosphere, the Councils of Ministers of the union republics, the Councils of Ministers of autonomous republics, the executive committees of the local Soviets of toilers' deputies, the organs charged with regulating the use and protection of waters and other organs authorized to settle these disputes take into account the expert testimony of the USSR Gosstroy and the gosstroys of the union republics as well as of the appropriate organs of the USSR Ministry of Health, the USSR Ministry of Fish Economy, the USSR Ministry of Geology, the Main Administration of the Hydrometeorological Services of the USSR Council of Ministers and of other competent bodies.

34. The USSR Gosstroy jointly with the Ministry of Chemical and Petroleum Machine Building and other concerned ministries and agencies is obligated to prepare in 1973, using the staffs of scientific and research and planning and designing organizations under their jurisdiction, the products list of equipment, instruments and automation systems corresponding to the best foreign models and subject to manufacture for the construction of installations for purifying waters for meeting the water needs of the population, sewage, industrial wastes emitted into the atmosphere, for utilization and incineration of economic-domestic and industrial wastes, as well as technical assignments for designing and production of the indicated equipment, instruments and automation systems.

The State Committee on Science and Technology of the USSR Council of Ministers is charged with providing in its plans of designing and manufacture of pilot models of the indicated equipment, instruments and automation systems, as well as the carrying out of their testing.

35. To establish that the conduct of scientific-research and planning-designing activities for the creation of high-performance equipment and fittings for purifying installations as well as their manufacture are entrusted to:

the Ministry of Chemical and Petroleum Machine Building, the Ministry of Construction, Road, and Communal Machine-Building and the Ministry of Heavy, Power, and Transport Machine-Building /in accordance with their specialization/ - for water main and sewerage installations of populated places and industrial enterprises;

the Ministry of Shipbuilding and the RSFSR Ministry of the River Fleet /in accordance with their specializations/ - for effecting installations aboard vessels for purifying water for drinking and consumer needs, for purifying of sewage on ships and for collection of sewage on ships for subsequent pumping over of these to shore capacities.

Elaboration on the basis of technical requests of concerned ministries and agencies and the creation of instruments and automation equipment for the control of sewage, natural waters and industrial wastes emitted into the atmosphere and the quality of their purifying function, as well as the organization of the series production of these devices and automation equipment for purifying installations and observation stations are entrusted to the Ministry of Instrument-Making, Automation Equipment, and Control Systems.

Manufacture of hose filters of a height of up to ten meters from special fabrics is entrusted to the Ministry of Construction, Road, and Communal Machine-Building, preparation and manufacture of synthetic materials for filter fabrics is given to the Ministry of Chemical Industry and the preparation and manufacture of filter fabrics for hose filters is entrusted to the USSR Ministry of Light Industry.

The Ministry of Chemical and Petroleum Machine-Building, the Ministry of Heavy, Power, and Transport Machine-Building, the Ministry of Construction, Road, and Communal Machine-Building, the Ministry of Chemical Industry, the USSR Ministry of Light Industry, the Ministry of Shipbuilding Industry, the Ministry of Instrument-Making, Automation Equipment, and Control Systems and the RSFSR Council of Ministers are charged, on the basis of technical requirements and requests received from the ministries and agencies, with elaborating and submitting during the first quarter of 1973 to the USSR Gosplan of a proposal on the production of equipment, apparatus and materials indicated in the present paragraph, including the production of basic sets of goods completing the list.

36. The Ministry of Chemical and Petroleum Machine-Building, the USSR Gosstroy, the USSR Ministry of Construction Materials Industry, the Ministry of Chemical Industry, the USSR Ministry of Power and Electrification, the Ministry of Heavy, Power, and Transport Machine-Building, the USSR Ministry of Nonferrous Metallurgy, the Ministry of Instrument-Making, Automation Equipment, and Control Systems, the State Committee on Civil Construction and Architecture of the USSR Gosstroy and the RSFSR Council of Ministers are charged with securing the elaboration of new types of equipment for installations for purifying sewage of cities and industrial enterprises, preparation of pilot models on enterprises within their jurisdiction and the mastering of the series production of this equipment conformably to Supplement No 5.

The Ministry of Instrument-Making, Automation Equipment, and Control Systems, the Ministry of Chemical Industry, the USSR Ministry of Petroleum-Refining and Petrochemical Industry, the USSR Ministry of Agriculture and the USSR Ministry of Nonferrous Metallurgy are charged with devising instruments for controlling the quality of natural surface waters and sewage and organizing at the enterprises under their jurisdiction their series production in conformity with Supplement No 6.

38. The Ministry of Chemical Industry is obligated to elaborate on orders of the USSR Gosstroy, the USSR Gassnab, the USSR Ministry of Nonferrous Metallurgy, the Ministry of Chemical and Petroleum Machine-Building, and the RSFSR Council of Ministers special brands of activated carbon for purifying sewage and industrial wastes emitted into the atmosphere, and within time limits arrived at in concordance with the USSR Gossnab to organize their production in quantities adequate to meet the needs of the national economy.

39. The USSR Ministry of Construction Materials Industry is obligated to complete the construction and to put into operation at the Yenakiyevo Plant of reinforced concrete products an experimental shop for the production of polymer reinforced concrete pipes, as well as to secure jointly with the Ministry of Chemical Industry the testing of these pipes in the presence of highly active industrial sewage and to submit to the USSR Gosplan, in 1974, proposals on organizing their production.

40. The USSR Ministry of Construction, the USSR Ministry of Industrial Construction, the USSR Ministry of Agricultural Construction, the USSR Ministry of Construction of Enterprises of Heavy Industry and the USSR Ministry of Power and Electrification are charged with setting up in 1973-1975, under the conditions of available volume of construction and installation work, specialized construction and installation organizations for construction of water main and sewerage facilities and purifying installations.

41. To set an assignment for implementing within the period of 1973-1975 the elaboration and introduction of new methods of purifying sewage in conformity with Supplement No 7.

The USSR Gosstroy is to generalize the experience in utilization of the outlined methods, as well as of experimental construction and exploitation of structures and installations for purifying sewage and adoption of necessary steps for the inculcation of the most efficient methods.

42. The Ministry of Cellulose and Paper Industry is charged with elaborating, while taking home and foreign experience into account, and implementing, within the 1973-1974 period, of measures in enterprises under its jurisdiction for substantial improvement of performance and the lowering of price of construction of enterprises for purifying industrial sewage and for increasing the recovery of valuable products from these waters.

43. The State Committee on Standards of the USSR Council of Ministers is charged with:

providing, starting in 1973, in plans of State standardization, an elaboration of the complex of general technical State standards for environmental protection and rational use of natural resources;

jointly with the Councils of Ministers of the union republics and the ministries and agencies of the USSR with elaborating and submitting, within the first half of 1973, to the State Committee on Science and Technology of the USSR Council of Ministers of a project of a coordinated Plan of activities for standardization in the area of protection of water resources and the protection of atmosphere from emission of noxious industrial wastes and exhaust gases of automobiles.

44. The Main Administration of Hydrometeorological Services of the USSR Council of Ministers, the USSR Academy of Sciences, the USSR Ministry of Health, the USSR Ministry of Irrigation and Water Resources, the USSR Ministry of Fish Economy, the USSR Ministry of Agriculture and the USSR Ministry of Power and Electrification are obligated to prepare before 1 July 1973, in concordance with the State Committee on Science and Technology of the USSR Council of Ministers, and implement within the 1973-1974 period measures for setting up a network of stations for hydrochemical, hydrometeorological, sanitary and hydrobiological observations for the control of quality and degree of pollution of surface waters, atmospheric air and soils, as well as for setting up, prior to 1975, of a unified system of assembly, storage, search and processing of data on the quality of water, atmospheric air and soils.

45. The USSR TsSU /Central Statistical Administration/ is obligated in concordance with the USSR Gosplan, the USSR Ministry of Irrigation and Water Resources, the USSR Ministry of Agriculture and other concerned ministries and agencies to establish a system of state accounts on the fulfillment by ministries and agencies of measures for rational use of natural resources, their protection from pollution and depletion, for

forestalling and elimination of the noxious effects of waters and industrial wastes emitted into the atmosphere as well as recultivation of lands, implemented in connection with the finding of deposits of useful minerals or the carrying out of geological exploratory, building, and other work.

46. To consider it necessary to intensify the dissemination among the population of knowledge on environmental protection and the elucidation of the importance of the rational use of its riches.

With these goals in mind, the State Committee on Television and Broadcasting of the USSR Council of Ministers, the State Committee on Publishing, Printing and Book Trade of the USSR Council of Ministers, the State Committee for Cinematography of the USSR Council of Ministers, the USSR Ministry of Culture, the USSR Ministry of Health, the All-Union Society "Znaniye", the republic State committees for environmental protection and societies for environmental protection, are urged to expand the publication of informational scientific-popular and instructive literature and belles lettres and the output of motion-picture films dealing with environmental protection, to intensify the lecture method of propaganda, to elucidate more fully these questions over radio and television.

Editorial boards of the newspapers Pravda, Izvestiya, Sel'skaya Zhizn, Sovetskaya Rossiya, Sotsialisticheskaya Industriya, Ekonomicheskaya Gazota, Komsomol'skaya Pravda, Trud, as well as of the republican, kray and oblast newspapers are to illuminate more fully the range of problems linked with an intensification of environmental protection and the better use of natural resources.

The USSR Ministry of Education, the USSR Ministry of Higher and Secondary Specialized Education, the State Committee on Vocational and Technical Education of the USSR Council of Ministers and other ministries and agencies which have jurisdiction over higher educational institutions, technikums /technical schools/ and vocational and technical schools, are urged to intensify their attention to the teaching of the fundamentals of natural science, rational use and protection of the ambient natural medium in all educational institutions.

The USSR Gosplan and the USSR Ministry of Higher and Secondary Specialized Education are charged with examining jointly with concerned ministries and agencies and resolving the problem of intensifying the training of specialists in the area of environmental protection and of utilization of its resources.

The AUCCTU and the CC of the KOMOSOMOL are charged with securing an active participation of toilers and youth in the cause of environmental protection.

47. To entrust to the State Committee on Science and Technology of the USSR Council of Ministers and to ministries and agencies of the USSR the securing of an active participation of the appropriate Soviet organization in the elaboration and implementation of programs of international cooperation in the area of study of the ambient natural medium and its protection from unwholesome influences.

Secretary	Chairman
of the Central Committee of the CPSU	of the USSR Council of Ministers
L. Brezhnev	A. Kosygin

Done at Moscow, the Kremlin, 29 December 1972 No 898.

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CSO: 8444/2534-W

- END -

WATER LAW AND ADMINISTRATION IN THE UNITED STATES OF AMERICA

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WATER LAW AND ADMINISTRATION IN THE UNITED STATES OF AMERICA

George E. Radosevich*
David Rainey Daines**

PART I - SUBSTANTIVE ASPECTS OF WATER LAW IN THE UNITED STATES

1. INTRODUCTION

1.1 Alternative Water Law Systems

> Suppose certain men, discontented with the irrigation of a country which is dependent for all its prosperity on the right direction being given to the waters of a great river, got the management of the irrigation before they were quite sure how exactly it could be altered for the better, or whether they could command the necessary agency for such an alteration. Those men would have a difficult and dangerous business on their hands; and the more sense, feeling and knowledge they had, the more they would be likely to tremble rather than to triumph. [1] G. Eliot - 1867

Hopefully, Eliot's conclusion is not the rule for water planners, lawyers and other decision makers today. Admittedly, the more one knows of any issue and probable solutions, the more difficult is a decision to be made and the more incapable one may feel. But a decision and confidence built upon a limited awareness can be subjected to untold criticism with the possibility of a short existence of usefulness. In the very important field of water resources development and management, the present demands and trends experienced by the majority of nations cannot afford solutions made in ignorance of possible alternatives and consequences.

This report is but one of a dozen prepared for this Conference explicating a major legal system which evolved to direct and manage the planning, development and utilization of a nation's water resources. Many components of this system may be common to those found around the globe, often because of the mutual characteristics of water resources. But, as resources are only one factor in determining the features of a system, it is only proper to say that each system is unique unto itself and must evolve from the endogenous characteristics of the particular soverign if it is to be successful.

Water law in the United States is a federal system with a delineation of jurisdiction at the national and state government levels. Federal water law is uniform and nationwide with regional flexibility in the implementing agency regulations. Each of the fifty states have adopted surface and ground water laws with significant variations. Their own water quality control laws are more uniform and follow a pattern set by federal legislation.

Because the water resource is only one factor in the constellation of inputs to a water law, the law and its administration must be a dynamic

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process if the total resources available are to be appropriately developed and used. Increased demands for food and fiber, development of new energy sources, population increases and shifts, new industries and an emerging era of national interdependencies are exerting unprecedented pressures upon relatively fixed water supplies. At the same time, unpredicted problems are emerging from past use, such as salinity in return flows, waterlogging and other forms of pollution which are further taxing the water resources base. To add insult to injury, water laws themselves often become solidified institutions, resistant to change, and thus may serve as a major constraint to progressive development and the implementation of new technologies and improved management practices. Hence, regardless of the state of national development, or whether the water laws are rudimentary or highly complex, the purpose for examing other legal systems for water resources control are the same:

1) to identify alternative approaches to similar issues or problems,

2) to examine both the positive and negative attributes of each alternative in order to capitalize on the experience and progress made, and

3) from the analyses, develop an approach - whether a code, law, order or regulation - suited to the particular needs of the jurisdiction to be served.

The manner in which water laws in the United States developed is somewhat analogous to the scheme described above.[2] The influence of the British, Spanish, and French are very prominent. In other areas of the country, a particular system evolved purely out of need to control the resources under prevailing conditions. But, two basic factors influenced the particular legal systems for water control found in the U. S. A. They are:

1) the geophysical conditions of the country, and

2) the socio-political philosophy adopted for land settlement and resources use.

1.2 Geophysical Background

The United States is a country of 210 million people inhabiting an area of 3,548,974 square miles under the political jurisdiction of fifty states and the federal government. Of the land mass of 2,271,343,360 acres, the federal government owns 755,368,055 acres, or 33.3 percent, primarily located in the western U. S. A. (See Figure 1) The remaining 66.7 percent is largely privately owned (1,406 million acres) with only 6.8 percent of 1,515 million acres in state ownership.

The climate varies widely from region to region and season to season. It ranges from tropical (Hawaii) to subtropical (Florida and the Gulf Coast) to highly variable climates in the rest of the continental U. S. A., to the subtropic climate of Alaska and high mountain ranges of the western states.

Precipitation is likewise varied over this great expanse of land. As Figure 2 illustrates, the eastern half of the country ranges from humid to subhumid, while the western states are generally semi-arid to arid with the exception of several high rainfall areas in the west coast states and Alaska. Total precipitation for an average year approximates 1,570 trillion gallons with an average natural runoff of 1,200 billion gallons per day

(gpd). During 1970, it was estimated that total withdrawals amounted to 370 billion gpd less uses for hydroelectric power. Industry withdrew 210 billion gpd, irrigated agriculture 130 billion gpd, public water supply 27 billion gpd, and rural and domestic uses 4.5 billion gpd. Streams supply 67 percent of the withdrawn waters.[3] Wolman prepared an analagous scheme showing the distribution of precipitation for the continental United States in 1962 indicating annual precipitation amounted to 4,750 m.a.f. of which 345 m.a.f. were witndrawn by industry, irrigation and municipal users. (See Figure 4)

Approximately 25 percent of the withdrawn waters are consumed in original use with the seventeen western states consuming 86 percent of this water and the 31 eastern states consuming 14 percent.

Water withdrawn for agriculture is perhaps the most significant amount of that presently in use. Of the 130 billion gpd used to irrigate 50,386 million acres of land, 95 percent of the withdrawn water is applied in states west of the Mississippi River. The seventeen western states contain 90.7 percent of the irrigated acreages with the four states of California, Texas, Colorado and Nebraska accounting for over one-half. Figure 5 illustrates the percentage of irrigated farms to non-irrigated farms on a state by state basis. Of the total 264,319 acres under farming, 213,933 are non-irrigated. Only 40 percent of this acreage is located in the seventeen western states and Louisana.[4]

In summary, it is important to note that in the past, the population distribution has been primarily located in water abundant areas of the nation. There is a present trend, however, toward migrations into the more arid western states as interbasin transfers bring water from surplus areas to water deficient areas (See Figs. 3 & 6) and as energy and associated industries materialize.

1.3 Water Policies

Water policies in the United States have been formed at various levels, but to understand a fundamental feature of the laws for allocating and diverting water, it is necessary to look at land settlement practices adopted when the country was founded. As stated earlier, 60 percent of the total acreage in the United States is privately owned with a large percentage of the western states lands in federal or public ownership.

The private landholdings in most states can be traced to the public land system developed after the Revolutionary War (1775). To form a union, the Thirteen Original Colonies on the eastern seaboard ceded their claims west of their boundaries to the national government. Subsequently, the national government encouraged settlement and reclamation of these lands through private ownership by disposing of large tracts at nominal prices. Substantial acreages were also granted new states for: 1) settlement under private ownership, 2) revenue base through land leases and 3) to dedicate parcels within towns and communities for a common school system.[5] One-third of the nation's land remains in public or federal ownership for parks, forrests, wildlife preserves and other uses in the public interest.

But this philosophy of encouraging the development of land resources through private ownership carried over in the west into the development of water resources in the arid regions and led to a clear distinction in attitude toward the role of government in managing this resource.

The initial federal water policy was directed to controlling navigable waterways for commerce and defense, regulation of power facilities and flood control. Water was abundant in the east, so no involvement beyond these measures was needed. Water quality was no problem, but if commerce was adversely affected, the reserved powers were broad enough to exercise jurisidction. With no guidelines or policies to follow or abide, the eastern states adopted the common law riparian doctrine of England as a policy for controlling the waters of the states.

To carry out the land settlement and development policy of the west, the federal government enacted many laws which not only made land available for private ownership, but recognized and granted water rights for these lands. The three most important acts are: Mining Act of 1866, Land Act of 1870 and the Desert Land Act of 1877. They acknowledge the validity of water rights created by local customs, laws and court decisions,[6] and declared all unappropriated water shall remain subject to "appropriation and use of the public for irrigation, mining and manufacturing purposes subject to existing rights."[7]

Based upon the federal government's recognition of local laws, the western states developed rules according to their particular needs. From this policy the doctrine of prior appropriation evolved and the basic principles were adopted by nearly every western state.

An important issue remained unsolved, however, until 1935. That issue concerned creating water rights by state law on federal land. In California Oregon Power Co. v. Beaver Portland Cement Co.[8] the court held in effect "that the acts taken together reflected a federal policy to strip federal patents of any claim to water and to quitclaim federal rights in water to those persons who establish a right under state law."[9]

At the turn of the century, the federal policy of western land development recognized the need for direct government involvement in the planning and financing of large scale water projects to supply the water users' needs. The Reclamation Act of 1902 was adopted which created the Bureau of Reclamation to implement this broadened policy of government assistance to individuals. The law, as amended, contained a policy of cost reimbursement over a repayment period, based upon an ability to pay formula.[10]

In the mid-20th Century, the real need for management of the nation's resources emerged as the multiple demands strained the limited resources and water pollution was seen as a major economic constraint. In 1965, the Water Resources Planning Act was enacted declaring that it is the policy of Congress "to encourage the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal Government, States, localities, and private enterprise with cooperation of all Federal agencies, States, local governments, individuals, corporations, business enterprises, and others

concerned."[11] The Act created the Water Resources Council to develop planning and evaluation policies, standards and procedures for preparation of comprehensive regional or river basin plans and federal water and related land projects. The Council is also to prepare an assessment of the adequacy of national water supplies and quality problems and regional or river basin studies.

Water pollution control still remains the primary responsibility of individual states. As most recently declared in the Water Pollution Control Act of 1972, section (b) "It is the policy of the Congress to recognize, preserve and protect the primary responsibilities and rights of the States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources. . ."[12] However, Congress has made it law that where the states fail in their duty, the federal government will control and abate water pollution.

Thus, the water resources policy of the federal government has gone through various growth stages beginning with a general laissez faire attitude of federal involvement supplemented by incentives for priavte development, to government involvement in planning and development of medium to large scale projects to the present stage of national and regional management and development influence through incentives or regulation. States have gone through a similar policy metamorphis, except their role has been more directly involved in policy formulations pertaining to the allocation, reallocation and distribution of waters within their borders.

2. FEDERAL WATER LAW[13]

2.1 Constitutional Powers

The basic legal authority of the federal government in the field of water resources is founded upon the Commerce, Property, General Welfare, and Treaty and compact clauses of the Constitution of the United States.

The General Welfare Clause[14] provides the legal basis for Congressional allocation of federal revenues through large scale reclamation and irrigation projects or other internal improvements.[15] The Bureau of Reclamation legislation referred to in the previous section is based primarily on this clause.

One of the most important and powerful provisions of the Constitution is the Commerce clause which states that Congress "shall have power to regulate commerce with foreign nations and among the several States and with Indian Tribes."[16] This provision has been interpreted to give the federal government a pre-emptive right to regulate navigable waters and non-navigable tributaries of navigable waters and interstate waters from which fish are sold in interstate commerce or used by industries selling products in interstate commerce. The power is broad enough to include water quality control, flood protection, watershed development, aquatic life and habitat protection, land use planning and improvements cost

recovery. Many of the activities carried out by the Corps of Engineers and Environmental Protection Agency are founded upon this clause. Through the broad interpretation of navigable waters, the federal government has been able to undertake projects within states, even over state objections, when it has been determined in the public interest and the state(s) have not addressed the issue. This clause has been the source of regulatory functions.

As the Commerce Clause has been most significant in the humid areas of the country, the Property Clause has been having its greatest impact in the more arid western states where federal reserved lands are located. A discussion of the "reservation doctrine" follows in the next section, but the crux of the doctrine lies in the clause which provides that "the Congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States."[17] This source of power enables the federal government to assert claims to waters arising on land withdrawn for specific purposes and to the extent necessary to carry out those purposes.

In addition, the clause serves as the basis for many programs of the Brueau of Land Management, National Park Service and Forest Service in maintaining and enhancing vast areas of grazing, recreation and wildlife lands. Irrigation projects partly or wholly constructed on or serving federal lands are authorized in part under the Property Clause. The clause enables the federal government to manage land, water and other resources to which it holds title, as a proprietor, with ability to direct the type and manner of use, to sell, lease or otherwise operate the properties in the public interest.

The Treaty Clause enables the President, with advice and consent of the Senate, to enter into treaties with other governments,[18] and the Compact Clause requires states to obtain Congressional consent to any agreement or compact with another state or nation.[19] These two clauses have greatly contributed to the ability of federal and state governments to resolve problems and more equitably and effectively utilize international and interstate waters. Treaties have been ented into with both neighbors on the north and sourth of the U. S. A., and over 30 compacts have been negotiated between states over trans-national and interstate waters.

2.2 Water Quantity Control

The federal government is involved in the use and control of much of the nation's waters either indirectly or directly and many studies have been undertaken on federal - state relationship over water control.[20] We have referred to control over navigable waters and other powers conferred by the Constitution. In this section two means of direct control will be addressed briefly as they pertain to potential alternatives for water management or conflict resolution in other jurisdictions.

The first means is the holding of water rights on federal reclamation projects by the Bureau of Reclamation until the project reimbursement costs are paid and the water users take complete charge of the waterworks. Before the Bureau undertakes the construction and operation of dams,

diversion and conveyance works for agricultural users, the usual practice is to negotiatie a contract with the local users as to the role, rights and obligations of the parties. The users must organize either into a water district or water users' association. Water rights needed to meet the project requirements are acquired by the federal agency through assignment of rights held by the users to the agency and filings by the agency under state law for unappropriated water. This enables the agency to carry out the purposes of the project, although local operation is carried out by the users themselves. The local entity remits annually the construction, operation and maintenance payment to the federal agency, which it collects from the water users as assessments based either upon acreage served or volume of water delivered.

The second means of federal control over water quantity is the Reservation Doctrine. A considerable amount of conflict exists between the federal government and states affected as to the parameters of this doctrine. However, it is sufficiently clear to permit a brief explanation. The doctrine gives the federal government the power to reserve water on lands that have been withdrawn from private purchase and which lands have been designated to specific federal purposes, i.e., national parks, forests, recreation areas and wildlife refuses, oil shale reserves and hydro-power locations. The reservation extends to present and future uses, is not lost through non-use and has a priority as of the date the lands were withdrawn from entry. The doctrine has recently been interpreted to include not only surface waters, but ground water as well.[21] The doctrine has its origin in the Property Clause discussed in section 2.1.

The theory of the doctrine is "property belonging to the United States" includes lands and appurtenant waters in the western states. As the states were admitted into the Union, they obtained power over waters of the state, but acquired no proprietory rights or title to lands owned by the federal government nor the waters arising on or flowing through such land. Thus, unless the federal government disposed of these lands and waters, title remains therein.

The reserved rights position of the federal government has created a great deal of concern over the jurisdiction of waters within the states since most water rights held by individuals* under state law pre-date the assertion and use of water by the federal government. Further, approximately 61 percent of the total natural runoff in the eleven western states with large federal landholdings comes from these lands. The doctrine directly conflicts with the majority system of water law in the western states - doctrine of prior appropriation - on a number of points:

1) no diversion and/or beneficial use is necessary to create the right,

2) the right is not lost through non-use,

3) existing water rights pre-dated by the reservation are in jeopardy, and

*Broadly refers to persons and private entities

4) no quantification of the federal rights have been made, thus states maintain appropriate water planning cannot take place.

The advantage to the doctrine is that it will permit the government to provide for present and future generations as time, technology and demands change. Problems are presented for those presently adversely affected, but solutions can be arrived at which take into account individual rights and public interest.

2.3 Water Quality Control

Water quality control in the United States was a matter of state and local concern in the early years of the country. Federal involvement was oriented toward navigable waterways under the Rivers and Harbors Act of 1899. But as industrial development began taking place with large population concentrations forming around waterways, a great deal of concern became expressed over the inadequacy of potable water supplies, estuarian degradation, and increased costs associated with bringing water up to a usable quality. Several attempts were made to develop a water quality program from 1912 to 1948, but the orientation was primarily directed toward disease control.

The basic water pollution act was passed in 1956. It provided matching funds for municipal sewage plants and for research into the extent and nature of pollution of our water resources.

In 1965, the Water Quality Control Act[23] was adopted which attempted to structure the federal program along realistic organizational lines and got the federal government into the water quality control field. The Federal Water Pollution Control Administration was created, more funds made available to states for treatment plants and most important, directing the states to develop stream quality standards and implementation plans by June 1967 or the federal government would take control over states not complying.

Amendments were made to the acts through 1970, and in 1972 the most significant law in this field was adopted. The Federal Water Pollution Control Act of 1972 declares as its objectives:

> "To restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of the Act - - -
>
> (1). it is a national goal that the discharge of pollutants into the navigable water be eliminated by 1985;
>
> (2). it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;
>
> (3). it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4). it is the national policy that federal financial assistance be provided to construct publicly owned waste treatment works;

(5). it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and

(6). it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans."[24]

The 1972 Act is the first federal water quality legislation that is comprehensive in setting target dates to accomplish certain pollution control practices and has a mechanism for dealing with stream standards and effluent discharge limitations. Stream standards are to be established by the states. A National Pollutant Discharge Elimination System (NPDES) program was created requiring discharges from point sources to obtain a permit, again according to state programs. If however, a state fails to develop an acceptable program, the federal government reserves the right to impose the national standards and permit requirements.

The control target dates require municipalities to use secondary waste treatment by mid-1977 and improved methods by 1983. Industry must have installed the "best practicable" control technology (BPT) by mid-1977 and "best available technology economically available" (BAT) by July, 1983. If technology has economically advanced to no pollutant discharge, then this standard can be imposed.

The act prohibits flow augmentation as a substitute for adequate treatment. (Dilution is no solution to pollution). The act further requires interstate cooperation in developing uniform laws and standards.

A great number of states have adopted identical or similar state programs. States are still primarily responsible for pollution control.

3. STATE WATER LAW SYSTEMS

3.1 Introduction

In early American history, water, like air and open space, was considered a common or free good with nearly unrestricted use due to minimal demands on existing supplies. But as the effects of use were felt and conflicts arose, the need for control along systematic lines was recognized.

It is commonly held that water arising within a state's boundaries is under the jurisdiction of the state, unless subject to powers reserved in the federal government.* Consequently as local customs developed, and states were formed, each state adopted its own particular system of water law. At first, surface water allocation and control was addressed, then gradually as groundwater was used, laws directed to its use were added to the statutes.

Surface water laws developed along two distinct philosophies consistent with the geo-climatic condition of the state. In the humid eastern half of the country, and along the west coast, the riparian doctrine was adopted. The more arid western half of the country was faced with an immediate problem of deciding how to allocate a scarce resource and thus was compelled to develop a system of law peculiar to arid lands. The result of trial, error and compromise is the doctrine of prior appropriation. Some states have a varied water availability and concluded by adopting a mixed riparian/prior appropriation system. Figure 7 identifies the general system each state currently operates under. Despite the general classification of state systems into these three groups, there is a wide variation between states following the same doctrine as to the manner for determining water rights, exercise of the right, water use efficiency criteria, and system for obtaining water rights and administering and enforcing the law.

3.2 Classification of Waters[25]

The law of either the riparian or prior appropriation doctrines has had great difficulty with the scientific world on the matter of classifying sources of water. From the legal point of view, it was considered necessary to distinguish between different "types" of water so that different rights of use could be formulated. The scientific community, of course, views water in the context of the hydrologic cycle and finds much fault with the pragmatic approach adopted in the laws.

*These powers have been discussed in Section 2, Federal Water Law, and under the administration of various agencies as described in Section 6.1.1., which follows.

In the U.S., as in most countries, water is commonly classified as follows. Surface waters are: 1) diffused, 2) flowing in watercourses, 3) waters in lakes and ponds and 4) spring waters. Groundwaters are: 1) diffused percolating waters or 2) waters flowing in defined channels.

In addition, water may also be identified according to a functional classification. As with the former classification according to the source of the water, the purpose of this classification is to further define the nature of water rights that can be obtained.

In this scheme, waters are classified as waste, foreign, and salvaged or developed waters. Waste water is water that has been "used" for the original purpose diverted and may come from seepage, leakage or tail water runoff. Usually the landowner may capture waste water and reuse it, if captured upon his land and before it has entered a watercourse.

Foreign waters are waters imported from another basin or watershed. The importance of this category is with respect to the right of capture. States apply various rules but generally the user who brought the supply into the basin has the right of recapture and to use the waste water from this source.

Salvaged or developed waters are the results of efforts to gain greater utility from a unit of water; water, that without any improvements, would have been lost through seepage, evaporation or transpiration. The general rule is that these waters belong to the persons developing or salvaging them. In the prior appropriation states, however, the developer must usually obtain a water right for the increased supply, otherwise it becomes part of the stream subject to appropriation.

3.3 Riparian Water Law

3.3.1 Introduction

The water laws of the humid states were patterned after the early common law of England. Under English law, every landholder, whose property was adjacent to a stream or body of water, was entitled to have the water flow past his land (or maintain a natural lake level) undiminished in quantity or quality. This rule is generally called the natural flow theory.

In a water abundant area with little withdrawal needs, this rule may be satisfactory. But, even in the humid parts of the U.S., conflicts developed as emerging industries, municipalities and agriculture began diverting water.

To resolve the problem, the American Rule of Reasonable Use developed. Under this rule, riparian landowners can divert a reasonable

amount of water with respect to all other riparians on the stream, and nonriparian lands may, under certain conditions, make a reasonable use of the available waters.

3.3.2 Nature of Water Right

Waters in states following the riparian doctrines are a public resource, held in trust for use by the people of the state. Thus, a landowner whose land borders a stream does not have an ownership right to the waters of the stream, but rather has a fundamental right by virtue of his land location to a reasonable use of the water and to be free from unreasonable uses of others that cause him harm. He is essentially a correlative co-user with all other riparians on the water source. Consequently, his right to the use of water is not a right for a fixed quantity of flow or volume, but rather is dependent largely upon the extent of development that has taken place.

3.3.3 Manner of Allocation

Fundamental to the riparian law is the location of land on a water source. Although this requirement has been relaxed in many states to permit use of water on nonriparian lands, as between riparians and nonriparians, water will first be allocated to the riparian landowner.

More important to the allocation of water under this doctrine, since the right does not consist of a definite quantity or quality of water, is the requirement of reasonableness in use. A definition of reasonableness that is often cited for its completeness states:

> In determining what is a reasonable use, regard must be had to the subject matter of the use; the occasion and manner of its application; the object, extent, necessity, and duration of the use; the nature and size of the stream; the kind of business to which it is subservient; the importance and necessity of the use claimed by one party; the extent of the injury to the other party; the state of improvement of the country in regard to mills and machinery, and the use of water as a propelling power; the general and established useages of the country in similar cases; and all the other and ever-varying circumstances of each particular case, bearing upon the question of the fitness and propriety of the use of the water under consideration.
>
> ... each use is required to be beneficial, suitable to the watercourse and of economic and social value. If these requirements are met, reasonableness may require each riparian to put up with minor inconveniences and to adjust to quantity of water used. (If conflict occurs, a solution involves consideration) of whether the first user's investment and other values are entitled to protection and whether the new user ought to compensate the former user for the loss of that which the latter gained. In most the cases in which the plaintiff has suffered substantial harm through his water supply for a reasonable use being taken, the decision has been that the taking is unreasonable...[26]

As concluded by Davis in his study of Riparian Law for the National Water Commission, the law "presents a process for reaching allocative decisions but does not offer clear principles for allocating."[27]

3.3.4 Preferences of Uses

Under either the natural flow or reasonable use theory, there is a preference for the "natural wants" over all other uses. The "natural wants" include household and limited livestock needs and have generally placed domestic called uses in a preferred position. As between other uses - agricultural, industrial, recreation, etc., there is no clear preference, but rather the courts have looked upon the reasonableness of use to determine conflicts between these uses.

3.3.5 Nonuse and Misuse of Rights

Riparian water law does not require a landowner to use the water in order to maintain the right in good standing. Unless the right to use water from an adjacent water source has been sold or transferred to other lands or uses, the right will continue as long as the land and water is contiguous. Abandonment of water right is nonexistent under riparian law.

There is a possibility, however, that a riparian who does not object to the open and notorious use by another, through prescription, may have his right reduced or lost.

Misuse of the right may result in a restriction on use and/or judgement for damages to those adversely affected. Parties injured through the misuse must assert their claim in court.

3.3.6 Statutory Modifications

There have been a number of significant recent changes in the water law of the riparian states primarily brought about by the inability of existing water supplies to meet the expanding demands on one side, and a recognition of public interest in water resources on the other.

The changes can be summarized into two major components: 1) establishment of a permit system to allocate water among certain users, and 2) creation of administrative machinery to access the water supplies and requirement and to allocate and manage the states' water resources through the permit system.

The most creative aspects of the permit system in riparian states is the limitation on the duration of the right to use under the permit. For example, the State of Iowa grants a 10 year permit, renewable upon a showing of continued beneficial use, and without any temporal priority between permit holders;[29] and New Jersey grants a permit long enough to allow amortization of capital investments, but not over 25 years.[30]

The advantage of the permit system is many fold, but generally, it allows conditions of use to be stipulated in the permit and it provides the state water agency a data base on where, to whom, what for and what quantity water is allocated.

Other changes include forfeiture provisions for nonuse (three years is common), minimum flow requirements for fish, wildlife and recreation, and greater flexibility and certainty in acquiring right to use water.

3.4 Appropriation Doctrine

3.4.1 Introduction

The appropriation doctrine is a water allocation system which developed in response to the geographic characteristics found over most of what constitutes the western United States. Though there were some small agricultural experiments during the era when this land was being opened to settlement, the first major users of water were the legendary gold and silver miners. It was these individuals who evolved the principals on which the appropriation doctrine is based.[31]

It was obvious to these people that the riparian water law under which they had lived in the water-wealthy eastern United States would not provide a workable system in the arid western region. However, these people were not learned in the law. Rather, they were miners who were forced to find a solution to their problem. In response, they applied the same principal to their water as they did to their mines. That rule was that the person who first discovered a mine was protected against all later claimants. In the water area this was translated into the appropriation doctrine or the doctrine that "first in time is first in right," or that the first person to use water acquires the right to its future use as against later takers.[32]

The evolution of this doctrine was a fortunate event for it proved equally as useful for the agriculturalists who came to the land after the miners had gone. The doctrine protected the first settler to come into an area and use water on his land. Later settlers had to respect the ownership of his land and had to respect the amount of water which he was using on that land. This meant that the second settler had to take another parcel of land and use whatever water was left after the first user had satisfied his needs.

The transition from riparian rights to the appropriation doctrine was not completely smooth. In the states that had some areas with a plentiful water supply, riparian rights were still recognized. This caused a considerable amount of difficulty in that these states had areas which were water-scarce. Thus, the riparian system's usefulness was limited throughout these states. As time had passed, the states recognizing both riparian and appropriation doctrines have all tended to limit the riparian rights. Most have required the riparian owners to quantify their right and now permit new uses to the made only appropriation.[33]

In the states with arid climates, however, the appropriation doctrine has always been recognized as the exclusive manner by which the right to use water may be acquired.[34]

3.4.2 Basic Principles

The general principles found in the law of appropriation are found in all the jurisdictions adopting this doctrine.

The first principle and cornerstone of the water law as it has evolved is that beneficial use is the basis of the right to use water. This means that in order to use water, it must be taken for a beneficial purpose. This has evolved into the position that not only must water be used for a beneficial purpose but the limit of the right is the amount being put to beneficial use.[35] Usually the term "beneficial use" is not defined per se but is decided on a case by case method. Among the uses recognized as beneficial are irrigation, domestic, power production, municipal, industrial, recreation and minimum flows for aquatic life. This short list is not meant to be comprehensive but, rather, only to illustrate the spectrum recognized. There appears to be an economic element in beneficial use. Though the use to which the water is put must be beneficial, the manner in which it is used must be reasonable. There is almost a bond between a use being "reasonable" and "beneficial."[36] The concept of reasonableness is playing an increasingly more important role in appropriation states. For example, it may no longer be reasonable to irrigate a crop by flooding when another method is readily available which will grow the crop as well or better but will save some of the water being used. Thus, even though the use - irrigation - is beneficial, the method of application is not reasonable. Herein lies the economic element developing in the law.

A second principle found in the law of appropriation is that the appropriative right must exist for a definite amount.[37] In general, the amount of water that an appropriator is entitled to divert is measured by the beneficial use involved. In some states the statutes prescribe the maximum "duty of water" or amount which can be appropriated but it is understood that if the reasonable use is less than this amount, the need will prescribe the limit.[38] The duty of water may range from 1 c.f.s. to 2 acre feet per year to complete discretion of the state engineer to determine the exact needs of the user under the given soil, water availability and use conditions.

The third precept of the doctrine of appropriation is that priority of right and not equality of right is the basis for dividing the water during periods of scarcity. This principle has been popularized as "first in time is first in right."[39] It means that all users are given a time priority by date of the beginning of the appropriation and that, when a water deficit occurs, the allocation among the users are closed down in an inverse order, i.e., the latest allocation granted is the first to be closed. The earliest is never closed. From this, it can be seen that the burden of shortages falls on those with later rights - there is no proration in times of scarcity. The rule is harsh on junior appropriators but does guarantee a firm supply to those with senior rights. Further, it forewarns all water users of the exact nature of their right. One would not reclaim a large area for growing high cash value, high water consuming crops on a small stream if the priority date for the water supply was a recent year, and there were several very early right holders who could command the flow during the critical crop growth period. For this reason,

the value of water rights depend greatly upon the priority date and the source of supply in terms of dependability of flow.

A final principle is one which brings a water right under the appropriation doctrine into the economic market system, and one which is intended, except for particular constraints in some state laws, to maintain a maximum use of the resource. The principle is that the water right is of indefinite duration so long as it is exercised in proper accordance to the laws, and that as a property right it is saleable, and transferable separate from the land.

The latter principle has both a positive and negative economic effect. On the positive side, a valuable right exists if properly maintained. Also theoretically, the use to derive the highest benefit could obtain a right in the market system, and thus optimum use would be gained. The negative side is that in practice, administration can not insure the rights are "properly" maintained, or just the amount of water necessary is diverted. Consequently, often waste occurs through lack of knowledge of crop on-use requirements, or to keep the full amount of the right valid.

3.4.4 Concept of Ownership

A water right is generally considered to be real property as opposed to personal property, especially for purposes of quieting or passing title, descent and inheritance and taxation. It is a conditional right - one dependent on the continuing condition of use for a prescribed purpose. It has been described by one author in this way:

> "A water right, acquired under . . . the doctrine of appropriation, may be defined as the exclusive, independent property right to the use of water appropriated according to law from any natural stream, based upon possession and the right continued only so long as the water is actually applied to some beneficial use or purpose. . ."[40]

It is an exclusive right but one which is conditioned upon the continued application to beneficial use. A person does not acquire absolute title in fee and this is illustrated by the fact that the right may be lost by nonuse.[41]

As has been noted, one of the elements of the appropriation doctrine is priority in time. Property rights in water consist not only in the amount of water but also in the priority of appropriation.[42]

Critical to the understanding of property rights in water is the notion that water is not subject to absolute ownership. The water right consists of a right to the use of water, whether it is in stream or diverted use. It is a usufructory right.[43]

It follows that unless one has appropriated water, there is no right of complaint if the natural flow of water past his land is interferred with or even totally diminished.[44] However, because of the doctrine of "relation

back" which was described earlier, water-right filings or approved applications are property rights and constitute a possessory interest in the right to use water once the right has been perfected.

Like other property rights, water rights may be transferred. The old rule in the western United States was that water was appurtenant to the land on which it was used. That is, it could not be sold separately from the land. This was a poor rule in that it restricted the transfer of water to other places as it was needed and prevented rational response to economic pressure. The modern position is that water may be transferred separately from the land on which it is used. It is still appurtenant, however to the extent that it is transferred automatically with the land unless the deed transferring the land specifically reserves the water.[45]

3.4.5 Preference of Uses

In response to a recognition that some uses necessarily are more critical than others, some jurisdictions have adopted statutes which recognize "preferred uses." The effect of a water right being preferred is that in times of shortage a preferred use may condemn a nonpreferred use in order to supply water for the higher use. When a preference is exercised, all or a portion of the water from non-preferred right may be taken temporarily or permanently. Compensation must, however, be paid for the taking of a right.

Another important function of establishing preferences is that it serves as criteria for the allocating agency when applicants for different uses are competing for the same unappropriated water.

The order of preference may vary somewhat from state to state, but normally the ranking is as follows: domestic use, agricultural use, industrial and power use, fish and wildlife and recreation uses. All jurisdictions unanimously place domestic (which includes municipal use generally) as the highest with a variation among other recognized beneficial uses according to particular attributes of the state or objectives of its citizens.

3.4.6 Manner of Allocation

The prior appropriation doctrine is remarkably dissimilar from the riparian doctrine in many respects, but in allocating the water it is diametrically opposite. Land and natural water source locations are immaterial. Under appropriation doctrine, regardless of where the land or other use is located, within or without the watershed, a right to unappropriated water can be obtained if the water can be diverted and put to beneficial use. Consequently, in the west, one may find canals winding along mountain sides and out in the highlands of a valley.

Important in the manner of allocation is the particular procedures set down by the state law. Generally, an application must be filed with pertinent information relative to the user, use and source of supply. If the application is approved, the right will normally have the priority date of the application. If the use is one requiring construction of

diversion, storage and delivery works over a period of years, the right, if the application is approved and notice to proceed given, will still retain the date of application when the water actually is put to use, through operation of the doctrine of relation back. If, however, the applicant does not construct the works within the time period acceptable to both parties, and the delay is unexcusable, the right may have a priority as of the date the water is put to use.

Several systems were developed by the states to handle applications of water rights, but now the predominant approach is the permit system. This is merely the filing of an application with the appropriate state agency, and that agency takes the procedural steps of evaluating and determining the disposition of the application. If approved, a permit is insured, which may state conditions of use. If denied, the applicant may appeal the administrative decision to the court.

Once the right has been approved, the holder may divert the waters according to the provisions of the permit or decree. This completes the three major functions of state agency or courts in vesting a water right. The functions are: appropriation procedure, adjudication or administrative determination of rights and distribution of waters.

3.4.7 Non-use

Water rights under appropriation doctrine can be lost through non-use of the right to use. There are four principle ways in which this may occur.

The first is abandonment. Should a right holder not use his right for a statutory period of time, and intends not to use it, his water right may be lost. The important element is not only non-use, but intent, and this latter may be very difficult for the state or party claiming abandonment to show. Someone, the state or another user, must bring the action against the user and prove both elements.

The second is forfeiture. This is a statutory remedy to non-use and only requires a showing of non-use of all or a part of the right. Automatically after the statutory term (usually three or five years) runs out, the right, if brought to the state officials attention could be extinguished.

Adverse possession is the third method, and this occurs when another openly and notoriously uses the water right of a person, and that person does nothing about it. If this continues for a specific period, the former can claim the right as his own. The practice is not looked upon with great favor by the courts, however.

Condemnation is the fourth major type. When a preferred user or the public entity granted condemnation powers, exercises this right, normally the only real issue is the amount of compensation. Colorado, however, recently passed a law requiring municipalities condemning agricultural water rights to show the necessity for taking such action.[46]

This is a very brief description of key points in the doctrine of prior appropriation. Many volumes have been written on the intricacies of its operation, and the authors of this report would direct interested readers to examine the footnote references to major works.

3.5 Groundwater Control Systems

3.5.1 Introduction

Groundwater resources are beginning to play a major role in agricultural, municipal and industrial water use. Approximately one-fifth of the water withdrawn in the country comes from this source. Nearly 1/3 of the country overlies groundwater from which a well capable of producing at least 50 gallons per minute could be installed.[47] Due to decreasing costs in groundwater removal as technology advances, this resource is increasingly being called upon to meet large scale needs such as oil shale processing, coal slurry pipelines and agrucultural uses.

Laws controlling the extraction and use of groundwater have become as complex as surface water doctrines. Basically, however, the states apply one of four doctrines - absolute ownership, reasonable use, correlative rights or prior appropriation. (See figure 8). These laws normally apply to "percolating" waters as distinct from waters in underground streams which follow the surface water law of the state.

3.5.2 Absolute Ownership

The doctrine of absolute ownership had its origin in the United Kingdon with the 1843 decision of Acton v. Blundell.[48] Simply stated, the doctrine holds that a landowner can withdraw any water from beneath his land with liability to his neighbors resulting from such action. This doctrine was originally adopted in a great number of eastern states where water was abundant. It still is in operation in many states, but the adverse effects of groundwater mining, land subsidence and adjacent landowner claims of water stealing are putting pressures upon several states to change their laws.

3.5.3 Reasonable Use

Due to the extreme position of groundwater use without liability proclaimed under the absolute ownership doctrine, many states began modifying the laws into what has become known as the "American Rule of Reasonable Use." This change is synonomous to the modifications in the surface riparian doctrine. The rule of this doctrine is since the rights of adjacent landowners is similar, and their enjoyment in the use of groundwaters is dependent upon the action of other overlying landowners, each landowner is restricted to a reasonable exercise of his own rights and a reasonable use of his own property, in view of the similar rights of others.[49]

This doctrine leaves much speculation as to what is a "reasonable use", but on the other hand affords some measure of protection to property now existing, and greater justification for the attempt to make new developments."[50]

3.5.4 Correlative Rights

The doctrine of correlative rights in groundwater originated in California and is a further refinement to the reasonable use concept. The doctrine holds that among landowners overlying an underground water supply, each landowner can make a reasonable use of that supply so long as the source is sufficient, but when the supply becomes insufficient due to the drought or draw-down effect, then each landowner is entitled to water in proportion to the percent of his land in relation to all other lands overlying the underground waters. The net effect is to provide great flexibility of groundwater use in an effort to maximize the resources, but have a remedy of equitable allocation when shortages occur.

3.5.5 Appropriation

Most of the western states found little reason to differentiate their systems of water law for surface waters and groundwaters, and as a consequence have adopted groundwater statutes of a similar philosophy that this source should be allowed maximum development according with recognition and protection given prior users. This does not imply, however, that surface water law was automatically applicable to groundwater. In fact, several states enacted laws to control groundwaters as late as mid-1950's.

The rule provides that groundwater is subject to appropriation for a beneficial use providing the intended user complies with the statutory requirements to obtain a permit or license as the case may be. The administrative official must determine if unappropriated groundwater exists and what adverse effects would occur from approving the application.

In most states, the law allows the state water official, upon a determination that a particular groundwater basin needs close management of withdrawals, to designate the area as critical or designated ground water basins. When this occurs, the users are placed under direct control for the protection of the acquifer and vested rights.

3.6 Conjunctive Use of Surface and Groundwater

In many areas throughout the country, the ground and surface waters are hydrologically interconnected that withdrawals from one source effects the other source. The usual situation is that surface water users are senior in time with a considerable investment in a diversion and delivery system for their water supply. Groundwater use began to increase at a rapid rate during the droughts of the 1930's with gas motors driving the pumps. Then in the late 1940's and 1950's, the west witnessed a mass movement toward groundwater pumping as the Rural Electrification Administration (REA) brought electricity to the rural areas and pumps could now be driven more economically by electric motors.

Conflicts soon arose in Colorado, New Mexico, California and Texas between surface and groundwater users. If the courts applied strictly the rules of appropriation doctrine, all wells would be shut down and a vast amount of water resources would not be utilized. However, if the wells were permitted to pump, people who made their way of life relying upon the security of their senior surface water right would be grievously affected.

Several solutions emerged.[51] In New Mexico the state engineer used his authority to declare critical areas as underground water basins, giving him complete control over water management in the area. Then for any groundwater user or applicant, whose withdrawals adversely affected streams flows, continued withdrawals must be offset by retiring surface water rights. Thus both surface and groundwater users' rights and economic interests are protected under this "retirement of surface rights" approach.

Colorado has taken a different approach. In this state, the "augmentation plan" is a scheme by which groundwater users in a common area can develop any scheme they wish that guarantees to surface users that when the surface user calls for his water, it will be supplied. The schemes may include purchase of reservoirs, surface rights, locating wells at the surface user's headgate, etc. Once drafted, the augmentation plan must be acceptable to the state water officials and surface water users before it can be placed into operation.

PART II

ADMINISTRATIVE AND ORGANIZATIONAL ASPECTS OF WATER RESOURCES IN THE UNITED STATES OF AMERICA

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4. INTRODUCTION INTO ORGANIZATIONAL PHILOSOPHY AND FRAMEWORK

The United States of America are a federated political democracy. The U.S. Constitution is the fundamental document which delineates the power of the Federal Government and reserves specified authority in the 50 state governments in water resources administration as well as all other areas of government control. This Constitution grants specified limited powers to the Federal Government, reserves specified powers to the states and protects specified rights in individual citizens. These constitutional power divisions between federal and state levels of government are both express and implied as interpreted by U.S. Supreme Court decisions. The rendered decisions do not comprehensively interpret the constitution. The application of constitutional principles to new problems and situations provides an evolutionary rather than a static quality to U.S. Constitutional Government and to the roles of the state and federal government in water resource administration. The constitution also provides the bases for the assignment of federal water resource administration responsibilities between the three branches of the Federal Government - - - the Legislative, the Judicial and the Executive branches.

The administrative and institutional framework in each of the 50 states for water resource administration is, in theory, open to an infinite variety of systems. However, as a result of a strong tradition of borrowing part or all of administrative systems from other states consistent with the adoption of a particular water law doctrine and other forces tending to uniformity, there are patterns of similarity that make possible some generalizing about state systems of water resource management as will be explained in more detail later. In each state there exists legislative, judicial, and executive bodies which separately have power over water administration.

5. DEFINING LEVELS OF ADMINISTRATION

5.1 Public and/or governmental water organizations:

5.1.1 National Level*

Federal Courts:

Article III Section 1 of the U.S. Constitution vests federal judicial powers in the U.S. Supreme Court and the federal court system.

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* See figure 9.

This system consists of federal district courts which are the trial courts of the system; U.S. Circuit Courts of Appeal and the Supreme Court. An appeal as a matter of right may be taken from decisions of these federal trial courts to the appropriate Circuit Court. There are 11 such circuits. In most kinds of cases the appeal from circuit court decisions to the Supreme Court is discretionary with the Supreme Court.

The general types of water related litigation that are within the jurisdiction of this system encompass the following categories of cases:

(a). Litigation related to water control and use where the U.S. Constitution, treaties or federal legislation or regulations are at issue. The extent of this jurisdiction is better indicated hereafter where the number and functions of federal executive agencies are explained.

(b). All maritime and admiralty litigation or disputes arising from traffic on navigable waters.

(c). Parties to litigation who are citizens of different states may invoke federal court jurisdiction for determination of applicable state laws in water and other types of litigation, provided the amount in controversy exceeds a minimum dollar amount.

(d). All controversies in which the United States is a party, and those in which two or more states are parties are within the Original Jurisdiction of the U.S. Supreme Court.

Executive Agencies on Federal Level:

Constitutional principles, existing federal legislation and regulations have provided for water administration responsibilities in the following executive agencies of the federal government:

Water Resources Council

This council is headed by a part time chairman designated by the President and the council members are the Secretaries of Interior, Agriculture, Army, Health Education Transportation and Welfare, and the chairman of the Federal Power Commission and associate non-voting members who are heads of other federal agencies and observers.

The council promotes the establishment of state regional institutions called "river basin commissions." The commissions are established by executive order of the President. Concurrence of the states is required. The purpose of these Commissions are to encourage conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis. Seven such commissions organized by the Council now exist and over thirty-two states are members of one or more such commissions.

The Council establishes with presidential approval, principles, standards and procedures for Federal participants in the preparation of comprehensive regional or river basin plans and evaluation of Federal water and related land resources projects.

Its projects have included development of planning guidance for flood plain management, cooperation in projections of water related ecomonic data, regional and river basin studies and making planning grants to states.

Department of Interior

Bureau of Reclamation. Bureau activities are carried out through seven regional offices servicing the 17 western continental states. Under current legislation the Bureau constructs and maintains facilities for multipurpose storage and delivery of water, to private and public projects. The following Bureau operational statistics for the year 1971 provide an overview of the extent of its water administration activities. In 1971 the Bureau programs delivered 27 million acre feet of water to the following purposes; irrigation, 24.9 million acre feet; 2 million to municipal and industrial use and 1 million to other nonagricultural uses. Water service was provided to 16 million people including 14.5 million served with municipal and industrial water and to 147,300 irrigated farms covering about 10.6 million irrigable acres of land.

The water rights for these projects are generally acquired by the Bureau through state water rights acquisition procedures and then marketed to the users under contracts with the Bureau which were originally designed to amortize the full project costs in a revolving fund for future projects but more recently have partially or completely abandoned that principle of full repayment.

$161 million was received from sale of generated electricity of 7.6 million KW capacity; flood control estimated benefits exceeded construction costs by 30 and 55 million visitor days recorded at 256 reservoir days for recreational uses of water.

Most of the Bureau's water activities are carried out under authority of the general welfare clause of the U.S. Constitutional implementing legislation.

National Park Service. 29 million acres of land are owned by the federal government in a proprietory capacity. These lands and their related water resources and uses are administered by the Service as 300 national parks, monuments, historic sites and recreational areas. In 1971 nearly 190 million visits were recorded at these facilities. As the agency responsible for administering national parks, the National Park Service can acquire water under state doctrines or like several agencies in the Department of Interior responsible for administering lands withdrawn from the right of private acquisition, can exercise the reservation doctrine to obtain needed water supplies.

Bureau of Indian Affairs. This Bureau is charged with the management of all Indian affairs and matters arising out of Indian relations, based on treaties and federal legislation.

Water related programs include maintenance of water supply, regulation of streamflow, prevention of soil erosion control and wildlife preservation on Indian lands. 850,000 acres of Indian and mixed ownership lands are served by approximately 300 irrigation systems maintained by the Bureau or tribal members. A significant factor in overall allocation of water in the western U.S. is the quantification Indian reserve rights in western water resources. The Bureau is "trustee" for these reserve rights.

Bureau of Land Management. There are approximately 450 million acres of land under the Bureau's jurisdiction. Some of these lands are classified for disposal based partly on water related classification criteria. Until such lands are disposed of the lands and their related

water resources are administered by the Bureau. The Bureau is also responsible for disposing of the mineral resources of the Outer Continental Shelf.

U.S. Geological Survey. This agency conducts surveys, investigations, research, stream measurement, and determinations of the water supply of the United States and also maps mineral deposits on the Outer Continental Shelf.

Bureau of Outdoor Recreation. This Bureau evaluates U.S. outdoor recreation needs and resources, and prepares nationwide outdoor recreation plans. It participates in administering the 27 rivers of the National Wild and Scenic Rivers Systems. The agency coordinates and reports on recreational aspects of multipurpose water projects and provides financing for state and federal outdoor recreational programs.

Others. The Office of Saline Water is engaged in research and development of methods for desalinization of sea water to serve multiple purposes.

The Bureau of Sport Fisheries and Wildlife's activities include land acquisition and management studies and investigations, cooperative activities with Federal planning and construction agencies and states for the protection and enhancement of fish and wildlife resources.

The Office of Water Resources Research stimulates, sponsors, researches, experiments and trains scientists in water resource problems.

Department of Agriculture

Forest Service. This service manages 187 million acres of national forests and grassland located in 41 states and Puerto Rico and as such has a significant impact on the nation's water resources. Many of the nation's watersheds for streams and rivers are located on national forests. Included among the specific responsibilities of the service is the protection of watersheds and stream flows for navigation, irrigation, timber supply and municipal use. The right to use water within the forests can be acquired by entities and individuals under procedures established by appropriate state laws or under the federal reservation doctrine.

Others. The Agricultural Stabilization and Conservation Service; Cooperative State Research Service, Economic Research Service; Farmers Home Administration and Soil Conservation Service are engaged in water related activities including research and dissemination of technical information, planning, loans, grants and other forms of financial support to private and public water development activities.

Department of Defense

Corps of Engineers. The Corps is the oldest Federal Agency with water resource programs. In 1973 its water program costs reached approximately 1.5 billion dollars. Its activities are carried out through 11 division offices and 37 district offices throughout the United States. These activities consist of the following:

i. Public works projects include improvement of rivers and harbors, flood control, fish, wildlife, recreation, storage for streamflow regulation, water supply, forest resource development, waterway improvements, shore protection, and waste water demonstration projects.

ii. Regulatory powers include granting of refuse permits for discharges affecting navigable waters, permits for dams, dikes, structures, dredging and filling of navigable waters and the supervision of construction and removal of obstructions from navigable waters.

Environmental Protection Agency (EPA)

The primary responsibility of this agency, as it pertains to water, is the regulation of water quality. Under the terms of the Federal Water Pollution Control Act, a permit program is established to regulate effluent discharges in terms of water quality standards of receiving waters.

The office encourages activities by the states including enactment of uniform state laws and interstate compacts for prevention and control of water pollution. Water quality standards are established for interstate waters. The EPA reviews and approves standards established by states and may compel compliance by states with the federal standards or guidelines. If the states fail to adopt appropriate standards the EPA may ultimately impose its standards and or enforce the state standards through federal enforcement machinery. The EPA administers a permit system for effluent discharges and other activities that may affect water quality.

Support programs of the EPA include funding and conducting of research, investigations, training, demonstrations and grants for construction in aid of its water pollution control mission.

Department of State

International Boundary and Water Commissions - United States and Mexico. This is an international body consisting of a U.S. and Mexican Section, each headed by an Engineer Commissioner. The commission administers the terms of treaties respecting water resources, and other aspects of the common boundary which involves the Colorado and Rio Grande Rivers. Many of the pertinent treaty provisions relate to water delivery guarantees and construction of multipurpose works.

International Joint Commission - United States and Canada. This commission is composed of U.S. and Canadian Sections. The commission has jurisdiction over rivers and lakes along which the U.S. Canadian international boundary passes. The commission passes on certain applications for works to be constructed in and rights to use these waters and administers the terms of treaties applicable to these waters. It also conducts studies and issues reports.

Federal Power Commission

The Federal Power Commission consists of 5 commissioners appointed by the President and confirmed by the Senate who serve staggered 5 year terms. The commission licenses proposed non-Federal hydroelectric projects and facilities. It also makes comments and recommendations on water programs of other federal agencies.

Tennessee Valley Authority

The TVA is a federal government owned corporation created in 1933. The three members of the board are appointed by President and confirmed by the Senate for staggered 9 year terms. The "Authority" owns and controls property for the purposes of carrying out a power, flood control, fertilizer, water conservation, recreation, fish and waterfowl development activities and promotes navigation on the Tennessee River and its tributaries. It regulates structures affecting navigation, flood control, public lands and reservations.

5.1.2 State Level

General:

The discussion concerning water administration organizations in the 50 states must necessarily refer at times to groups of states as the "Western States", or 'Eastern States" because of the general similarities within those regions which are consequences of their having originally adopted either the riparian or prior appropriation doctrines for water allocation as is more fully explained in the substantive section above. In this section we will describe state administrative organizations in terms of adminstrative functions related to water resource administration and regulation.

Applications for Water Appropriations in Western States:

In the Western States except for Colorado and Hawaii, all appropriators of surface water courses are required to make application to a state water administration agency before appropriating water. (See figure 10). In some of these states the application to appropriate is not the exclusive method of appropriation of all classes of water. Some states treat underground and surface water differently and do not require an application in the case of appropriation of underground waters for example.

The more typical requirements for processing applications for water use are as follows: The applicant files the application with the state water administration agency. The agency reviews the application and either approves or rejects it. The approval or rejection is based on whether or not there is unappropriated water available in the sources without interfering with existing rights. Some state statutes now require that the agencies refuse the application when granting it would injure "instream values," even if there may be unappropriated water.

It is difficult to accurately generalize concerning detailed statutory procedures for applications to appropriate water in all western states. The following quoted excerpts are from a recent National Water Commission Publication are a good brief generalization of such proceedings.

> "By the way of general procedures and principles, however, a few observations can be made. It can be said that applications ordinarily are filed with a central State office and are reviewed by the State administrative officer charged with water rights administration; notice of the application is published so that all water users who might be affected by the proposed appropriation will be aware of it; protests may be filed by any water user who believes that he would be adversely affected if the application were approved; if protests are filed, hearings are held to hear the testimony of the applicant and the protestants, and their supporting witnesses; the administrative officer makes a determination either approving the application or rejecting it, or approving it subject to conditions or limitations, or for a lesser amount of water than applied for in the application; and any party aggrieved by the administrative decision is allowed to appeal to the court."

In Colorado the application to appropriate is processed in special water Courts with basically the same procedural safeguards as are explained above for the proceedings before administrative bodies.

"The appeal is usually in the form of a trial in the district court, although there are differences with respect to the scope of review. Some States provide for a trial de novo, where the proceedings begin anew as if there had been no hearing before the State engineer. Other States provide for the substantial evidence rule, whereunder the district court may reverse the determination of the State engineer only if he finds that there is no substantial evidence to sustain the engineer's decision. There may be an appeal to the State supreme court from the decree of the district court."

Generally when the application is contested or protested the hearing that follows is conducted in oral proceedings following the Anglo-American tradition. Witnesses are sworn and examined and cross-examined at the hearing.

In those cases where the right to appeal is in the form of a trial de novo before a higher tribunal then the testimony in the original hearing is generally not recorded verbatim. However when by state law, the appeal is based on the lack of substantial evidence to sustain the administrative determination, the proceedings are recorded verbatim and the appeal is based on a review of the verbatim record.

"If the application is approved, it is only an inchoate right, to be perfected by exercising reasonable diligence in constructing necessary works and facilities and applying the water to use. The approved application usually states the time in which the water must be applied to use, and the period of time prescribed will vary in accordance with the magnitude of the project or the complexity of completing the diversion. In most States the administrative officer is given discretion to extend the time for completing works and facilities, upon request for the same by the applicant, if it appears that the applicant has exercised diligence but has been unable to complete the appropriation through no fault of his own. Sometimes other water users are required to be given notice of requests for extension of time, so that they may challenge the claim of the applicant that he has exercised diligence. Successive requests for extension of time to complete appropriations ordinarily may be granted, in some instances for as long as a cumulative period of 50 years from the date the application was approved, although in actual practice extensions for such protracted periods are rare.

"If the applicant cannot, or does not, show due diligence, his application may be terminated, or "lapsed." If he fails to appeal such action, it becomes final; although he may thereafter petition the State engineer to reinstate his application. However, a reinstatement carries a priority date as of the date of reinstatement, and the priority date of the original application is lost - - - so, for practical purposes, the petition for reinstatement operates as a new application to appropriate."

Many of the similarities in procedures in administrative proceedings above noted are based on Section 1 of the 14th Amendment to the Federal Constitution which provides "nor shall any State deprive any person of his property without due process of law." As interpreted by U.S. Supreme Court decisions, this provision imposes certain procedural requirements on the States in proceedings where water use rights are at issue.

Stream or Water Source Adjudications in the Western States:

In the arid west, as prior appropriative rights accumulated on water sources, many conflicts surfaced because there was not a detailed definition of the interrelationship between water rights in the same water source.

Statutory stream or water source adjudications are now provided for by the statutes of almost all western states.

The judicial adjudication may be initiated by water users or specified state officials and the objective of the proceeding is to obtain a court determination of all the water rights in a particular river or other water source.

All water users from the common source must become parties to the proceedings and everyone concerned is required to submit all their claims to water for adjudication regardless of the historical source of the claim.

The state water administration agencies play a significant role in the adjudication process. The state agency is always responsible for investigating the relevant facts and executing surveys.

In some states the agency also establishes in the first instance a document describing in detail all water rights on the water source which is later presented to the court and water users. The agency in other states also makes administrative rulings on objections by the users to its proposed determination and then dissatisfied users may appeal the administrative ruling to a court. The final determination of individual water rights in adjudications are made by courts with administrative agencies executing varying degrees of responsibility in the preliminary proceedings.

State Administrative Control Over Water Distribution:

In almost all Western States there are statutes authorizing appointment of water commissioners who have the responsibility of policing the distribution of water in accordance with established rights.

The independence of the commissioner from the water users is a primary feature of these statutes and the Commissioner is usually appointed by a state agency and sometimes supervised by a court. The criteria for the area served by a commissioner varies widely from state to state.

The scope of authority of the commissioner usually ends with his control over the amount of water diverted from the water source and does not extend to policing canals or use beyond that point.

Administration and Management of Water Rights Records in the West:

Most Western states require by statute the recording in some administrative office in the state of certain types of water rights which are granted by state administrative processes or generally required to be recorded in their original forms in the administrative office which granted the rights. In some states the water rights claims were historical and in some cases continue to be recorded in the county recorders' offices, and occasionally are recorded in both the county recorders office and in the state water administration agency's records. These records, in general, do not accurately reflect the current legal status of all water rights.

General Overview of State Involvement in Water Rights Administration in the Eastern States

Historically in the Eastern states, there was no significant state administrative control over water use. Riparian water rights conflicts which developed were decided in ordinary judicial proceedings. More recently there has developed a trend in the eastern states toward the adoption of permit systems. These permit systems establish statutory procedures and statutory agencies for granting "permits" to use water. A "permit" is more temporary and less secure to the holder, than a right acquired by an appropriator under statutes in the western states. The procedures provided in most cases for the granting of a permit in the eastern states is roughly equivalent to the process for the application to appropriate water in the Western States as explained above. In general, the permits to use water granted eastern states which have permit systems apply to waters in excess of those needed to satisfy basic historical riparian rights. These statutes generally have not attempted to limit the way in which a riparian exercised his right. However, recently the eastern state of Florida imposed permit requirements and limitations on all waters of the state including those which were previously covered by established riparian right.

State Water Quality Control Agencies:

There is sufficient similarity that now exists in agencies on a state level exercising authority over water quality control to make some generalizations useful in an understanding of these systems. Historically the primary interest of the state in water quality control was directed toward controlling public health. Because of broader present concern in water quality beyond the aspects of public health, state administrative control has more recently been broadened to involve state agencies in the regulation of most aspects of water quality control.

The state controlled agency is generally a subagency of the Department of Health, but is designed to protect water uses and values including irrigation, domestic, industrial, fish, wildlife, and recreational uses. The statutory scheme for control is generally found in the adoption of standards of quality for various classes of water. This scheme is complimented by a classification of various water courses based on their presnt and probable future uses. Permits for sewage effluent and industrial discharges into waters are generally required. Waste disposal facilities and their construction are under the control of the state agency. If the established standards are violated, the one causing pollution is usually given notice of an administrative hearing to determine whether or not he is in violation of the standards and regulations. He has a right to present evidence and generally a right to appeal the administrative decision to the courts.

With the exception of California, Washington, and New York, there has been little or no integration between water quality control agencies and their water quality control function with the process of granting appropriative rights or permits to use waters. See Figure 11 inductive of water quality and quality control administration.

State Court Resolution of Water Rights Disputes:

Water rights disputes and their resolution in general, come within the jurisdiction of district courts or courts of general jurisdiction within each state. The general exceptions to this rule is in those cases where water rights disputes are generated in the administrative processes above described for the processing of applications for permits in the eastern states and for appropriative rights in the western states and the resulting protests. The disputes which do come within the original jurisdiction of the ordinary court system are resolved in accordance with the common law and procedural concepts as modified by modern procedural statutes. In a comparative context, the following points about the ordinary general court procedures utilized in the resolution of water disputes in this category are significant. The proceedings in the court for the resolution of the disputes, if contested, are adversary proceedings, consisting of a trial in which the proceedings are oral in general, where witnesses are examined in oral proceedings that are recorded either stenographically, verbatim, or mechanically, so that a verbatim record of the proceedings can later be produced in the event of appeal or other need. The judge or jury renders a decision based on the evidence presented. Precedent and statutory modifications and enactments define the procedural and substantive rules. The substantive laws which are applied are discussed under the substantive portion of this paper.

In the event that the parties are dissatisfied with the judgment rendered by the court, there is always a recourse of appeal to a higher court, usually the state supreme court. In some of the larger states there are intermediate courts of appeal.

5.2 Local Public or Governmental Water Organizations

5.2.1 Cities or Municipal Governments and Counties

City governments and counties are local government units providing governmental service needs in urban areas and subdivisions of a state with varying degrees of population density. These organizations function within the limitations provided by state legislative enactments, have limited taxation power, and are governed by democratically elected bodies which make, administer, and adjudicate local ordinances and regulations within the limitations provided by state statutes.

These local organizations perform significant water administration responsibilities in the following areas:

(1) Supplying domestic or culinary water service to inhabitants, industries, and businesses;
(2) Sewage disposal; and
(3) The design, construction, and maintenance of flood control measures and systems, within these areas.

5.2.2 Local Districts for Water Administration

State statutes in every state provide for the creation of a local government entity for the purpose of performing some water administration function or functions as follows:

(1) Scope of authority

The districts vary in the scope of their functions. The title given to these districts by the state statutes is not always an accurate indicator of the scope of their responsibilitites and frequently the scope of their responsibilities are greater than or more restricted than would be suggested by the titles. However, within these limitations the following is provided as a general overview of the functional titles of these water related districts and the number of states where such a district title is provided by statute: Water distribution, improvement, or conservancy, 20 states; Drainage, 27 states; Irrigation, 15 states; Water, 15 states; Levee, dike, or flood control, 17 states; Public water and sewer, 13 states; Watershed, 12 states; River, 4 states, Sanitary, 4 states; Groundwater management, 3 states; Reclamation, 2 states, Lake water, 2 states; Recreation water, 2 states; Natural resources, 2 states.

(2) Organization

These districts are usually organized by a petition of a certain percentage of the inhabitants of the district or percentage of the land owners, or the owners of a certain percentage of land within the district. They are usually governed by a board of directors elected periodically at regular local elections by the inhabitants or land owners within the district. The district boundaries and jurisdiction may vary greatly and may include relatively small parts of counties. Some kinds of districts may include a number of counties.

(3) Taxing power

One of the more common features of these districts is their powers to tax land and/or property for the purpose of raising funds to purchase property, equipment, and install and maintain the necessary systems to carry out their water management functions in general. This taxing power is limited by law. The districts also have limited authority to issue bonds to be paid from their future tax assessments to pay for present costs of improvements within those districts.

5.3 Private and Quasipublic Use and Management Entities

5.3.1 Mutual Irrigation Companies

In arid western states where irrigated agriculture is common, there are large numbers of organizations which fall into this class of mutual irrigation companies. These organizations are operated as cooperatives. Many are organized as formal corporate entities under state charters and stock is issued to their members as evidence of the members proportionate voting rights in the election of directors of the company. Generally the number of stock shares held by any individual divided into the total number of outstanding shares in the company, establish the formula for the proportion of the total water right of the company that any shareholder is entitled to. Many of these organizations are informal associations where the officers are elected on the same voting base as in the formal corporations, but operate as associations rather than as formally registered corporations. The basic water right managed by the corporation is generally acquired under state laws in the name of the company or association. The governing board of directors manages the protection of the overall water right, provides for maintenance and operation of the canals and distribution works and through water masters, police the internal distribution of the water. These organizations are generally non-profit organizations. They acquire their

funds for maintenance and operation of their system from assessments made against shareholders or members in proportion to their stock holdings as a general rule. If the shareholders or members fail to pay the assessments as made, the only recource of the organization is the sale of the stock and the water right. These organizations are distinquished from formal districts as earlier discussed primarily in their lack of taxing authority against lands which they serve and the corresponding lack of bonding power to finance present costs of capital improvements in their systems. There are a minimal number of state statutory regulations applied to these private corporations and associations. In the state of New Mexico, however, a specific elaborate scheme for the operation of "Acequias" or irrigation cooperatives is provided for in the water laws of the state of New Mexico.

5.3.2 Culinary Water Supply Companies

There are some private companies or corporations in the United States that are engaged in the business of diverting a quantity of water from a natural source and delivering it through private company supply systems to private individuals. They charge rates to customers for the water service. These companies are relatively limited in number. They are generally controlled by state regulatory agencies in the quality of water supplied and some state authorities control the rates charged by these companies to their customers. It should be noted, however, that by far the largest majority of water supplied for culinary and domestic purposes is supplied through the medium of governmental agencies at the local level as noted earlier in this paper.

5.3.3 Private Power Companies

A significant part of electrical power provided and used in the United States is supplied by public utilities. These organizations are private corporations where the stock is owned by individuals. They frequently generate electricity through the medium of hydroelectric plants. Their rights to utilize water in these plants is acquired from state water administration authorities but they are carefully controlled in the rates that they charge to customers and the profit levels of the corporation by state and federal regulatory agencies and boards. Their water use is of the non-consumptive type in general.

7. CONCLUSION

Much can be written about the water laws of the United States, and there is no end to the combinations of topics to select from. But, as most every country is now experiencing, there is a need for close collaboration among colleagues and disciplines in the field of water resources management and control at the international level to exchange information and ideas on alternative approaches.So with a condensed version of key topics on this country's water laws, we hope to initiate a dialogue that wil lead from the general to the specifics of this system.

In the Western United States where water is already in short supply, new energy resources have been discovered which, according to recent projections, could take the majority of natural water supplies to develop them.[52]

The question becomes -What is the opportunity cost of a) developing the resources at the expense of existing water uses, b) retaining existing uses at the expense of developing the needed energy resources, or c) some combination of preservation/development cum water reallocation and increased water use efficiencies. Similar situations face other parts of the country as projected water requirements far exceed available supplies.

This is not a localized problem, it is global. The realism of the situation can best be described by adapting the position of Garret Hardin on the balance of population and common resources as he notes it is " an implicit and almost universal assumption of discussions published in professional and semi-popular scientific journals that the problem under discussion has a technical solution." [53] But, to paraphase Hardin, although technical solutions are always welcome, for many problems there are no exclusive technical solutions. We are addressing such a problem - the ability to properly allocate and manage a resource of relatively inelastic supply that is a key ingredient and catalyst to a high quality of life and environment. Regardless of the technical solutions, the laws and organizations for water allocation and control must be dynamic and enjoy the input of multi- disciplines, economic sectors and societies if the problem shall be dealt a successful solution.

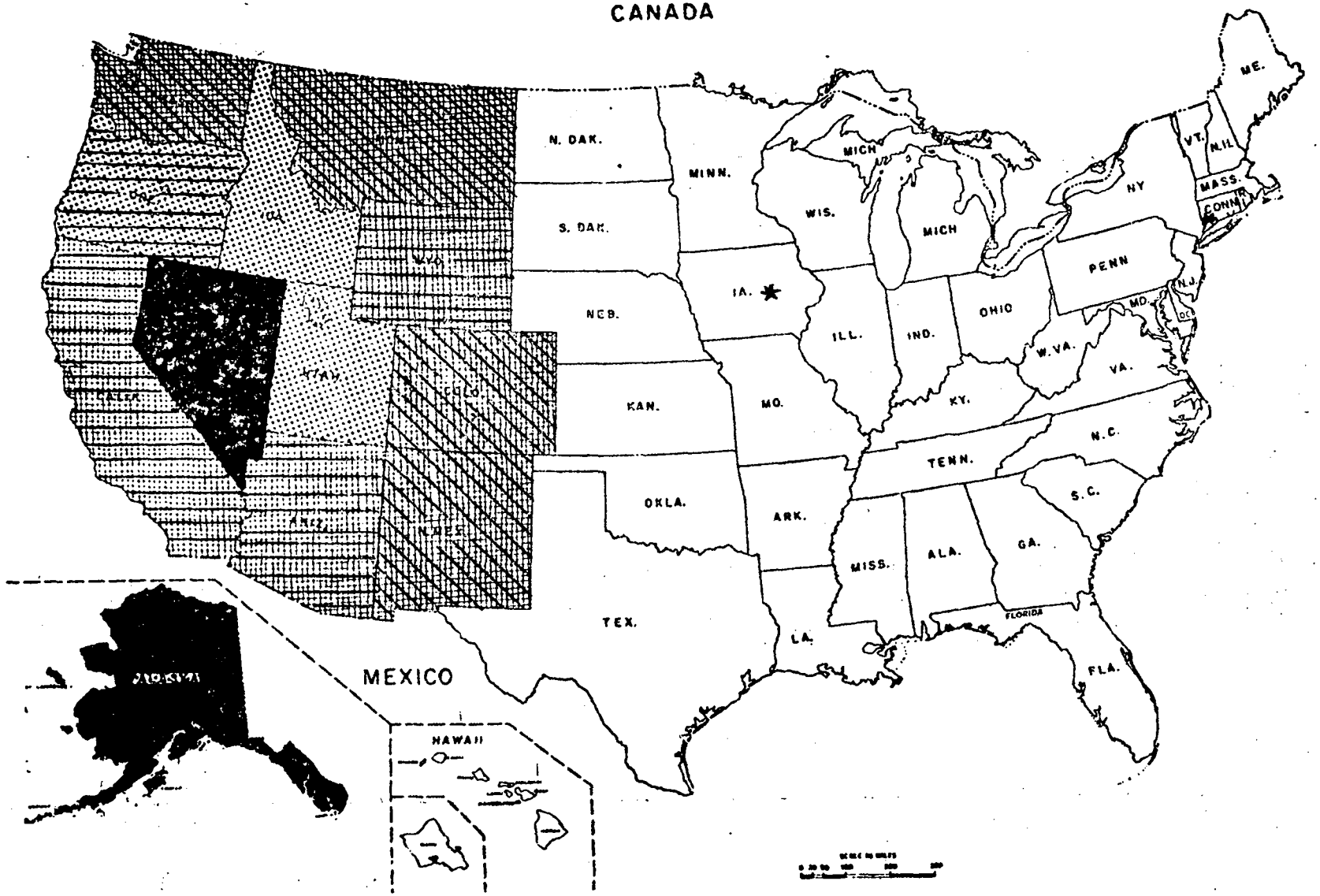
WATER LAW AND ADMINISTRATION

IN THE

UNITED STATES OF AMERICA:

FIGURES

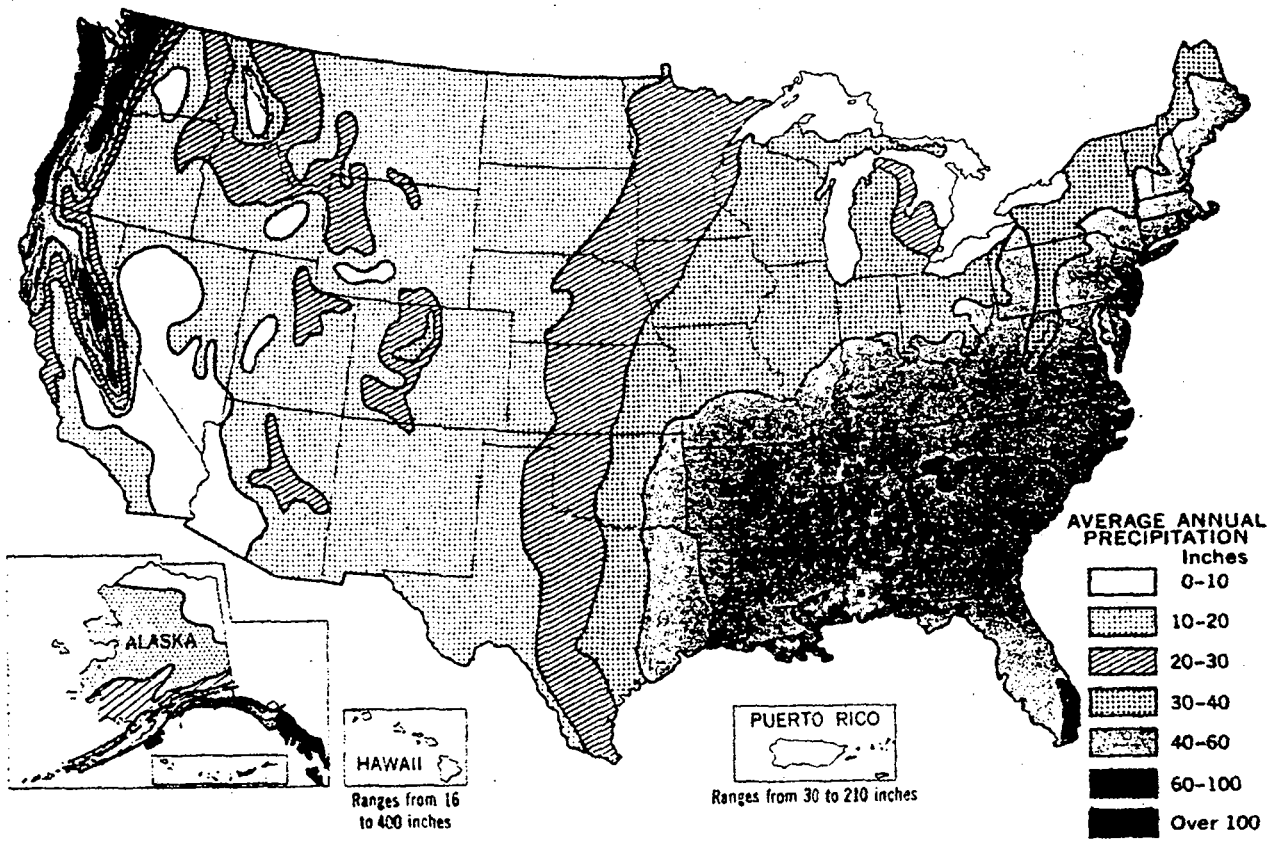
DISTRIBUTION OF FEDERAL LANDS - Percent of Each State Area Federally Owned 1968



SOURCE: ONE THIRD OF OUR NATIONS LAND, p. 23, 1968

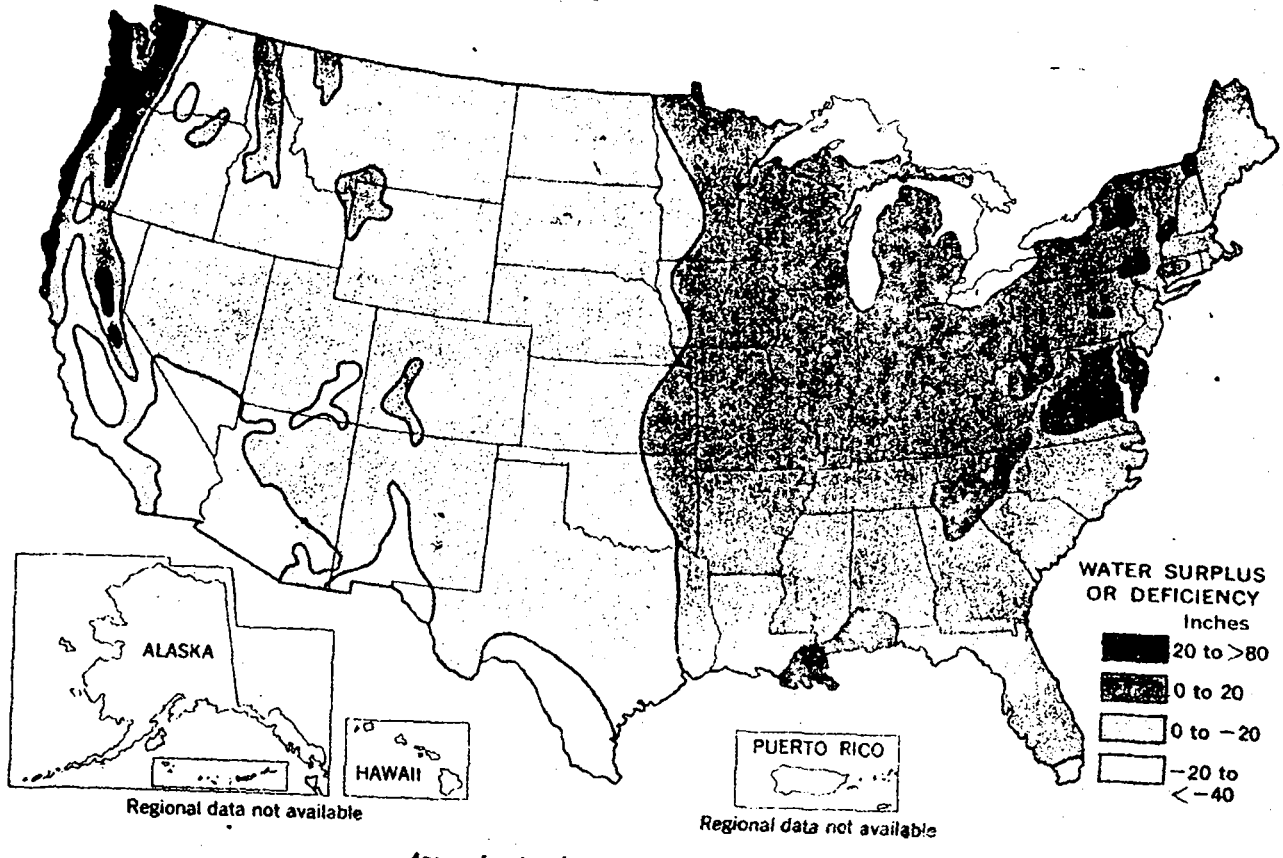
Figure 1

Figure 2



-Average annual precipitation.

Figure 3



Areas of natural water surplus and natural water deficiency.

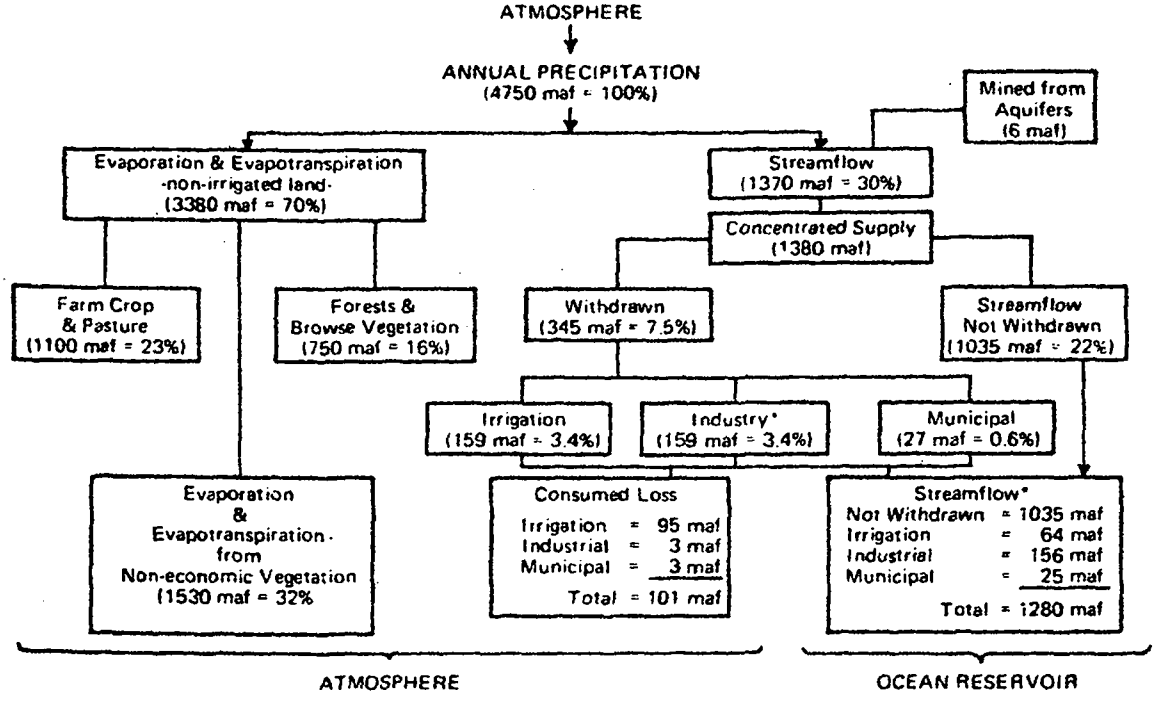
Source for Figures 2 & 3: The Nations Water Resources, 1968, pp. 3-2-2 & 3-2-4

Figure 4

DISTRIBUTION OF PRECIPITATION IN THE CONTINENTAL UNITED STATES

(Source: Wolman, Publ. 1000-B, National Academy of Sciences–National Research Council, 1962)

[Average values in million acre-feet (maf)]



*The same water may be reused at points spaced along a single stream.

Source: Todd, The Water Resources Encyclopedia, P. 61

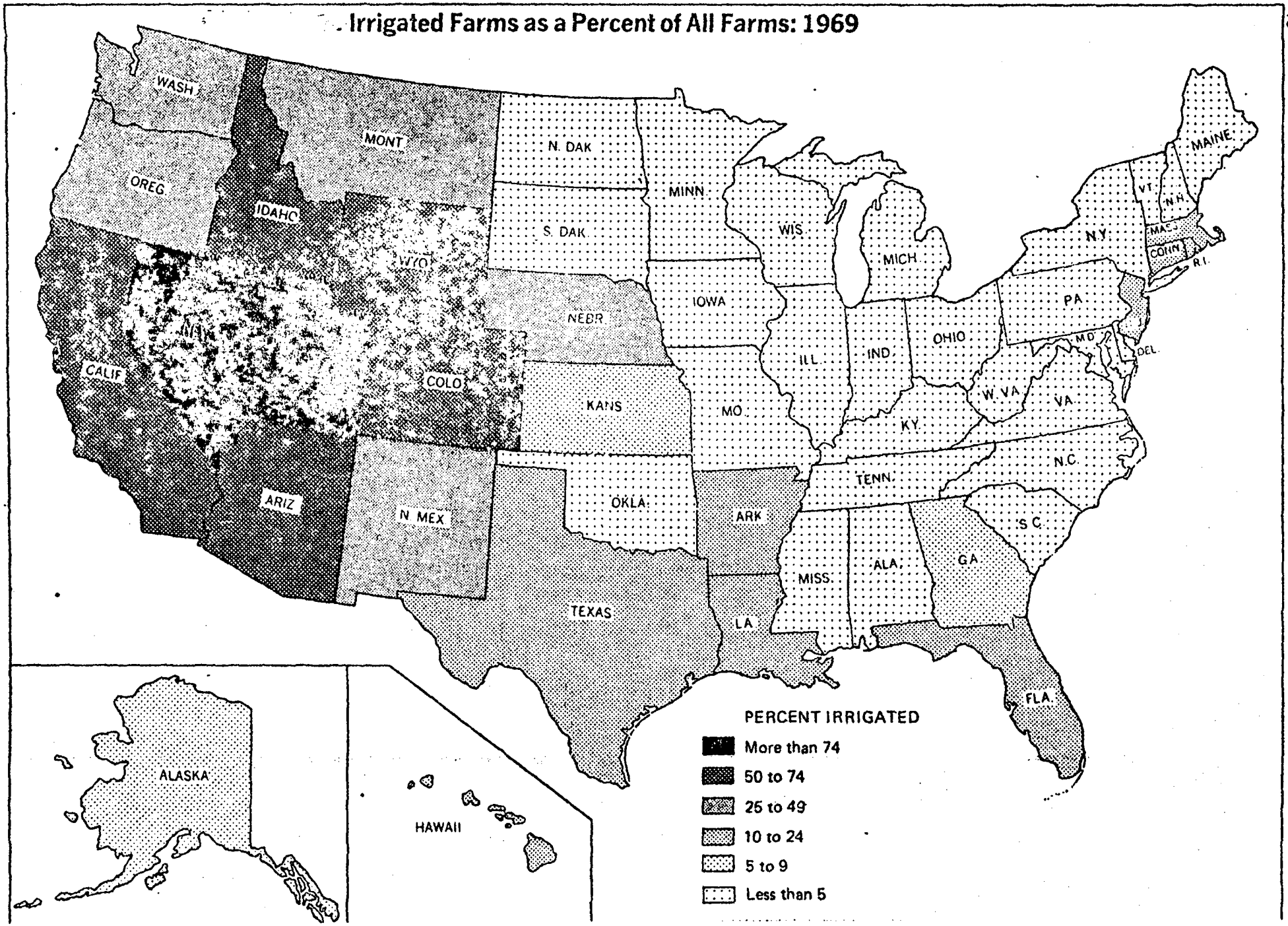
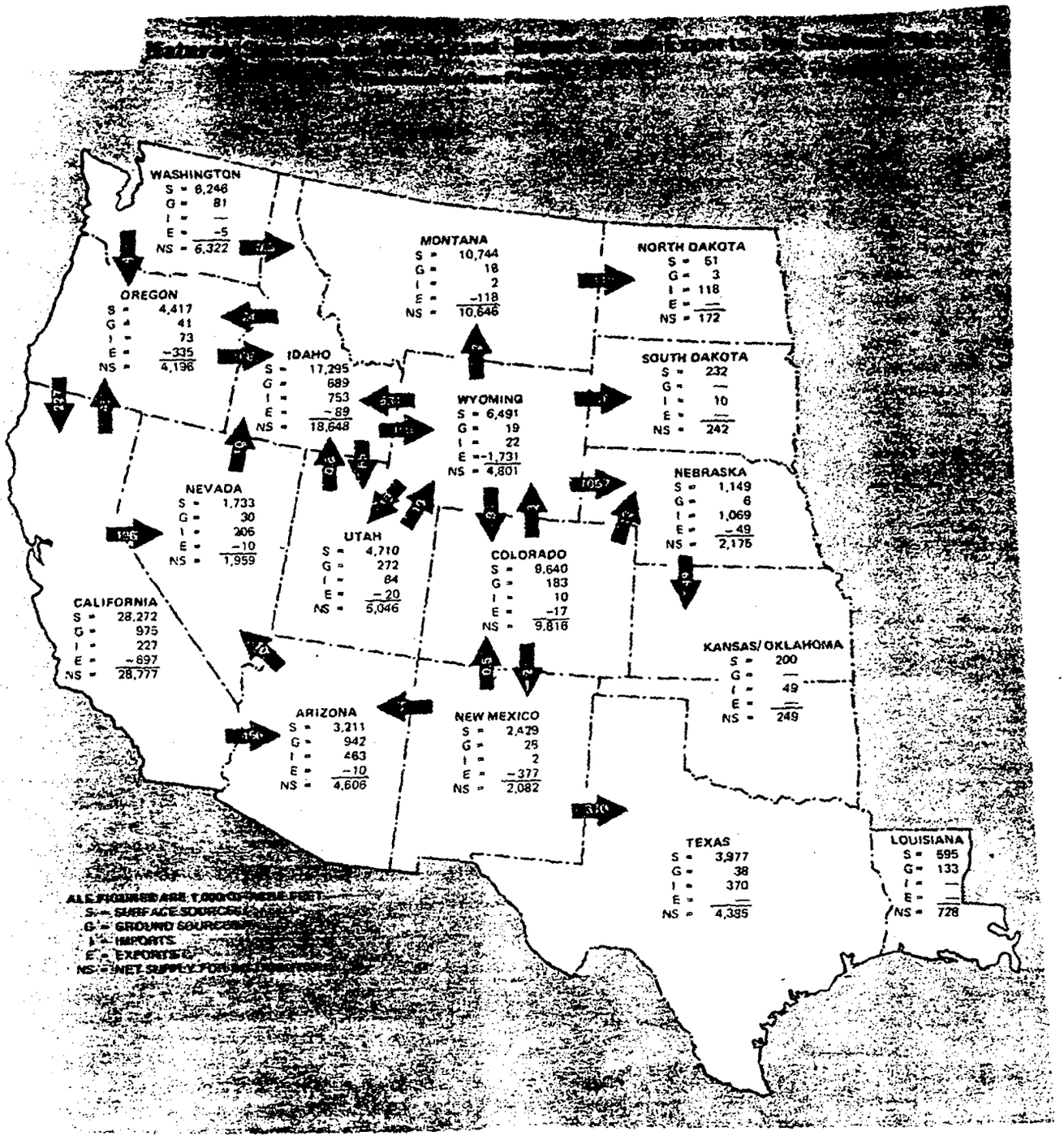
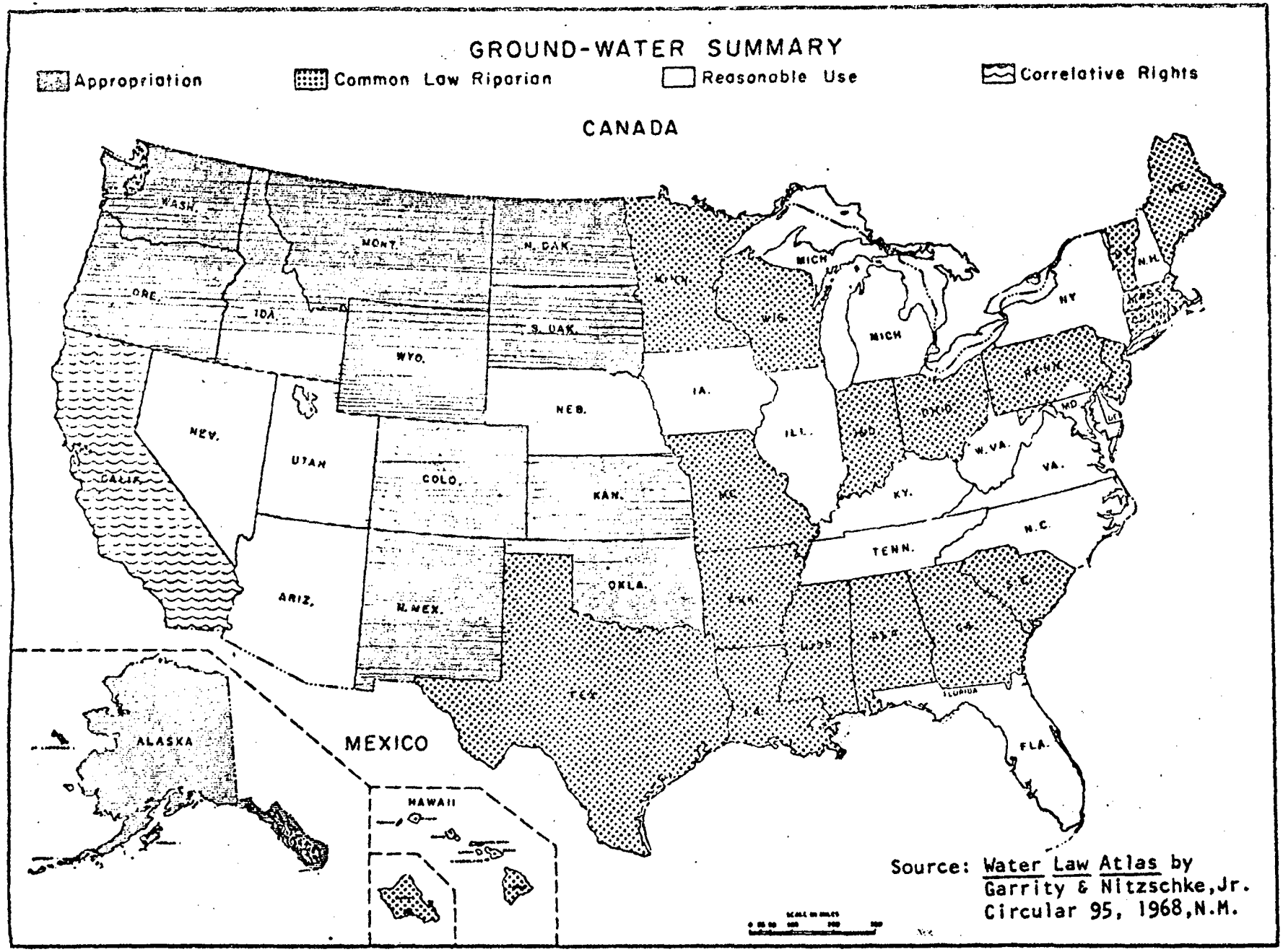

Irrigated Farms as a Percent of All Farms: 1969
WASH
OREG
CALIF
IDAHO
NEV
MONT
WYO
COLO
ARIZ
N MEX
N. DAK
S. DAK
NEBR
KANS
OKLA
TEXAS
MINN
IOWA
MO
ARK
LA
WIS
ILL
MICH
IND
OHIO
KY
TENN
MISS.
ALA.
GA
FLA
S.C.
N.C.
VA
W.VA
PA
N.Y.
MD
DEL
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
ALASKA
HAWAII
PERCENT IRRIGATED
More than 74
50 to 74
25 to 49
10 to 24
5 to 9
Less than 5

Figure 4

Figure 6



SOURCE: Census of Agriculture, Vol. IV Irrigation, Bureau of Census, 1973.



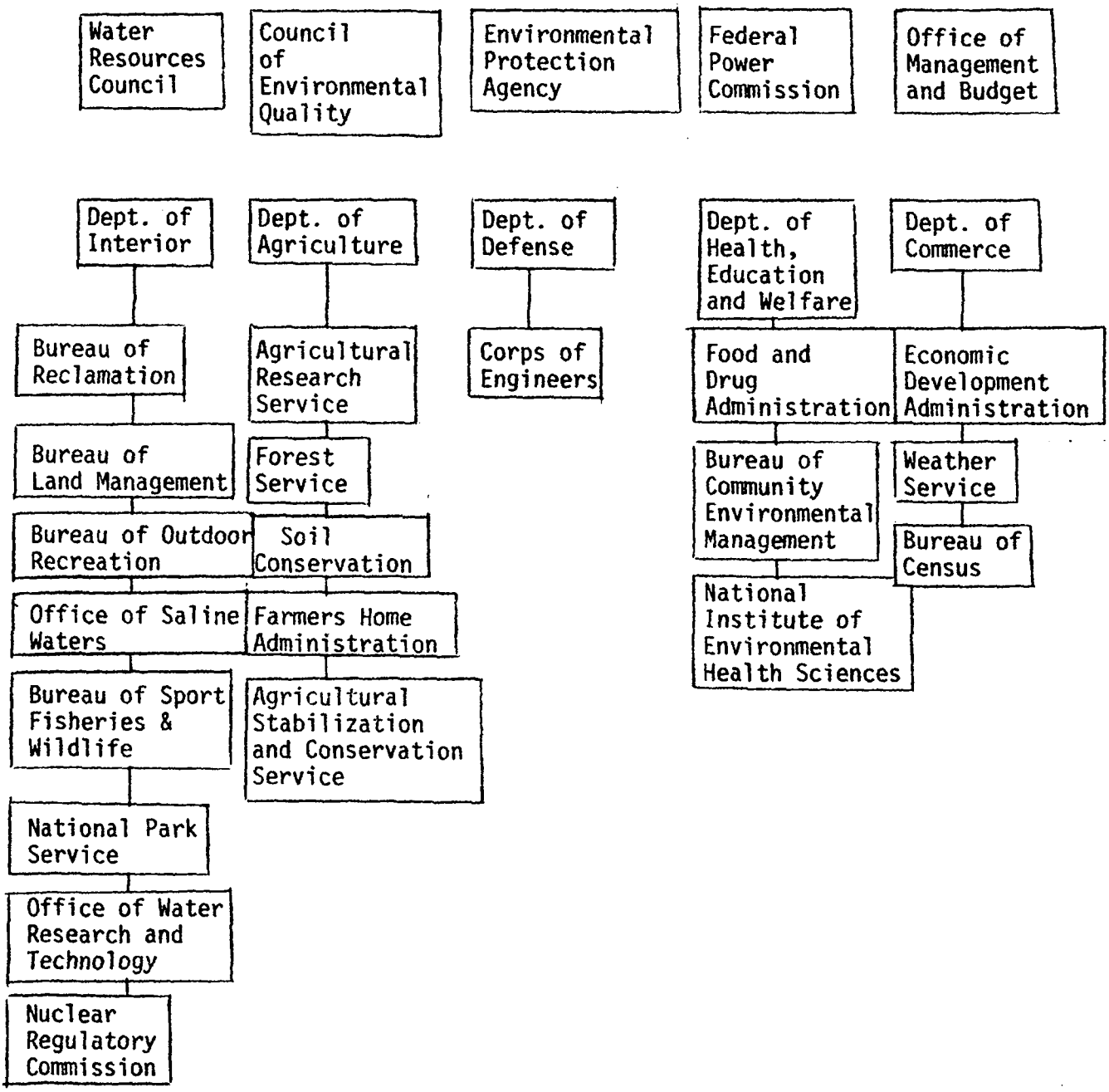
Source: Water Law Atlas by Garrity & Nitzschke, Jr. Circular 95, 1968, N.M.

Figure 8

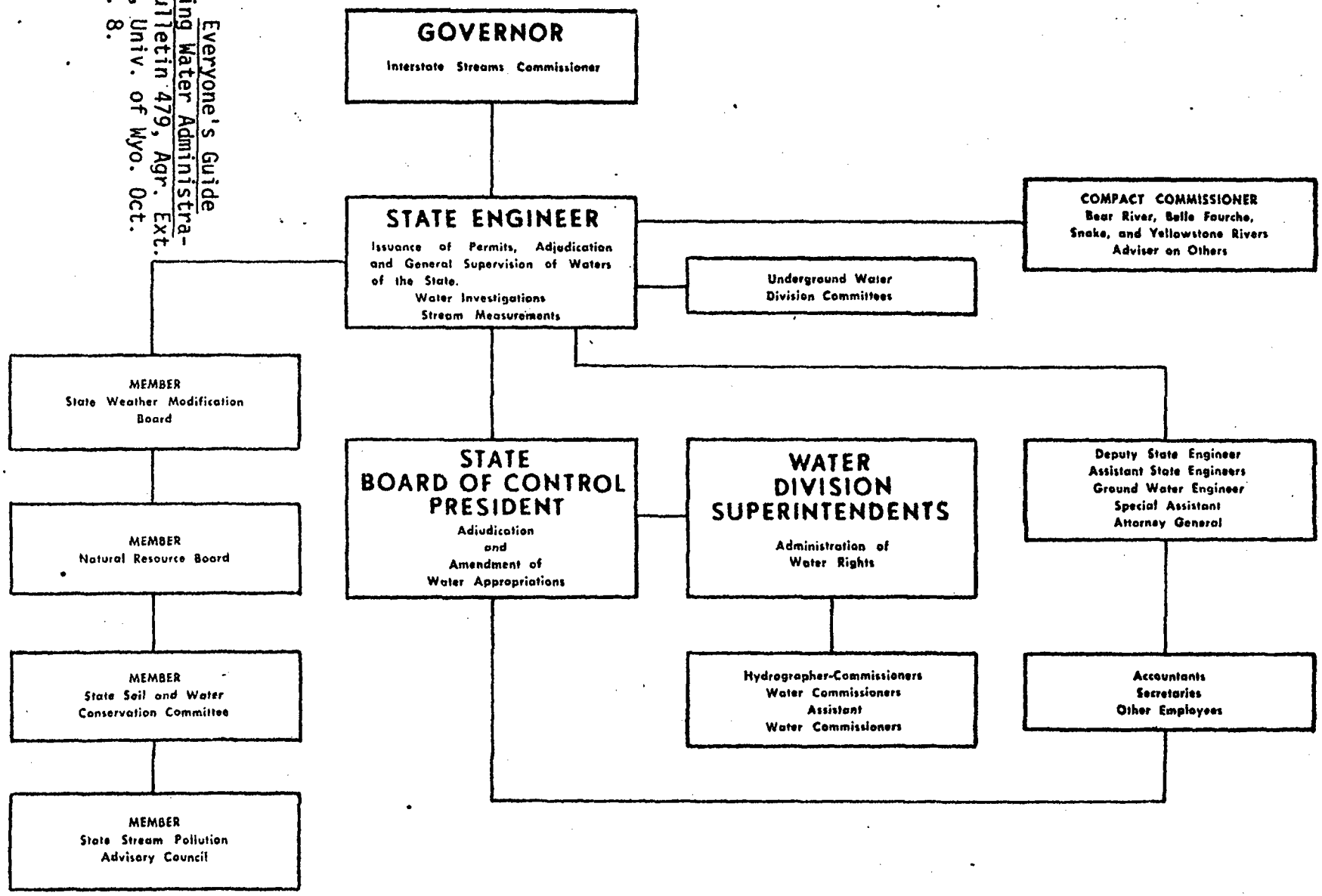
Figure 9

MAJOR FEDERAL DEPARTMENTS AND AGENCIES

CONCERNED WITH WATER



Functional Organization of the Wyoming State Engineer and Related Offices



Source: Everyone's Guide to Wyoming Water Administration, Bulletin 479, Agr. Ext. Service, Univ. of Wyo. Oct. 1967, p. 8.

Figure 10

Organization of California State Water Resources Control Board

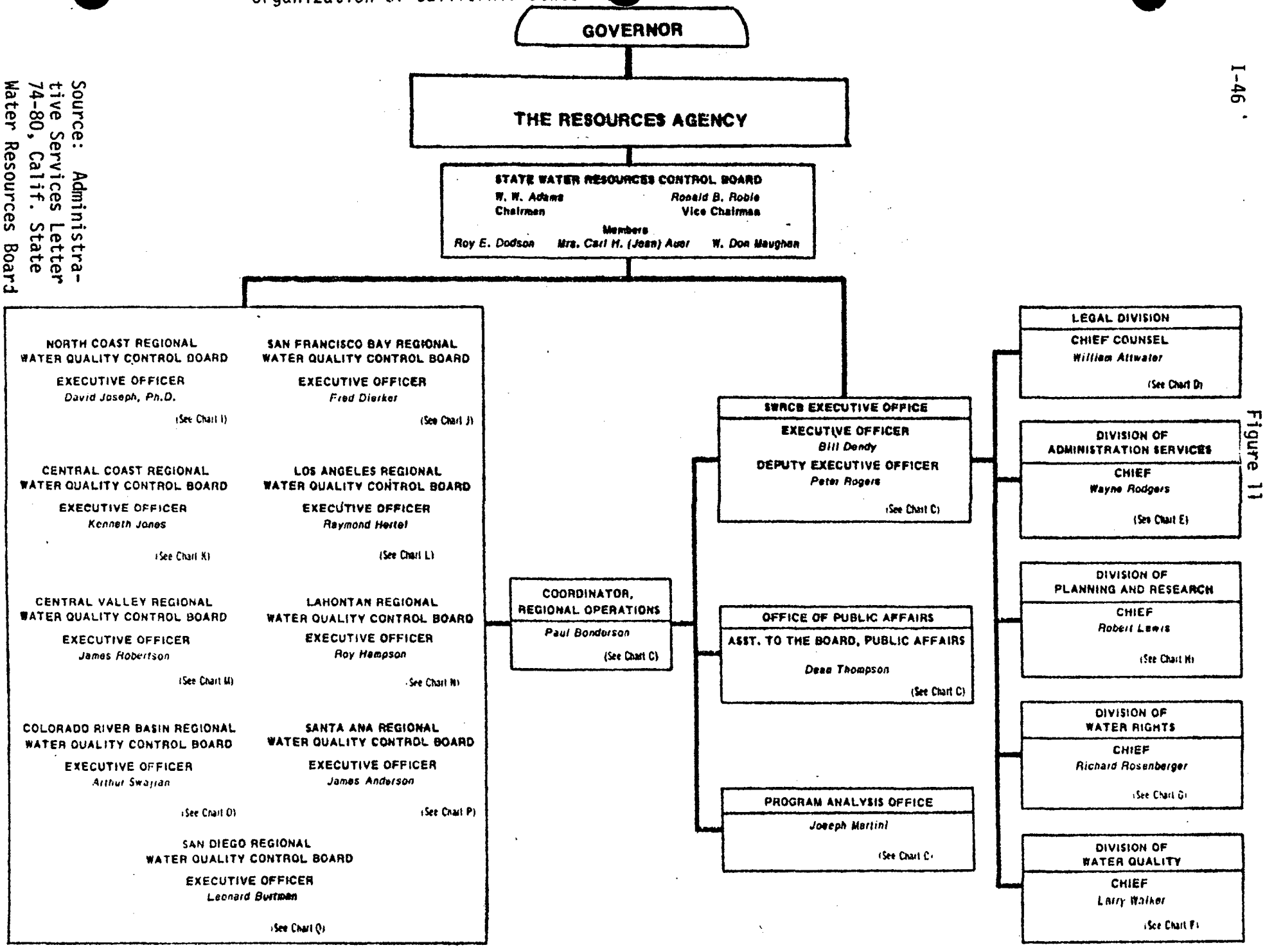


Figure 11

Source: Administrative Services Letter 74-80, Calif. State Water Resources Board Nov. 1974.

FOOTNOTES

1. Quote from George Eliot, "Felix Holt's Address to Workingmen," (1867) Works, III, 337 as quoted by Clifford Davis, Riparian Water Law: A Functional Analysis, p. 1 National Water Commission Legal Study No. 2, PB 205 004, National Technical Information Service, Springfield Va., Oct. 1971

2. This pattern of observation and transfer of knowledge is not contemporary. Lieut. C.C. Scott Moncrief examined the irrigation practices of France, Spain and Italy in 1867 at the request of the Government of India in order to bring together as much knowledge as possible in designing or modernizing one of the largest irrigation systems of the world, the Indus. See Moncrief, Irrigation in Southern Europe, W. Clowes & Sons, Publisher, London 1968. Likewise, William Hall, State Engineer of California toured the same three countries in early 1880's and found as did Moncrief, not only the water use practices, but also system of administration of great value to resolving problems in California. See Hall, Irrigation Development, Vol. 1, State Printing, Sacramento, Cal., 1886.

3. Hydrologic data was taken from Water Atlas of the United States, by Geraghty, Mitles, Van der Leeden & Toraise, Water Information Center, Inc., Manhasset Isle, Port Washington, N.Y. 11050, 1973; The Nation's Water Resources, Water Resources Council, Washington D.C., 1968, and The Water Encyclopedia by Todd, Water Information Center, Supra, 1970.

4. Agricultural data is from 1969 Census of Agriculture: Vol IV - Irrigation, U.S. Dept. of Commerce, Washington D.C., 1973.

5. One Third of Our Nation's Land, Public Land Law Review Commission Report, U.S. Government Printing Office, Washington D.C., 1970, p. ix.

6. Sec. 9. Act of 1866, 14 Stat. 253, as amended 43 U.S.C. §661 (1964).

7. Desert Land Act, 19 Stat. 377 (1877) as amended 43 U.S.C. §321 (1964).

8. 29 U.S. 142 (1935).

9. Meyers, C.J. Functional Analysis of Appropriation Law, National Water Commission Study No. 1, P.B. 202 611 National Technical Information Service, Springfield Va., (1971).

10. For a comprehensive analysis of the reclamation program see: Dickerman, Radosevich & Nobe, Foundations of Federal Reclamation Policies: An Historical Review of Changing Goals & Objectives, NRE-8, Colorado State University, 1970.

11. Public Law 89-80, 79 Stat. 244, 42 USCA §1962. Also see: Johnson, Reuben J. "Adoption & Implementation of Water Resources Policies in the U.S.," Report to U.N. Panel on Water Resources Development Policies, Buenos Aires, June 1970, ESA/RT/AC. 1/8.

12. Public Law 92-500, 70 Stat. 498, 33 USC §1151.

13. For greater detail see: A Summary-Digest of the Federal Water Laws & Programs, ed. by DeWeerdt & Glick, National Water Commission, U.S. Government Printing Office, 1973, and Lower Colorado Region Comprehensive Framework Study, Appendix III: Legal & Institutional Environment," U.S.G.P.O., Washington, D.C. June 1971, p. 3-100.

14. U.S. Constitution, Article I. Section 8, Clause 1.

15. U.S. v. Gerlach Livestock Co., 339 U.S. 725, (1950).

16. U.S. Constitution, Article I. Section 8, Clause 3.

17. U.S. Constitution, Article IV. Section 3, Clause 2

18. U.S. Constitution, Article II. Section 2, Clause 2.

19. U.S. Constitution, Article I. Section 10, Clause 3.

20. See: Trelease, Frank J. Federal-State Relations In Water Law, Legal Study 5, National Water Commission, PB 203600, National Technical Information Service, Springfield Va. 22151, Sept. 1971 and "Water Resources," Chapter 8, One Third of the Nation's Lands, U.S.G.P.O. 1970.

21. U.S. v. Cappaert 508 F2d 313, (9 Cir. 1974).

22. Federal Water Pollution Control Act, P.L. 84-660.

23. P.L. 89-234.

24. P.L. 92-500, 86 Stat. 816 sev. 101.

25. "Water Law & Hydrology - Problems of Classification," p. 16-29, Water & Water Rights, ed. by R.E. Clark, vol. I, Allen Smith & Co., Indianapolis, Indiana, 1967.

26. Red River Roller Mills v. Wright, 30 Minn. 29, 15 NW 167, p. 169 (1883).

27. Restatement (Second) of Torts, Ch. 41, Topic 3, Scope Note (Tent. Draft No. 17, 74-76, 1971).

28. Davis, Clifford, Riparian Water Law, A Functional Analysis, Legal Study No. 2, NTIS, Springfield Va. Oct. 1971.

29. Iowa Code Ann. Ch. 455 A (Supp. 1968).

30. N.J. Stat. Ann. §58:1-44 (1966).

31. Trelease, Frank J., Federal-State Relations in Water Law, Legal Study No. 5, a report to the National Water Commission, 1971, p. 22.

32. "Has the Doctrine of Appropriation Outlived its Usefulness?" John U. Carlson, 19th Annual Rocky Mountain Mineral Law Institute, p. 530, 1974. The first decision in American courts which recognized this doctrine was Irwin v. Phillips, 5 Cal. 140 (1855). The California Supreme Court cited no precedents in its decision for there were none. The developing common law had received a new addition.

33. See, for example, the statutory revisions in Oregon and Washington requiring all ripariansto quantify their rights and the new permit systems in those states.

34. See Trelease, Frank J., Federal-State Relations in Water Law, Legal Study No. 5, a report to the National Water Commission, 1971, pp. 28-29 for a listing of the states who have passed strict appropriation doctrines along with the dates of the passing of these laws.

35. See, for example, Farmers Highline Canal & Res. Company v. Golden, 129 Colo. 575, 272 P2d 629 (1954); Dick v. Caldwell, 14 Nev. 167 (1879) and Nev. Rev. Stat., §533.070.

36. Dewsnup R.L., "Legal Aspects of Water Salvage," a report to the National Water Commission, 1971, pp. 13-15. See also City and County of Denver v. Sheriff, 105 Colo. 193, 96 P2d 836 (1939).

37. R.E. Clark (ed.), Waters and Water Rights, The Allen Smith Company, Indianopolis, Indiana, §51.7, p. 296.

38. Ibid., §51.7 at 297.

39. See, for example, Reagle v. Square S Land and Cattle Co., 133 Colo., 392, 276 P2d 235 (1954).

40. 2 Kinney, Irrigation and Water Rights (2nd ed. 1912) pp. 1313-1314.

41. Ibid, p. 1317.

42. Nichols v. McIntosh, 19 Colo. 22, 34 P278 (1893).

43. A usufructory right is the right of enjoying a thing, the property of which is vested in another, and to draw from the same all the profit, utility, and advantage which it may produce, providing it be without altering the substance of the thing. Black's Law Dictionary, West Publishing, St. Paul, 4th ed. (Rev.) 1968.

44. Clark, R.E. (ed.), Waters and Water Rights, The Allen Smith Company, Indianapolis, Indiana, §53.7, pp. 350-351.

45. Utah Code Annotated, §73-1-11 (1953).

46. 1973 Colo. Revised Statutes 38-6-201 to 38-6-216 (acted June 1975).

47. For a thorough treatment of groundwater and the law refer to: Cocker, Charles E., Groundwater Law, Management & Administration, National Water Commission Legal Study No. 6, PB 205 527, National Technical Information Service, Springfield Va. 22151 Oct. 1971.

48. 152 Eng. Rep. 1223 (1843).

49. Meeker v. East Orange 77 N.J.L. 623, 74 A. 379 (New Jersey 1909).

50. Katz v. Walkinshaw, Supreme Court of California, 141 Cal. 116, 70 P. 663, 74 P. 766 (Cal. 1903).

51. See: Radosevich, G.E., W. Sutton, "Legal Problems & Solutions to Surface-Groundwater Management," The High Plains: Problem of Semiarid Environments; ed. by D.P. MacPhail, American Association for Advancement of Science, 1972.

52. See: Western States Water Requirements for Energy Development to 1990, Western State Water Council, Salt Lake City, Utah, Nov. 1974.

53. Hardin, Garrett, "The Tragedy of the Commons," Science vol. 162, p. 1243 Dec. 1968.

THE ASIAN REGION

by

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1. INTRODUCTION

This paper is closely based on one prepared by the author for the Working Group of Experts on Water Codes held in Bangkok in 1967.[1] That paper, in its turn, was based on country studies provided for the purpose of that conference.[2] Additional studies have been subsequently undertaken, resulting in the publication of "Guidelines for the Drafting of Water Codes."[3]

In the space allotted for this paper it is extremely difficult to do justice to the topic. Three particular difficulties beset the author. Any descriptions of systems in the area must be impressionistic and sweeping. When engaging in such broad-brush comparisons, it is almost impossible to be evaluative or constructively critical. Finally, the scope of the topic means that one is unable to comment with fruitful particularity on any system, country or issue. While the author would have preferred to offer a paper which broke new ground and may have been a starting point for useful discussion, this has not been possible within the topic allocated. No claims of originality are made for this work; it has all been better and more exhaustively treated in the three volumes emerging as a result of the Working Group of Experts previously referred to.

In defining Asia for the purposes of this paper I have generally taken the countries within the regions served by the United Nations Economic Commission for Asia and the Pacific. Recent political changes will doubtless render many of the statements made about Cambodia and South Vietnam inaccurate but it has been impossible to obtain any relevant information to quality the statements made.

2. OUTLINE OF PREVAILING SYSTEMS

Most countries of the region have, with respect to their legislation (as distinct from their own customary and traditional laws) been profoundly influenced by European models. Thus, the English common law doctrine of riparian rights was carried to most countries in which England had a colonial interest. Similarly, legislation which has qualified the common law in the interests of better water management tends to follow the English mould in countries such as Bangladesh, Burma, India, Pakistan, Singapore, Malaysia, Australia, New Zealand, and Fiji. On the other hand, the French legislative system provided the basis for legislation and administration in Cambodia, Laos, and Vietnam, and profoundly influenced the form of the Thai codes. Again, German legislation has had a profound effect on water administration in Japan and Korea; Dutch law was important to Sri Lanka and Indonesia; and the Philippines are still subject to the so-called Spanish Law of Waters. Sometimes, as in India, Pakistan, Australia and New Zealand, the legislation passed in the late eighteenth or nineteenth centuries has survived and is still relied on as the basis

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of the present administrative system. In other countries, however, the actual implementation of legislation, the extension of administration and the construction of irrigation and drainage works did not always proceed as rapidly. Consequently, when such countries achieved political independence the existing legislation based on English or European models was often more of theoretical than practical importance.

This fact must be born in mind when assessing comparative papers of this kind. In describing the legislation that exists and formulating theories of administration on the basis of such legislation, one is often far from reality. In much of Asia, legislation exists but lies unused in practice. Often this reflects the fact that it is unsuited to the particular social and economic needs of that society. Even in countries which still use earlier legislation as a basis for present management activities, it is often found that modern administrative and technological needs do not fit happily into the old legal framework. In most countries of the region then, which share a colonial heritage, the renovation of existing water legislation and its adaption to the practical present and future needs of each country are uniformally important.

3. POLICIES OF THE LAW

It is difficult to delineate the policies of the law in relation to one country, let alone in relation to a group of countries each of which has different social and cultural roots and has been differently influenced by its colonial experiences. Insofar as any policies are common to the region, there has been a general tendency to ensure that any right to use water in significant quantities or for significant purposes is either dependent upon an administrative grant or subject to qualification by administrative action.

As a corollary to this, there is a general policy of limiting the rights of action between individual users of water and of relying on systems of administrative apportionment of resources rather than judicial apportionment.

Thus, the tendency has been to qualify the rights to take water and the rights to bring actions against others enjoyed under the common law riparian doctrine. In devising legislative alternatives, there has been little enthusiasm for doctrines such as the American doctrine of prior appropriation, or for rights which require litigation for their verification.

4. CLASSIFICATION AND OWNERSHIP

The purpose of classifying waters, whether it be into navigable and nonnavigable waters; major or minor rivers; public or private waters is merely to define the different regimes to apply to those waters. Ultimately, the purpose of such classification is to establish who will have either the right to use such waters or to control and administer them.

In this sense, the concept of ownership is merely another means of classifying waters for the purpose of establishing who shall have dominion over them.

The most common distinction drawn throughout the area is between waters which may be privately owned and those which may not be privately owned. It is important at the outset to note that the conclusion that certain waters cannot be privately owned does not necessarily lead to the conclusion that they are owned by the public or the State.

4.1 Waters Which Cannot Be Privately Owned

Generally speaking, major rivers or lakes which flow through the lands of several owners cannot be privately owned. Private persons can only possess a right to use such water akin to the Roman usufruct. The ultimate right to allocate, to control, and to manage such waters generally lies in the State.

Much unnecessary conceptual debate has been devoted to the question whether the State must "own" such water in order to be able to exercise dominion over it. Some countries consider that public waters cannot be owned at all. They naturally belong to the "negative community" and can merely be used, not owned. Others consider them to be "public property" and therefore attribute ownership to the State.

Countries influenced by French law regard public waters as falling within the public domain. Elements of the public domain are dedicated to the service, use and protection of all persons and are inalienable and imprescriptible. Yet the exact nature of the State's interest in the public domain has been disputed. One view is that running waters are not owned and that the State must merely exercise guardianship and superintendence over the public domain and preserve it for posterity.[4]

Another view is that administrative agencies do have some sort of "property" in the public domain. "Ce n'est sans doute pas le régime de la propriété privée qui s'appliquera à ces biens, mais une 'propriété administrative' qui lui ressemble."[5] Thus in the Philippines, the State may own waters either as "public property," "patrimonial property" or "private property," depending upon the character in which it is acting. In countries influenced by the English common law, however, the traditional view is that water cannot be owned either by the State or by private persons. Mere ownership of riparian land, whether by the State or by a private person, does not imply ownership of the public waters flowing through it. The right to take water which accompanies the ownership of riparian land arises merely because the land of the riparian owner is in actual contact, vertically or laterally, with the flow of the river.[6] It has never been suggested that the riparian owner, whether it is the State or a private person, also owns the water. Such a suggestion would be "founded on a mistake between property in the water and the right to have its continual flow."[7]

In most parts of Australia, in Brunei, Burma, Hong Kong, New Zealand, Singapore, Samoa and India, the State does not own public water, even if it is the ultimate owner of all lands. Nevertheless, these countries have acknowledged that it is essential for the State to be able to control the use made of public waters. Thus two statutory devices have been adopted to confer effective administrative powers on the State.

(i) In Brunei, parts of Australia and New Zealand, a strip of land on either side of a river is declared to have remained the property of the State. This technically makes the State the riparian owner and no private person can obtain usufructory rights to such waters. The same result is achieved in Singapore by ministerial declaration.

(ii) In Burma, some Australian States and Samoa, legislation declares that "the right to the use, flow and control" of all waters not subject to private ownership vests in the State. This confers complete control on the State, but carefully avoids any declaration of ownership which would impinge on the basic theory that running water cannot be owned.

Some countries influenced by the English law have declared that the property in public waters belongs to the State. This is so in South Australia and Fiji. In legal theory, however, the only difference between such a declaration and that mentioned in paragraph (ii) above is that the State would have a common law action for larceny if it also owns water that is unlawfully abstracted.

Conclusion

The concept of "ownership" in the private law sense is generally inapplicable to public waters. Experience in the Asian region indicates that a declaration of State ownership of water is really only appropriate in a country where the legal tradition is accustomed to such declarations and there are clear principles which define the attributed and consequences of such ownership which must, themselves, be appropriate to water. Where this is not the case, a declaration of State ownership has to be accompanied by a special definition in the legislation to explain precisely what is meant by the phrase. From the practical point of view, it might be simpler and clearer to express the intended attributes to be conferred on the State in a self-sufficient form, without involving the external concept of ownership at all.

There are also important social factors which, in some countries, argue against expressions of State ownership. Thus, many countries have traditionally viewed the right to use certain waters as belonging to the overlying or underlying land owner. In some cases the water itself is said to be privately owned. One view is that, when the need arises to impose restrictions or controls on such users, to declare that water will thereafter become the property of the State may lead to unnecessary disputes. According to this view, it is better to avoid any statements about the ownership of water, either public or private. If the requisite

division of powers between the State and private persons can be achieved by other formulae.

4.2 Water Which May Be Privately Owned

There is remarkable similarity in the rules of private ownership of water. Generally, a landowner owns all the water which he collects and gains in pools, dams or artificial channels, wholly contained on his land, provided that the water does not supply or form part of a river system.

Again there is some dispute as to the theoretical basis of this interest. Private ownership of water is generally an adjunct to the ownership of land upon which or under which the water naturally occurs. However, the maxim dominus soli est dominus usque ad coelum usque ad inferos does not fully explain the interest of private owners. It does not allow for the fact that certain waters cannot be privately owned, even though they naturally flow through privately owned lands.

Private ownership is perhaps more accurately described in the following way. It adheres to those waters naturally occurring on lands owned in a private capacity. It is confined to water either collected naturally, or by the exertions of the landowner, within the limits of his land. It can only exist over water which no other person could, in the normal course of events, necessarily expect to reach his own land as an indentifiable body of water.

The practical reasons for permitting private ownership of such water can be simply expressed. The interest of the public in such water is slight, because it tends to remain within the lateral boundaries of the owner's land, or does not noticeably contribute to major rivers. The interest of the landowner in the quiet enjoyment of his land and its natural advantages is deemed, in this respect, to outweigh the advantages which the use of such water would confer on the public.

5. ACQUISITION AND ALLOCATION OF RIGHTS TO USE WATERS

5.1 Means of Acquiring Rights

Rights to use water may be acquired either by the direct effect of some law which confers rights without administrative intervention or may be acquired by the administrative recognition of preexisting use. Most often, particularly in relation to public waters, the right is dependent on some administrative action either for its validation or existence. Each of these categories must be examined.

5.1.1 Rights Directly Conferred on Consumers by the Mere Effect of the Law

(a) Privately owned water

The normal incidents of private law ownership apply to such water. It may be used freely, subject only to the rights of third parties and general legal duties in relation to one's neighbours. Such water may be acquired, sold, transferred or inherited in the same way as other private property. Sometimes, as in Hong Kong and Singapore, however, administrative approval may be necessary to use even such water for certain purposes.

(b) Rights in public water

In most countries there are certain limited rights to use public waters without intervening administrative permission. Under English common law there is a "riparian right" to take water from public rivers. This is a right to receive the flow of a river in its natural state, coupled with the right to make "reasonable use" of the water. It may only be enjoyed by those who own land in contact with the actual flow of the river. In many countries, however, this riparian right has been qualified in some of its incidents in order to ensure that major uses of water are subject to administrative sanction and also that water can be distributed widely. Other countries also recognize wider public rights. In many countries the public may take water for domestic and stock purposes from any river to which the public has a right of access. In Fiji, for example, an easement is preserved along the banks of all major rivers to enable the public to pass and repass, to take water for domestic and stock purposes, to fish and to do acts incidental to navigation.

(c) Easements

Easements or servitudes may either be granted or purchased from private landowners, or directly conferred by law. They may exist for such purposes as:

(i) Drainage. There is often a right to discharge drainage waters across the lands of another. In Australia, Cambodia, Laos, New Zealand, Thailand, Vietnam the right may be conferred by private treaty. There is also a statutory power to take such an easement, subject to compensation of the servient owner. In Iran and the Philippines, apparently there is no right to compensation.

(ii) To let natural waters flow. This right is not strictly an easement but rather a natural right of all landowners. Water percolating over land in undefined channels may either be used by the owner himself or allowed to flow naturally onto the lands of others. If the channel is defined, or the water is not capable of private ownership, other rules generally apply.

(iii) To bring water to land. In Australia, Cambodia, Laos, New Zealand, the Philippines and Vietnam, a landowner may acquire the right to conduct water to his land over intervening holdings. This right may be created by private agreement or conferred by statute. Compensation is payable.

(iv) To take private waters. A community right to quench thirst from private waters in case of need exists in Afghanistan. It may only be exercised if there is surplus water. In most common law countries, an easement to take privately owned water may be created by deed. This is a real interest in land and may survive for the benefit of the dominant tenement.

5.1.2 Rights Obtained Through Earlier Use of Waters

The so-called "prior appropriation" doctrine developed in the western states of the United States of America is unknown in the Asian region. Although a superior right to take water may be accorded to certain users on the grounds that they have put the water to use before others, the "prior appropriation" doctrine as it is commonly understood does not apply.

In certain circumstances, preference is accorded to earlier uses by administrative recognition of their prior claims. This may happen in two situations.

(i) Retrospective recognition. Most of the countries in the area have introduced radically new systems of water administration within the last one hundred years. In so doing, they have often provided machinery for recognising and confirming vested rights conferred by the earlier law.

Although this is the case in Taiwan, Japan, Australia, and probably other common law countries, the concept is most clearly expressed in the Philippines. Rights acquired under legislation which preexisted the Irrigation Law 1912 are confirmed and cannot be defeated by subsequent appropriators. All rights granted under the new legislation are subject to these earlier interests. Where persons were in fact using water at the time of the Law, but had not perfected their right under the old legislation, special provision is made for them to register their claims. Such persons may then be granted priority from the date of appropriation.

(ii) Prospective recognition. In Taiwan, Japan and the Philippines, all administrative concessions are accorded priority by the date of application. Between private persons, then, the right to use water in times of shortage will depend on the date of the original application. In this sense, future rights are subject to a rule of prior appropriation, although the doctrine would be better called the doctrine of "prior administrative recognition." In other countries, an administrative concession apparently does not confer personal rights on the grantee against subsequent grantees. In times of shortage it is more usual to apply general restrictions in all users. This ensures that all consumers will enjoy some water and that the loss is evenly distributed.

5.1.3 Rights Recognised or Conferred by Administrative Action

Administrative grants or permits to use water for purposes such as irrigation can be classified according to the apparent role of the administrative authority in the transaction. One group of countries seems to view public water as "community property" belonging, in a sense, to all subjects. Here the State acts as a registrar of personal claims to water.

The rights acknowledged are primarily rights between individuals themselves, rather than rights against the State or administrative authority. In a second group of countries, the State appears to act more in the capacity of an overlord or grantor of rights. Such rights create a "grantor-grantee" relationship between the State and the individual consumer, but do not create rights between the consumers themselves. Here the State itself will adjust the competing rights of consumers in times of shortage.

(a) Where the State acts as Registrar

In Taiwan, a water right is not valid until it has been registered with the Provincial Water Conservancy Board. Licences are then issued by the board, but failure to possess a licence does not destroy the right. The fact of registration validates the claim. Priority over other claims is determined from the date of the application for registration.

Rights are for between five and twenty years, but are, in effect, permanent. They may be extended for as long as beneficial use can be shown.

In Japan, either central, local or municipal authorities may issue water rights, depending on the classification of the river. Authorities may impose conditions of use on the applicant, but they must not impose unreasonable duties. All rights, when acknowledged, are subject to any prior water or fishery rights. Such rights are normally granted for ten years and are reappraised at the end of that time. Usually they are renewed.

In the Philippines, all claims to water existing before the present legislation are acknowledged and provision made for their registration. New applications to take water can only be granted if there is still unappropriated water in the source from which the applicant wishes to draw. Priority dates from the filing of an application, and all permits are issued subject to existing rights. The right is issued centrally, but is also registered locally.

In each of these countries, the consumer is specifically granted rights enforceable against later applicants. To this extent, the administration may be regarded as the third party to the transaction, although it does retain the power to cancel rights for nonuse, disobedience of statutory regulations, or for certain public purposes.

(b) Where the State acts as a Grantor

In Australia, Brunei, Burma, India and New Zealand, an administrative order is necessary to bring a particular area under the control of the administration. Once an area is declared, water may only be taken with the permission of the particular authority placed in charge of that area. Generally, there is an express statutory provision that the authority is under no obligation to supply water to any consumer, and if it does so, it may impose such conditions and make such bylaws as it deems necessary. Usually there is an express provision that the authority shall not be liable for any failure to supply water under a contract if prevented by drought, or unusual circumstances.

The rights granted to consumers under such a system may be classified more as a contract between the administration and the individual consumer. The administration may cancel rights for nonuse, disobedience, nonpayment of rates and charges, wastage, improper use, and may resume rights for public purposes. It may determine the amount of water to be supplied to each consumer in times of shortage, and the uses to which it may be put. There are thus no rights existing between the consumers themselves.

Within this framework, there may be several types of concessions granted. In many countries, all lands in an irrigation district are assessed to determine the benefit they might obtain from the works in the area. On the basis of this assessment, water rates are levied and a right to take a certain amount of water assigned. The prospective consumer does not have to apply for such an assignment. It is allotted to him automatically. Sometimes additional rights may be allotted on application, or, alternatively, the authority may agree to sell additional amounts of water to a particular consumer at a certain time.

In some countries water rights are granted on the application of a consumer who also intends to undertake approved supply or hydraulic works.

Such general principles apply both in common law countries and in countries influenced by the doctrine of the public domain. In public domain states, public water can only be enjoyed by virtue of an administrative grant. Such grants are always subject to the rights of third parties and revocable in the public interest. In Thailand, a private irrigator who is granted a right to construct channels and take water may be required to distribute water to neighbouring lands as a condition of his right.

5.2 Means of Allocation and Control

5.2.1 Metropolitan and urban supply

The rules for supply from urban authorities are similar throughout the region. If premises are already connected to mains, the authority will usually commence to supply water once the prospective consumer has completed a standard application form and paid the necessary charges.

If the applicant wishes to connect new premises to the mains, the authority will require technical specifications to be observed and will supervise the necessary connections.

Usually water for domestic purposes will be supplied from year to year on the terms and rates laid down by the authority. If water is used industrally, permission will be subject to further rules as to mode of use and drainage.

5.2.2 Agricultural, irrigation and other supply

In rural areas, applicants generally wish to abstract or divert water from a public river or canal. The procedure for obtaining permits

is basically the same in Burma, Cambodia, Fiji, Papua New Guinea, Taiwan, Japan, Laos, the Philippines, Thailand and Vietnam. With certain qualifications, the same procedure applies in Australia. It includes the following elements:

(a) An application

In Taiwan applications are made to a central authority, but in Burma, Cambodia, Laos and Vietnam they are locally handled. Both central and provincial authorities may grant permits in Australia, Japan, Korea and Thailand, depending on the river in question or the quantity of water sought.

Typically, the application must state:
the nature of the projected use;
the land or premises to be supplied;
the source from which water is to be taken and the proposed point of diversion;
the detailed nature of any existing or projected diversion works;
the volume of water to be diverted.

In Cambodia, Laos and Vietnam, the proposed duration of the diversion is also required.

(b) An inspection

On receipt of an application, the responsible authority will assess the proposal. It may require further plans or inspect the proposed site of diversion. In many countries, specific powers are conferred on officers to enter any lands to take levels and measurements relating to proposed schemes. To obstruct or interfere with such operations is a punishable offence. After inspection, the officer must report to the granting authority.

(c) A public announcement

Before matters can proceed further, the applicant must publish his intention to request a permit. The exact point of time when this notice must be given varies from country to country, as does the mode of publication. Usually it is published in the official Government Gazette and newspapers circulating in the area. Copies of the application and plans are available for inspection at the local public offices. The object of this requirement is to ensure that all persons whose interests may be prejudiced are advised of the application.

(d) Filing of objections

After the required period of publication has elapsed, all persons who are likely to be affected by the grant may place objections before the authority. Between four and eight weeks are generally allowed for the filing of objections.

(e) Consideration by granting authority

The completed dossier, including, perhaps, administrative recommendations for alterations to the proposal, are put before the granting authority. It must consider the application together with objections and recommendations and decide whether it should be granted. The permit may be granted in the same terms as the application, or subject to qualifications. Usually it will impose conditions as to the type of use, works which may be built, periods when water may be taken and fees and charges payable.

In the state of Victoria, Australia, similar steps are taken but they arise in a different context. The landowners or municipal councils within a particular area may apply to have the area constituted an irrigation or waterworks district. The application must be accompanied by plans showing the proposed works and the lands which would benefit from the scheme. If the application is granted, a district is formed and all owners in the area are liable to contribute by rates and charges to the improvement works. Individual owners within the area are then allotted shares of water on the basis of an administrative assessment of the capacity of their land to benefit from water supplied. They are not required to make individual applications unless they require additional water.

Similar procedures exist in Fiji for the constitution of Drainage Areas, though not for Irrigation Areas.

5.2.3 Concessions for hydraulic energy

In Cambodia, Laos and Vietnam, procedures for granting permits for hydroelectric purposes appear to be similar to those just discussed, although it is uncertain how many such permits have been issued in practice. In Taiwan, New Zealand, the Philippines, Papua New Guinea and Thailand, a national authority exists which is responsible for the actual construction of and distribution of energy from such schemes. In most countries, private concessions may exist for such purposes, but the way in which they are granted differs from country to country.

5.2.4 Forfeiture or suspension of rights

Rights may be affected for the following reasons.

(a) Insufficient supply

The exercise of rights may be suspended in times of shortage. In countries such as Taiwan, Japan and the Philippines, priority is accorded from the date of appropriation. In other countries it is usual to discriminate between various uses in creating priorities. Domestic supply is invariably of first priority.

(b) Breach of condition of concession

Failure to observe any condition of a permit, including failure to pay rates and charges, may invalidate rights in Australia, Brunei,

Cambodia, India, Taiwan, Hong Kong, Laos, New Zealand, Singapore and Western Samoa.

(c) Breach of the general law

Disobedience to the general requirements of water legislation may invalidate permits in Australia, Brunei and Japan.

(d) Failure to use water beneficially

Nonuse will invalidate permits in Taiwan and the Philippines. Failure to construct works within the requisite period will result in cancellation in the Philippines.

(e) Reclaimed for public purposes

Water rights may be either cancelled or reacquired in the public interest. This is so in Australia, Cambodia, Taiwan, Hong Kong, Laos and Vietnam. Sometimes the grantee will be entitled to compensation for any technical works or improvements undertaken.

6. PREFERENCES BETWEEN USES

When the supply of water is insufficient to meet all demands it may be necessary to restrict certain consumers in favour of other more privileged consumers. A similar problem of establishing preferences exists when large-scale river basin development is contemplated and it is necessary to decide what rights should be cancelled in the public interest, or who should be permitted to take water from the completed scheme.

6.1 Preferences Between Consumers

It has already been stated that in Taiwan, Japan and the Philippines, each consumer obtains priority over all subsequent appropriators from the date of his application. Such rights are enforceable as between the consumers themselves. Such a simple system, however, does not take account of the different uses to which water may be put. In the public interest it may sometimes be necessary to qualify the right of, say, a prior industrial consumer in favour of a later domestic use.

6.2 Preferred Uses

Only two countries appear to have a definite order of priorities established by legislation.

In the Philippines, the order of preferences is domestic purposes; agricultural purposes or power development for agricultural purposes; industrial purposes; ponds for fisheries; mining purposes. This order

is relevant only when it is impossible to establish priority by time of appropriation.

In Taiwan, the Water Law lists domestic purposes as having the highest priority, followed by irrigation, then hydro-power and industrial purposes. The application of these priorities is of greater importance than in the Philippines. Although Taiwan also recognizes a system of priority of appropriation, these priorities are only relevant between consumers if the uses are identical. The procedure in case of dispute is to look first at the respective uses. Only if the disputants rank equally as to use is the time of appropriation relevant.

It is significant that the most elaborate legislative statements on priorities occur in countries where the State acts merely as a registrar of individual claims. A necessary consequence of a system which recognizes that individual consumers possess rights against one another is that those rights must be closely defined by law. The problems of interpretation which occur in Taiwan are inevitable and can only be aggravated by the fact that the priorities established are not absolute, but may be altered by the responsible authority whenever it deems necessary.

In countries where the State acts more in the capacity of grantor, legislative statements on priorities of use are rare. Usually the administration reserves an unstated right to create its own priorities when deciding on water-use applications. Again, as the only rights created are between the administration and the individual consumer, who is only entitled to a supply on the terms stated from time to time by the administration, it is easy to regulate priorities in times of shortage.

In Australia, Brunei, Cambodia, Hong Kong, Laos, New Zealand, Japan, Singapore, Vietnam and Western Samoa priorities are regulated in this ad hoc manner, by ministerial or departmental consultation. Priorities and policies for development are similarly established. As a matter of practice, first preference seems to be given in all these countries to domestic consumption.

7. REGULATION OF GROUNDWATER

Most systems assert that the overlying land owner has a right to intercept and use any groundwater percolating or flowing through his land. In many countries, it is stated that such water is owned by the overlying owner, although distinctions are drawn sometimes between percolating waters and defined underground streams.

Despite the proprietary interests enjoyed in such waters, most countries have legislated to qualify the way in which such water may be used by the overlying owner. From the hydrological point of view, it is essential to control those who engage in drilling for water, and to ensure that they are properly qualified. To prevent possible damage to aquifers and to reduce the dangers of overpumping, most countries also have moved to regulate methods of bore construction and to control the rate and volume of extraction as well as the purpose for which water is used.

Quite often, as in Burma, New Zealand and most of Australia, special areas may be established by ministerial declaration. Regulations or by-laws may prescribe the depth of wells, their mode of construction and the amount of water which may be taken. The relevant authority may issue licences to pump such water and impose necessary conditions on such licences. Applications for licences, or to alter wells, are subject to similar rules as applications for surface concessions.

A variation on this system occurs in the Philippines. There, private consumers may obtain permits from local municipal councils and their operations were supervised by the local district engineer. Exploration licences may be granted to prospect for water on public lands. A permit is necessary to extract water so found, but it becomes the absolute property of the finder.

In Japan, unique provisions exist to counter problems of subsidence which have occurred through large-scale industrial extraction and to prevent harmful effects from polluted sources which are unsuitable for industrial or domestic use. The law provides that a Cabinet Order may designate special areas, and any person then wishing to extract water for industrial or domestic use must apply for a Ministerial permit. When the Minister fears the depletion of underground resources, he may restrict the extraction of such water. It is understood that the controls potentially permitted by legislation have not in fact been introduced in the Tokyo Basin. One of the reasons for this is that consumers have recognized the need mutually to limit their pumping and have reached consensual arrangements about extraction which have effectively reduced the dangers of overpumping.

In most countries of the region, controls over groundwater have only been introduced in recent years. This seems to be due to the fact that, until comparatively recently, the behaviour of groundwater as a matter of some speculation and most societies were hesitant to make laws regarding it. The result is, however, that groundwater is treated separately from surface water and often is separately administered. Theorists point out that it is hydrologically unsound to view groundwater as separate from surface water and that both systems should be regulated and administered as a whole.

8. REGULATION OF CERTAIN HARMFUL EFFECTS OF WATER

This section embraces such matters as flood control, overflow protection, drainage, erosion control, siltation, salination and reclamation of land. In most countries, only very broad, general legislation exists on these matters. This reflects, in part, the fact that many countries of the region are arid or semi-arid, and the traditional concern has been to arrange for getting water on to the land, rather than getting water away from the land. Again, it is only in comparatively recent years that the cumulative effects of rising water tables and salinity have become obvious. Thus, many countries lack specific drainage legislation. In Fiji, for example Drainage District and communal works have only received legislative sanction in the last three years. Similarly, the State of

Victoria in Australia is currently debating a Drainage Code. If passed, it will be the first such legislation in Australia.

On the other hand, there are countries in the region where the primary thrust of the major legislation relating to water is flood control and river protection. Thus the Japanese River Law of 1964, which is the legislation under which the primary division of administrative functions in relation to rivers is established, emphasises flooding, river management and improvement. The first article declares:

> "the purposes of this Law are to contribute to the land conservation and development of the country and thereby to maintain public security and promote public welfare, by administering rivers comprehensively to prevent occurrence of damage due to floods, high tides, etc., to utilise rivers properly and to maintain the normal functions of the river water."

The emphasis and particularity of legislation on these matters thus varies greatly from country to country. In most countries, only broad general legislation exists. In four or five countries, the provisions are more elaborate, but they may be divided into countries which vest control over such matters in the hands of bodies which are generally responsible for other aspects of river and water management under a national plan, and those countries which establish diverse authorities for diverse functions.

8.1 Countries Where Only General Legislation Exists

Control of all water is vested in one authority or government department in Brunei, Cambodia, Hong Kong, Laos, Vietnam and Western Samoa. In these countries, control over various harmful effects of water is vested in the same authority or department, either by express reference or by necessary implication. It will be noticed that each of these countries adheres to a system where the State is generally regarded as a grantor of water rights, and it is logical that it should impose restrictions and control uses which may be detrimental in effect.

In the Philippines, Singapore and Thailand, there are some legislative provisions concerning the harmful effects of water, but they are mostly of a general nature. Control is conferred on the same central or local authorities who administer water for other purposes. In Burma, there is considerable legislation relating to overflow protection and drainage. These powers exist in the central or local government authorities which, by implication, also have control over flood protection and explicitly may control siltation and erosion.

8.2 Countries Where Control is Exercised by Authorities Generally Responsible for Water Resources

In Taiwan and Japan, all harmful effects are regarded as part of the overall problem of river management. As proper control of such matters as

flooding, erosion and siltation cannot be exercised in one locality on a river without regard to the effects on another locality, it is sensible that planning should be carried out in a co-ordinated fashioh, on a national basis.

Thus in Taiwan, all aspects of river management are planned by the Provincial Water Conservancy Board. Its policies and directions may be carried out either by the Board itself, by a particular country, or municipal government. Local control, according to central directives, is exercised over the obstruction of rivers, the use of adjacent lands, and the taking of material from river beds and flats. Emergency flood measures are to be taken by the responsible country or municipality under the supervision of the Board.

Drainage is generally under the direct control of the local responsible authority, which may make regulations for the purpose. River management schemes are financed from government subsidies, the sale of reclaimed lands and flood control charges levied on landowners.

In Japan there is elaborate legislation which requires the formulation of an over-all plan for river management and improvement throughout the nation. On the basis of this plan, aimed at reducing the catastrophic effects of post-war flooding, rivers have been classified and variously assigned to State or prefecture control. Whichever body is responsible for the administration of a river must adhere to the master plan and ministerial directives. While plans primarily relate to flood control, they also govern erosion, overflow protection and other harmful effects. The master plan is to be implemented in a series of five-year plans. Expenses are met partly by the State and partly by the province benefiting from the work. The exact formula varies with the type of work undertaken.

The final result is that permission must be sought from the responsible authority before undertaking any action which could conceivably have harmful effects. Siltation, salination, drainage and erosion are all controlled by the one authority.

Drainage in municipal areas is controlled by the local city authorities, and certain other munistries have powers to prevent erosion of forests and sand deposits.

8.3 Countries Where Harmful Effects Are Controlled by Diverse Authorities

In some countries, power to control various harmful effects are conferred on different authorities at both the national and regional level. A good example may be found in Australia, where the policy is often to set up local committees or trusts, recognised by statute, to implement various functions, as well as allowing several central authorities to carry out work. For example, districts may variously be declared as flood protection districts, levee bank areas, drainage districts, sewerage districts, river improvements districts or soil conservation districts. In each case,

different authorities have different administrative powers, and it is conceivable that more than one authority will have responsibility in the same area.

Difficulties can arise in such a system of administration. In some areas, several river improvement trusts have powers at different points on the same river, and this can lead to conflicting policies and administration.

Works are generally maintained by the levying of special rates and improvement charges on the landowners in a particular district. Moneys from the sale of reclaimed land are also sometimes available for river improvement.

9. WATER QUALITY AND POLLUTION CONTROL

9.1 Waste and Misuse

The remedies against wasteful use of water are usually enforced by official authorities, rather than by private individuals. This was not always the case. Under the old common law riparian doctrine, a riparian owner could obtain an injunction against the unreasonable use of water by a higher landowner. It was not necessary for the plaintiff to prove damage to his own rights in order to succeed. With the exception of New Zealand, however, this right has been extensively restricted by legislation in the Asian region.

The riparian's private right to prevent waste stood in marked contrast to the situation at common law concerning groundwater. It had been held that the overlying owner could extract groundwater and let it run to waste, without any regard to the possible effects on persons whose supply he interrupted. Decisions in common law courts in recent years have qualified this right, and require that the use be reasonable if liability is to be avoided.

In those countries where personal rights of priority are granted to consumers, presumably an action can be maintained privately to prevent the misuse of water by later appropriators in times of shortage. In Afghanistan and Iran, customary law also confers personal rights to restrain unreasonable uses.

Apart from these instances, however, most controls on waste and misuse are exercised by the administration through the effective threat of possible cancellation of supply.

9.1.1 Control by terms of permits

In all countries which require an administrative permit to use public waters, the granting authority has power to impose terms and conditions on the consumer. In Cambodia, Laos and Vietnam, there are elaborate

conditions governing waste and misuse. In many other countries an authority may either include such conditions in the licence, or alternatively, make bylaws or regulations of general application which must be observed by all consumers.

9.1.2 Statutory powers

In Australia, Burma, Hong Kong, the Philippines, Singapore, Fiji, Taiwan, Thailand and Western Samoa, special statutory powers are granted to the authorities responsible for supply. In metropolitan or urban districts these powers often are:

to regulate the installation of pipes and apparatus to prevent wastage;
to enter premises to inspect installations and require them to be repaired;
to carry out necessary repairs and recover the cost from the consumer;
to prevent the use of water by unauthorized persons or for unauthorised purposes;
to cut off supply to any consumer who wastes or misuses water, and sometimes to recover the cost of any water wasted.

In other areas, the responsible authority generally has power to prevent any person who is diminishing the flow of any river, interfering with works, or using unauthorised structures. Failure to comply with notice to desist is generally punishable, and will entitle the authority to abate the nuisance and to recover any cost involved from the offender.

Recent legislation concerning groundwater also concentrates on the dangers of waste and misuse. In many instances, one of the reasons for requiring drillers to be licenced is to ensure that the work will be carried out in such a way as does not lead to unnecessary waste.

9.1.3 Statutory penalties

Commonly disobedience to the conditions of any licence, regulation or bylaws established by an authority, or of any direction given by an authority, will result in a penalty being imposed. Sometimes, as in Australia, Burma, Hong Kong and the Philippines, a statute will specifically prohibit the waste or misuse of water and impose a substantial penalty. Often there is provision for a continuing penalty for every day the offence continues.

9.2 Pollution

In many countries of the region, control over pollution is of much the same character as control over wastage or misuse. Provisions may be written in to permits or in to supply contracts; local authorities may make bylaws and exercise specific statutory powers; or penalties may be provided by statute for the doing of specific acts.

In recent years, more stringent legislation concerning water quality has become common, particularly in industrialized areas. In such legislation there has been a marked tendency not to rely on the older forms of statutory prohibitions accompanied by penalties. It is recognised that, to exercise effective controls and to ensure that the accumulative impact of wastes on river systems does not exceed safe levels, it is necessary to establish particular standards and often to licence particular outfalls.

In a number of countries, new agencies have been created for the purpose of establishing such standards, policing them, and licencing polluters. Until a few years ago, many countries experienced an unhappy division of functions between agencies responsible for public health and those responsible for water when fixing standards of water quality and policing those standards. In some instances, the new "watch-dog" agencies have helped to rationalise these divisions of functions. In others, it appears that the main effect has been to complicate the picture further.

One of the more difficult legislative problems is to formulate a satisfactory statutory definition of pollution. In Western Samoa, a pollutant is defined as

> "any substance that can contaminate water so as to change the physical or chemical condition thereof in such a manner so as to make the water unclean, noxious, offence or impure, or as to be detrimental to the health, safety or welfare of persons using the water."

A definition from one Australian state is:

> "pollution means any direct or indirect alteration of the physical, thermal, chemical, biological or radio-active properties of the environment by discharging, emitting or depositing wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, birds or wildlife, fish or aquatic life, or to plants or to cause a contravention of any condition, limitation, or restriction to which a licence under this Act is subject."

The common difficulty in most definitions is to accommodate the fact that pollution is a relative concept. An act which may be harmful on a river serving domestic consumers may not be noticeably harmful if other factories are the other consumers. Again, absolute standards of pollution may be unnecessarily repressive to industrial development, if they are rigorously enforced. It may be that administrative authorities can be trusted to use a wide discretion in launching prosecutions, but the modern concept of regional planning can help to establish pollution-free zones while permitting extensive industrial waste in others.

This thinking is reflected in the legislation of Japan and New Zealand. Japanese law declares that the objects of pollution control should be the "mutual harmony of industries" and "the improvement of public Health." Industrial development must not be weighed against other

water uses and should not be hindered by too strict a control of pollution. To implement this policy, the Economic Planning Agency may designate certain areas and fix standards of water quality in each area. Persons wishing to discharge industrial waste may only do so with the consent of the competent Minister, whose task it is to see that the discharge complies with the prescribed standard for that area. In addition to these provisions, the authority responsible for a river in a nondesignated area is competent to control pollution.

In New Zealand, a central advisory council exists to carry out research and provide technical information on pollution. It may create regulations establishing purity standards and prohibit certain acts. As the actual policing of pollution is often done by municipal authorities, it may suggest suitable bylaws to be adopted by the local authority concerned.

10. IMPACT OF LAW ON THE ENVIRONMENT

In a general paper such as this, it is difficult to describe the particular effects of specific laws on the environment, or to criticize or evaluate such effects as being either desirable or undesirable. The latter is impossible because the question whether particular environmental consequences are thought to be acceptable or unacceptable depends on a complex of economic, political and social criteria as well as on the actual effects of a particular proposal on the environment.

There is, however, considerable concern and interest within the region in experimenting with techniques for multi-objective planning, in so far as these can be accommodated in the existing planning structures of the region. It is interesting to note that, at the very time of this conference, ESCAP is conducting a regional seminar related to techniques of multi-objective planning for water resources in Bangkok.

While such interest exists, the author knows of no legislation within the area which compels comprehensive multi-objective planning or lays down procedural and substantive requirements for such planning along the lines, say, of the US Water Resources Council's Principles and Standards for planning water and related land resources. Certainly, some countries of the region are experimenting with such planning procedures, and the Australian Water Resources Council is currently funding a project to evaluate the US Principles and Standards as applied to Australian conditions.

Such principles generally call for the separate but equal evaluation of the economic consequences of particular proposals, the environmental consequences and the social consequences. One of the techniques for evaluating the environmental consequences of a particular proposal is that of the Environmental Impact Statement. A limited number of countries in the area has moved to pass legislation governing the preparation of such studies. Yet, in evaluating the adequacy of such legislation and whether or not it should be extended to other countries in the region, it is necessary to bear in mind certain fundamental propositions. Ultimately, the decision whether environmental, economic, political or social

consequences of particular projects are to be predominant is a political decision to be made within the context of a particular society. In many developing countries, the urgent commitment to economic development is likely to outweight the possible environmental effects of particular proposals, at least in the short term.

This is particularly so as the cost of developing, administering and applying environmental evaluation techniques to planning is considerable. It also necessarily extends the planning process considerably. One OECD estimate in relation to water resources management was that the planning process could be extended up to five times. Similarly, many developing countries face an extreme shortage of trained personnel, particularly in the areas of sociology and environmental evaluation, techniques for which are still imperfect even in the most developed societies.

Thus, if a developing country were to do a hard-headed benefit cost study of environmental procedures such as those developed under the United States National Environmental Policy Act 1969, the resulting ratio is likely to be most unfavourable. For most developing countries, strong administrative control over water management is essential, and unnecessary resort to litigation is regarded as wasteful of resources. In looking at the American experience, then, most countries would wish to avoid the attenuated litigation which has accompanied the implementation of that legislation. In particular, they would wish to remove the following issues from the field of litigation:

What projects require the preparation of environmental assessments?
Who is responsible for establishing the terms of reference of such studies?
Who should be responsible for carrying out such studies?
Who shall determine whether either the thrms of reference or the work is adequate?
What agencies will be responsible for reviewing and commenting upon the work?
When should public hearings be held or public comment invited?
How should the findings be integrated into the decision making process?

In the United States, all these issues have been subjected to considerable litigation. One technique for removing such issues from the courts (whose responses have not always been framed with an eye to the administrative and budgetary difficulties involved) is to leave such questions to be determined by the responsible government agency or the responsible Minister. The obvious difficulty with such a solution is that it permits political factors unduly to influence the resolution of such questions. This difficulty has already been experienced in Australia.

It is important for advocates of environmental and comprehensive planning to recognise the considerable costs involved in such exercises and to be restrained in their advocacy of such procedures when applied to developing countries.

11. LEGAL CONSTRAINTS TO RATIONAL WATER MANAGEMENT

Most countries have instances of overlapping administrative responsibilities and problems of coordination which work against rational planning. These are, however, not really legal restraints on water management. It is difficult to isolate particular legal restraints which are common to the area as a whole, although an indication can be given of the type of legal difficulties which detract from proper management. Surprisingly, these restraints usually arise under laws which do not specifically relate to water, but which are of more general application.

11.1 Constitutional Difficulties

Entrenched constitutional powers and rights sometimes stand directly in the path of modern planners, presenting obstacles which cannot be brushed aside by inventive judicial interpretation. One well known case in the United States occurs in Texas which, by long standing judicial tradition, holds to the rule that a landowner is the absolute owner of all percolating water beneath his land. This has created grave difficulties where controls over the over use of groundwater have been required. The United States' Fourteenth Amendment to the Constitution forbids the deprivation of private property without due process of law. Subsequent judicial interpretation indicates that if Texas passed an Act directly vesting underground waters in the State, or imposing compulsory limitations on the right of individuals to use their own property, this would be unconstitutional. It would, however, be economically and administratively impossible for the State to purchase the water from each landowner. The only way out was to devise legislation providing for protection districts which had to be formed voluntarily and at the instance of the landowners within a district. Such laws lack compulsion and therefore lack teeth.

Certain similar examples exist within the Asian region. Part III of the Indian Constitution posits certain "fundamental rights" of the subject including the right of property. Article 13 forbids the making of laws which abridge these rights. Within a year of its adoption, doubts arose as to the power of the States to acquire lands compulsorily in order to undertake agrarian reforms. Article 31A was therefore inserted into the Constitution, and the States acted on the faith of decisions that the Amendment validly empowered them to acquire, extinguish or modify rights in land.

In 1967, the Supreme Court had to face the argument that the fundamental rights contained in the Constitution were entrenched and could not be amended. The only way the Court could see to retain the reforms that had been introduced and to allow them to continue was to adopt the confusing rule that existing Amendments abridging fundamental rights would continue to have full force and effect; but future Amendments invading fundamental rights would not be tolerated![8] The powers of acquisition, essential to agrarian or water development, were thus assured, but only by doing violence to accepted principles of interpretation.

Section 8 of the Constitution of Fiji similarly creates extreme difficulties for Government, not only by limiting the circumstances in which land may be compulsorily acquired, but by setting down elaborate procedural means for determining whether such acquisition is reasonable and what shall be paid by way of compensation. Since the new Constitution came into force, no public authority has attempted to compulsorily acquire land in Fiji, and there seems to be a great reluctance to face the inevitable problems which will arise in the future.

Other recent constitutions, however, have anticipated the need for powers of acquisition. The Constituion of Thailand, whilst guaranteeing the right of private property, permits expropriation by the State where it is necessary for the purposes of public utilities or for the exploitation of natural resources. The same section requires "just compensation" to be paid. Such a principle is laudable in modern political theory, but it must be pointed out that the interpretation of the phase "just compensation" can be the decisive element in determining whether a particular water project is economically feasible.

11.2 Customary Rights to Water and Land

In countries such as Fiji and Papua New Guinea, steps were early taken to protect native communities from possible exploitation by expatriate settlers. In Fiji, this took the form of a Commission to establish lands to which native communities asserted title. These lands were henceforth regarded as inalienably belonging to the native peoples, and any dealing in relation to the land must now be approved by a Native Lands Trust Board. Some 82% of the total area of the country falls into this category. Similarly in Papua New Guinea there are numerous sections preserving particular rights to native communities. Thus the Water Resources Ordinance declares that the section which generally vests the right to the use, flow and to the control of certain water in the Crown shall not affect customary rights to the use of water by natives.

Provisions such as these raise important points for future legislation. From the point of view of river management and bank protection, it is often necessary for the State to exercise dominion over the bed and banks of all watercourses and of areas adjacent to the banks. Some countries, with an eye to the difficulty of ascertaining the high water mark or the limits of a particular bank, have given the State power to declare the strip of land over which it will have controlling powers. Adjacent land owners may have access over such land, but are limited in the activities they may perform thereon.

It is extremely difficult to introduce such necessary controls where there are conflicting guarantees of native ownership. Similarly, it is possible that rights will be asserted as "customary" which cannot previously have existed. Thus, in a certain area in Papua New Guinea, highland communities are asserting the right to fish rivers to the exclusion of others, although prior to an artificial stocking programme by the Government, such waters never held fish.

Quite apart from the practical difficulties created for water managers, the continued preservation of customary rights raises important questions of the ramifications of nationhood, self-rule and independence. Where native customary rights are treated as an indentifiable sub-stratum to the law, but apart from it in the sense that the administrative system imposed is primarily intended to regulate uses other than those of native communities, difficulties can be foreseen. It is unlikely that this philosophy will fit in with an organic view of nationhood. If law is regarded as an emanation of the people's needs and desires then, theoretically at least, it represents the values chosen by all, including native communities. While there may be good social and political reasons for continuing to allow particular customs to survive, it is dangerous to remove them so completely from the possible impact of the law. Part of the integrating process of government is to render all people subject to the law. While pains must be taken to ensure that each administrative system is compatible with social views of property and communal rights, it is theoretically undesirable to view the customary rights of native communities as beyond the law.

11.3 Acquisition of Private Easements

A recurrent problem in certain countries of the region stems from old doctrines of the inviolability of private land. The common law riparian doctrine, which restricted the use of water to landowners abutting the watercourse, took its form largely because there was no way of more remote landowners obtaining access to the watercourse. In order to distribute water more beneficially and more widely, some countries have provided statutory means for remote landowners to obtain rights to lay supply or drainage channels across the land of intervening owners. This has been particularly important in countries where private irrigation development has been encouraged.

Numerous countries do not provide means of obtaining access over privately held lands, other than by private agreement. This will often not be enough. Statutory means should exist for applying to a court for an order to acquire compulsory access across another's land, subject to the payment of compensation.

PART II - ORGANISATIONAL AND ADMINISTRATIVE ASPECTS

1. INTRODUCTION

Countries in the Asian region present a wide variety of organisational and administrative systems. There are both federal countries and unitary systems of government. Some are used to long traditions of strong central government; others have been decentralised rural or village communities with little history of central management. Some are densely populated; others comparatively sparse. Certain countries have highly industrialised areas and may be primarily urban, others are mainly rural peasant communities.

In these circumstances, it is not possible to describe or comment in detail upon the administrative systems prevailing throughout the region. It is necessary again to generalise rather than to be descriptive of detail.

In view of this difficulty, it is probably most useful to describe in broad terms what seem generally to be the major functions of those bodies administering water in the region, and to set out the powers which invariably seem necessary to achieve those functions.

2. FUNCTIONS OF A WATER ADMINISTRATION

As the organisational structures for water management differ enormously throughout the area, "water administration: is used generically, but it must be borne in mind that in many countries, numerous agencies will share the responsibilities referred to.

A broad categorisation of the general functions of water management is:

(i) the maintenance of a water resource inventory;

(ii) the establishment of policies and plans for the development and protection of water resources and the co-ordination of various imputs to this end;

(iii) the execution of works for water development;

(iv) the allocation, administration and supervision of private rights to build structures or to use water.

2.1 Maintenance of Water Resource Inventory

Water, despite its transient character and annual variations in its availability, must be treated as a finite resource. Very often, the full implications of this nation are not appreciated until the proliferation of water users produces a situation of absolute or relative scarcity, which

may be measured either quantitatively or qualitatively. Rather than waiting until such problems reach critical dimensions, modern theories of planning require that administrative action should, if possible, be taken well in advance, to ensure that problems do not arise.

The establishment of proper techniques and networks for the gathering of hydrological data is the first essential function of a water administration. Even if the implementation of other administrative controls is not immediately feasible, a network to measure streamflows and other sources of available water must be established as soon as possible to ensure that, when the time comes to plan more closely, a representative spread of date is available.

In many countries of the region, selected data have been collected for quite long periods. Often, however, no steps have been taken to revise the systems in existence or to examine the usefulness and compatibility of existing data. It is not uncommon for hydrologists to discover that accumulated data in a particular country of the region are largely unusable for the particular development purposes they are interested in.

A second problem is that, in order to know the total water available in a given system, it is necessary to know the amount of water which is used and withdrawn from that system. A prerequisite to development planning is thus often knowledge of the occurrence and extent of existing uses. In many countries of the region, accurate data do not yet exist as to the scope of existing uses.

The following powers seem to be generally important to the establishment and maintenance of water resources inventory:

(i) power to survey the cross-section of streams and to install, operate and maintain gauges;

(ii) power to investigate and assess snow fields and other sources of water;

(iii) power to operate meteorological stations;

(iv) power to carry out trial drilling and inspections for groundwater;

(v) power to enter lands for any of the above purposes, for carrying out surveys and for examining uses of water on private land;

(vi) power to require records to be kept by private persons or public authorities as to naturally occurring water and as to the manner and quantity of their use;

(vii) power to require and control analysis of water quality by private persons or public authorities, or to carry out such monitoring activity;

(viii) power to obtain access to all such records or existing data and to require the submission of core samples and drilling records for inspection and analysis;

(ix) power to require the installation of meters or gauges for measuring water used or waste discharged and to levy charges for the provision, installation, maintenance and operation of the same;

(x) power to make regulations or issue directives prescribing the manner in which each of the above activities is to be carried out.

2.2 Establishing and Co-ordinating Policies and Plans for Water Development

2.2.1 Formulating Policies for Water Development

There is often much discussion as to the need to formulate "a national policy" for water development. It is sometimes difficult to isolate what such a policy should be, or how it should be formulated, and it is probably best for present purposes to view a national water plan or policy not as an abstract document or framework from which the structure of administration flows, but, rather, as the total administrative and decision-making system which grows out of the need to deal with specific water management problems. In purely practical terms, the important issue is whether the breakdown of administrative and decision-making responsibilities within a particular country successfully resolves practical problems of planning which often beset the successful management of water in other countries.

Several specific functions are necessarily involved in formulating policies for water planning.

(i) Making decisions between alternative possible water development programmes in any one budgetary period.

Projections of future economic development, patterns of demand, and incidents of flooding are among the factors which would be interpreting the national goals which will influence the choice between development alternatives. It is at this level that such guidelines as the US Water Resources Council's Principles and Standards for evaluating water projects become important.

As mentioned earlier, the skills and techniques required for such planning have not traditionally been available to water management authorities, with the consequence that new techniques and standards must be developed for drawing up planning proposals, and different arms of government with particular concern for particular environmental or social ramifications of water development must contribute to the planning process.

(ii) Establishing long-term and short-term objectives for particular regions or areas. In most countries, it is only possible to introduce proper administrative controls gradually. Limitations of personnel, expertise and available finance mean not only that there must be selection between works to be undertaken, but also that the other controls of water use, such as registration or licensing, may need to be introduced selectively. One function of the water administration is, in the light of the

availability of resources, and the evaluation of the administrative necessity for water control in particular areas, to establish priorities for the execution of works and the progressive introduction of both short-term and long-term controls.

(iii) Formulating and reviewing specific plans for the construction of works and the diversion of waters.

Reviewing plans of both private and governmental bodies is relevant to the co-ordinating function of the water administration, to its planning role, and also to its task of administering rights to take water and build hydraulic structures.

Because of the universal importance of water, its use, management and control are significant to many aspects of government and it is usual to find that existing legislation confers different powers with respect to water on many different branches of government. Historically, this was often unimportant.

A Ministry of Agriculture, with responsibility for irrigation in rural areas could often happily co-exist with a Ministry of Construction, whose responsibility was to supply water in urban areas. Greater competition for water, and the consequent need for major storages to make demand and supply curves correspond, has emphasized the interdependence of these two different functions. Sometimes the existing division of administrative responsibilities is unable to accommodate the modern needs of co-ordinated planning.

This problem is apparent in most countries, but the Republic of Korea affords one convenient example. There, as in Japan, rivers are classified according to their public importance. The responsibility for administering rivers of premier importance belongs to the Central Government while the various Provincial Governments have the task of administering and controlling less important rivers, or the tributaries of main rivers. This division of responsibility obviously neglects the relationship between the water flowing in tributaries and water in the main stem of a river. Yet the situation is further complicated. Applications to develop and use water are in fact filed with the local municipal authorities. In certain cases, uses may be approved by the municipality without reference to either the Provincial or Central Governments and without lodging documents notifying the nature and extent of the use with either Government.

There is thus a triple division of responsibility. Even more significant, however, is the horizontal proliferation of agencies with powers directly bearing on water management. At the Central level, the Ministry of Construction has primary importance for waters controlled by the Central Government, but the activities of the Ministry of Agriculture and Forestries, the Ministry of Commerce and Industry and the Ministry of the Interior all overlap. Furthermore, each is subject to the control of the Planning Commission and, indirectly, the Ministry of Finance. The situation is rendered even more complex by the existence of numerous semi-independent special development authorities, each with planning and executive powers. Thus, there is the Korea Water Resources Development

Corporation, the Agricultural Development Corporation, the National Association of Agricultural Co-operatives and the Agriculture and Fisheries Development Corporation.

Each Provincial Government also maintains its different bureaus and departments which, similarly, have responsibilities that either overlap or potentially conflict. Manifestly, then, at some stage in the process of planning for water development, it is necessary to assign to some element of the administrative structure the function of co-ordinating the activities of different branches of government. It is sometimes assumed that government organizations have a magical way of solving their own administrative problems; that a statutory declaration that certain bodies share responsibility automatically means that they will rationally co-operate and co-ordinate their endeavours. This is, unfortunately, far from the case, and the problem of co-ordinated planning is exacerbated with a resource like water, which is of intimate concern to so many different branches of government.

There are complex factors which contribute to administrative confusion. In one country of the region although administrative responsibility is divided between many branches of government, legislation provides for interdepartmental committees whose express purpose was to enhance co-operative planning. It was frankly admitted, however, that the system just does not work, although the shortage of available land, the high density of population, the pattern of precipitation in relation to the growing season and the recurrent tragedy of devastating floods, mean that co-operation is critically important. Traditional attitudes of personal pride and responsibility mean, often, that one Minister will not willingly share information with another, for fear that the mere sharing of data will lessen his power. Ministers or their representatives will often not attend committee meetings because they regard themselves as competing with, rather than co-operating with, other Ministries. The only effective co-operative committee deals with flood relief and this committee works only because flood damage is a recurrent problem with grave political consequences and the chairman is a particularly powerful Minister who is in a position to compel co-operation.

It is thus apparent that the function of co-ordination must be built into the administration. This is important both to the planning and executive functions of the administration. Thus Fiji is presently considering draft legislation which will create a Water and Related Resources Management Board, to have ultimate broad authority over all relevant aspects of water use. Among its members would be the heads of the Departments most intimately concerned with water management and its primary object would be to ensure and, if necessary, to enforce the co-ordination and co-operation necessary for rational planning. Although it is envisaged that the Board would delegate most of its powers to various arms of government, it would ultimately have the necessary authority to intervene in any case where the need was seen.

The following specific powers are relevant in establishing and co-ordinating policies and plans for water development:

(i) power to obtain information and technical data from both public and private sources on a wide variety of matters concerning water use;

(ii) power to formulate plans and policies and to compel private persons and public authorities to comply therewith;

(iii) power to allocate water for particular purposes in particular regions and to establish priorities for development, and between particular types of use;

(iv) power to issue directives to, and to compel co-operation from, all competent segments of the government administration and other public authorities in the preparation and evaluation of plans;

(v) power to require that all proposals for the development of water resources are submitted to it, and power to approve, qualify or reject all proposals or plans;

(vi) power to establish advisory committees and engage technical consultants;

(vii) power to establish procedures and, where necessary, to make regulations for the execution of these procedures.

2.3 Executing and Authorising Water Development Projects

One of the reasons why Government has involved itself actively in water management is that the complexity of many major development schemes and the capital cost involved make it essential for Government to take a prominent role. Thus it is usual that some level of the administrative structure for water resource management be given power to actually design, construct, operate and maintain water management facilities.

Such activity may be assigned to different levels of government. Thus, construction is sometimes undertaken by a national authority, sometimes by bodies at the provincial, municipal or even local village level. On occasions, a quasi-independent special purpose agency may be created to undertake such tasks. In each of these cases, it is common to provide that a specific element of the total water administration shall have power to review, authorise and oversee the execution of projects.

The following specific powers are important for executing and for authorising water development projects:

(i) power to enter lands to make surveys, take samples and carry out investigations, subject to making compensation for damage caused;

(ii) power to develop, approve, qualify or reject detailed plans and specifications for water structures and to require that all such plans are submitted for approval;

(iii) power compulsorily to acquire land or interests in land;

(iv) power to enter contracts;

(v) power to execute works and to supervise the execution of works;

(vi) power to order the alteration or removal of unauthorised works and, in default, to enter land to carry out such alteration or removal, and to recover necessary costs from landowners;

(vii) power to raise moneys. This is only sometimes included as one of the powers necessary for a water administration, and depends upon the particular administrative structure adopted by the country concerned.

2.4 Administration of Rights to Use Water and to Build Structures

The degree to which controls must be exercised over hydrological structures and the extraction of water again depends on the circumstances of the particular country concerned. For the purposes of maintaining an accurate resource inventory, it is sometimes stated that major extractive uses of water should be licensed and quantified in all countries. Again, this proposition cannot be always maintained in countries such as Papua New Guinea where major extraction of water might still make very little impact on the water available in a particular system.

The introduction of a scheme of registering works and uses requires manpower and proper policing if it is to be effective and to achieve its objective. For these reasons alone, such controls are likely to be introduced progressively as the need becomes apparent.

Many powers will necessarily be incidental to the function of administering rights to use water and build structures. Among the most important, however, are:

(i) power to enter private land and to inspect existing uses, structures, or to monitor waste discharge;

(ii) power to require the registration of all existing uses, structures or discharges selectively by area;

(iii) power, in the case that traditional uses are not properly quantifiable, to fix the extent of such rights;

(iv) power to order alterations to, maintenance or removal of existing structures, or cessation of existing pollutive discharges;

(v) power to license all new uses, structures or waste discharges and hence to require the submission of applications, designs and plans, the details of which are to be established by regulations;

(vi) power to allocate water between various uses and users, and hence to require the submission of applications, designs and plans, the details of which are to be established by regulation;

(vii) power to allocate water between various uses and users and to restrict rights in the case of emergency;

(viii) power to require private persons and public authorities to keep records concerning their use of water and the quality and quantity of discharges and to have access to such records;

(ix) power to prescribe general or specific terms and conditions for inclusion in licences concerning water use, the construction of works or the emission of waste, and power to police the same;

(x) power to provide for the renewal, qualification, suspension, cancellation or termination of licences;

(xi) power to intervene to prevent wasteful or harmful uses or acts;

(xii) power to impose charges relating to the inspection, approval, monitoring and granting of licences, and for the use of water or discharge of waste;

(xiii) power to prosecute for harmful acts, and, where constitutionally possible, prescribe offences by regulation;

(xiv) power to make regulations for the carrying out of the above matters.

FOOTNOTES

1. Clark, "A General Comparison of Water Legislation and Administration in ECAFE countries," U.N. Water Resources Series No. 35, pp. 117-198 (see note 2 below).

2. United Nations, "Water Legislation in Asia and the Far East - Part 1," Water Resources Series No. 31 (New York, 1967) (ST/ECAFE/SER.F.31); United Nations, "Water Legislation in Asia and the Far East - Part 2," Water Resources Series No. 35 (New York, 1968) (ST/ECAFE/SER.F/35).

3. United Nations, "Guidelines for the Drafting of Water Codes,: Water Resources Series No. 43 (New York, 1973) (ST/ECAFE/SER.F/43).

4. Ducrocq, Droit Administratif, 7th edition, pp. 85 et seq.

5. Waline, Droit Administratif, 4th edition, p. 430.

6. Lyon v. Fishmonger's Co. (1876) 1 App. Cas. 662.

7. Chasemore v. Richards (1859) 7 H.L.C. 349 per Lord Wensleydale.

8. Golak Nath v. State of Punjab (1967) 54 A.I.R. 1643.

HINDU WATER LAW AND ADMINISTRATION

IN BALI

By

Bernard J. Wohlwend*

1. INTRODUCTION

1.1 The geophysical setting

Bali is an island lying east of Java in the Indonesian archipelago. With an area of 5,560 square kilometres, it extends for 153 kilometres between the shallow Bali Strait on the west and the deep Lombok Strait on the east which marks the edge of the Sunda platform. The extreme width of the island is 80 kilometres. Its population reaches 2.3 millions. Bali constitutes one of the 26 Indonesian Provinces; it is administratively divided into eight Kabupaten, or Regencies, corresponding to the traditional princely states; each Regency is governed by a Peoples' Assembly of which the chairman is usually the reigning local Raja, or his heir apparent.

Most of the island is mountainous and consists of volcanic formations. The narrow western section, Djembrana, is a wild, almost uninhabited upland. The Central Highland, of recent volcanic formation, rises to 2,370 metres on Mt. Batuku, or Tabanan Peak, and has three crater-lakes, Brantan, Bujan and Tambelangan. In the eastern highland rises the majestic volcanic cone of Mt. Agung, or Bali Peak, 3,105 metres high; within its rim to the northwest is the crater-lake Batur and the active volcano of that name. North of the mountains lies a narrow lowland fringe, slightly indented. The main lowland lies to the south of the Central Highland. There, numerous rivers emerge from the ravines they have cut in the soft volcanic rock, and flow across a composite plain of their own making. These rivers are unsuited for navigation. Practically dry at one season, they become choked and are likely to flood during the period of heavy rainfall.

Because of its position immediately south of the equator, Bali has no real seasons. Although rainfall is naturally influenced by the mountains and increases with altitude, it is nowhere less than 1 metre a year. Nevertheless, an east and west monsoon provokes respectively a dry northern summer between May and November and a humid southern summer subject to major rainfall from December to April. Singaradja, on the northern coast, has a mean rainfall of 1143 mm; Denpasar, the Provincial capital in the south, receives twice as much rain.

Given such conditions, agriculture plays a preeminent role in the economy of the island in terms of both employment and revenue. The three

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major types of cultivation are wet-rice field (sawah), dry field (tegalan) and slash-and-burn (ladang) cultivation. An intensive irrigation system, which is a prominent feature of the landscape wherever sufficient flat-land and fertile soils exist, makes wet-rice farming profitable; dams, canals, dikes, sluices and other appurtenances of the system are to be seen in other crop areas as well. The average Balinese farm is of about one hectare, a quarter of which is irrigated, the remainder being used for dry crops. Terracing is practiced in the foothills.

1.2 The juridico-political history

The juridico-political history of Bali is to be viewed within the context of that of the Republic of Indonesia, which may be divided into four main periods. The first period extends from the origins until Islamization in the 14th Century. The early population of the main islands in the archipelago is of uncertain origin, probably of Papuan and Melanesian stock which penetrated from the east around the 3rd Century B.C. and, later, of Malay and Indo-chinese import following subsequent migrations from the continent. It is at that time that wet-rice cultivation appears to have been introduced into the fertile low-lands of eastern Java replacing shift cultivation, the earlier and tradi-tional agricultural pattern in Indonesia. Between the 3rd and 7th Centuries A.D., Indian and Indo-chinese traders brought first Hindu and then Buddhist cultures which were particularly well received by the populous communities in Java, though these were rapidly given Javanese shapes. By the 10th Century, Bali only had maintained a largely pure Hindu heritage, an actual expression whereof is the centralized "Subak" system of water management as opposed to the administratively decentralized "Desa", or village irrigation of adat, or Indonesian customary law to be found elsewhere in the irrigated areas of the archipelago. From the 7th until the 14th Century, a number of Hindu and Buddhist dynasties succeeded each other in the domination of the Indonesian spice market. Among them, mention may be made of King Dharmavamsa (985-1006) who promoted the first codification of Javanese laws, and of Gadja Mada (1331-1364), Chief Minister of the Madjapahit Empire who subsequently commissioned a new codification of the law. It is during that time that most of the Indo-nesian customary, or adat law became established.

The second period begins with the establishment of Moslem traders on the coast of Java in the 14th Century. It is however not until the 16th Century that Islam, of the Shafite School, became the dominant doctrine in Indonesia. It nevertheless remains that Islam was adopted by Indonesians more as a religion than as a legal system and Moslem customary water law principles retained only where these conformed to traditional adat, an altogether not so different system in the field of water management. As a consequence of Islamization however, those who had selected to maintain their ties with the Hindu doctrine migrated to Bali which thus became the stronghold of Hinduism in Indonesia.

From the 17th Century and until 1819, or third period, the Indonesian archipelago witnessed the incursions of the Portuguese, the Dutch and the British. The direct effects of these events were the removal of the spice

trade from indigenous control and the introduction of Christianism in some parts of Indonesia. Through the United East India Company chartered by the Dutch in 1602, a trade monopoly was soon established which, by means of a limited production and low selling prices to agricultural producers, widened the disparity between an agricultural subsistance economy for the indigenous population and a mercantile economy generated by and for the Dutch. An indirect effect was the rising opposition of the Moslem community against the western power and the strengthening of the Javanese Kingdom of Mataram which could thus bring Moslem law back into effect and empower Shari'ah, or Islamic law courts to handle criminal and personal status cases. By the end of the 18th Century, however, the Dutch had full administrative control over most territories through their residents, regents and staff of plantation supervisors. Events in Europe then favoured a short British inter-regnum from 1811 to 1816 during which the government administration was centralized and a land Tax system introduced while all land resources were made to vest in the government. Having recuperated their colonies, the Dutch largely maintained the British reforms though, from 1870, introducing a paternalistic administrative rule and promulgating a liberal agrarian law. It is during that time, and until World War II, that the land and water legislation of the Netherland Indies was promulgated. Accordingly, western, or European land was governed by the Civil Code, the Agrarian Law of 1870 and related special legislation; Indonesian land was governed by adat law and special government regulations; and foreign-oriental land was partly subject to the provisions of the Civil Code and partly to special legislation. In Bali however, traditional and customary rules of law continued to apply. The 19th Century also witnessed two colonial wars and several uprisings which led to the formation of the first nationalist groups in 1908 and to the rise of Sukarno as the founder of the Indonesian National Party in 1927. With the outbreak of World War II, Indonesia fell under Japanese rule from 1942 until 1945, during which years the dual Moslem and secular court system was abolished.

The fourth, and current period starts with the proclamation of independence in August 1945. In 1949, the Republic of the United States of Indonesia was established by a Dutch-Indonesian treaty. In August 1950, the federal states emerged into a unitary state, the Republic of Indonesia. From that date, Bali was made one of the present twenty-six Indonesian provinces, but it is only in 1972 that its water legislation was finally codified and patterned to a certain extent on the Dutch General Water Regulation of 1936. Since 1959, date of the revival of the 1945 Constitution, the government had launched a programme of socialism, guided democracy, guided economy, Indonesian identity and law reform, or the five pillars (Pantajasila) of the Indonesian State. By 1960, a new Agrarian Law was promulgated which repealed the Dutch legislation governing agrarian rights and introduced a unified legal régime for land and water resources based on traditional adat law.[1] Internal political unrest did however prevent the effective implementation of the new legal régime until early 1967. Since then, agriculture which occupies some 70 per cent of the total population of Indonesia has received priority in development plans and water resources management and

legislation given particular attention wherein the experience of the Subak water management system of Bali is bound to have a determining influence.

2. SOME PRINCIPLES OF HINDU LAW

2.1 General Remarks[2]

It is not the purpose of this study to attempt a comprehensive investigation into those concepts, norms or rules that could be given the name of Hindu law. Because of the very nature of the Hindu doctrine and of its multiple modes of expression, such a task would undoubtedly prove unfeasible and could certainly not fit any "systematic" analysis. Nevertheless, a brief exposition of some of the major elements of the doctrine is essential if anything is to be understood of what corresponds therein to the concepts of order and justice.

First and foremost, Hinduism, or Brâhmanism, is regarded by its followers neither as a religion nor as a philosophy, but as a living tradition expressing one form of the Universal Truth in the exclusive possession of which no civilization nor historical period may have a claim. Whereas the Westerner adhers to either a Religion, a Morale or a philosophy, the Hindu revers neither a faith, nor any moral concensus, nor anything that would be his own or any man-made truth. His doctrine is that of the Supreme Knowledge of which all that is perceptible, materially or otherwise, constitutes a participation and an adequate expression. Hence, his own individuality represents effectively nothing in absolute terms while, at the same time, it forms an essential constitutive element of the Universe, or Cosmos, seen as the substantial and formal expression of Truth.

Correspondingly, man is considered simultaneously as a whole made of parts, or as a body made of limbs, and as an integral part of the community, or body of which he is a member. Similarly, communities are regarded as constitutive elements of Humanity, as minerals, plant and animal life, together with Humanity, make up the World, itself considered as a microcosm in relation to the Universe. The same concept is expressed in Islamic doctrine as "The World is a tall man, and Man is a small world".[3]

As a consequence, in Hindu cosmology nothing is left apart nor remains an individuality isolated from its environment and the Hindu, whatever his race, cast or personal degree of perception of Supreme Knowledge, is aware of his effective participation therein, together with all that circumvents him, as a necessary element of total and universal harmony.

This concept of Universal Harmony implies in turn that of a necessary correspondence between the cosmic and human orders. As the Cosmos is symbolically, and by analogy, represented as Manu, or the prototype of Man (mânava),[4] such a correspondence is naturally present within the very structure of the individual, as it is within the organization of any human community, itself seen as a "social corpus" with organs and functions similar to those of the human body. Harmony is thus achieved only

provided man's action, or Karma, is in conformity with the functions assigned to him by his very nature, a rule that applies not only to the individual and for the duration of his life, but to any organized collectivity, to the present Humanity throughout its cycle of existence and, ultimately, to the total Order of the Universe.

As a consequence, it is to this fundamental equilibrium, to the integral harmony resulting from the conformity with such a hierarchy that corresponds, free of any moral connotation, the Dharma, or eminent principle of Order, or Justice, the axis around which all things revolve, the motionless axle around which the World accomplishes its revolution, the immutable centre which regulates the cosmic movement without participating therein,[5] as represented by the wheel (chakra) on the Indian flag or by the ancient symbol of the "Swastika", the emblem of Ganêsha, the Lord of Knowledge.

2.2 The concept of Dharma

The less inappropriate English term that may be used to express the concept of Dharma[6] is that of "Law" in its widest acceptation of fundamental norm with its corresponding character of permanence, immutability, origine. In this sense, it constitutes the Sanâtana Dharma, or Primordial Tradition[7], both as the fundamental Principle of the Hindu doctrine, or Brahma, the Divine Will and Supreme Master of the Universe and, simultaneously, as the substance of the doctrine as a whole.

According to the law of correspondence, the Principle governs, though in relative terms, all levels of the cosmic and human order. Thus, conceived as the principle of the conservation of all beings, the Dharma embodies the necessary conformity of all elements of the Universe with their very nature and purpose.[8] In this sense, it is possible to envisage a Dharma specific to each being (swadharma), to each collectivity or to a whole humanity and for the full duration of its cycle of existence. In this case, the Dharma appears as the specific Law or Norm of this particular cycle, as formulated from its origin by the Manu that governs it, that is by the Cosmic Intelligence reflecting into this world the Divine Will expressed as the Universal Order.

As the substance of the doctrine, the Dharma thus constitutes, by extension, the content of the Sacred Books as a whole;[9] in a restricted sense however, it expresses as well the legislative aspect of the doctrine as applicable to the social order.

The whole of the traditional Hindu scriptures form the Vêda; hence the name of "Vêdism" sometimes used as a substitute for Hinduism or Brâhmanism. The Sacred Books are however of two kinds; those which emanate directly from the divine revelation form the "Shruti", whereas the "Smriti" contains the collection of the traditional Hindu commentaries. Although of a lesser degree of traditional purity because of their human authorship, the commentaries are nevertheless considered to be perfectly orthodox as authorized developments of the various principles of pure doctrine.

The Shruti contains the four Vêdas, or fundamental Books, and the six Darshanas as corresponding "points of view" or branches of the doctrine. These have often erroneously been taken for different, or even opposed schools of thought whereas, in reality, they only express different aspects of the same doctrine. It is the last Darshana, entitled Vêdanta or "end" and "ultimate purpose" of the Vêda, which contains the precepts of the Sanâtana Dharma, or "Lex Perennis", as synthetized in the Brahma-sûtras.[10] As to the pennultimate Darshana, known as Mîmânsa or Karma-Mîmânsa, it refers to the field of action (Karma) and constitutes, among others, the source from which the principles of Hindu jurisprudence have been developed.

As for the Smitri, it contains among others the various treaties on the six fundamental Sciences and the four practical sciences or Arts, the Shivaïte and the Vishnuïte commentaries or books, and the Dharma-Shâstra,[11] or codes of law, which constitute effectively the Law of Manu as applicable to the social order.[12]

2.3 The Law of Manu

Unlike the legal rule of western societies which emanates from man's exercise of legislative power, the Law of Manu constitutes for the Hindu the expression of the Divine Will, or Principle of Universal Order, as the necessary norm of correspondence between the essential nature of man (Dharma) and his deeds (Karma). This Universal Will expresses itself in each Humanity as "Prajâpati", the "Lord of produced beings", and in each particular cosmic cycle as the Manu, or the expression of Brahma[13] as the primordial and universal Legislator, that gives it its own law. Each Manu is therefore not to be seen as an individuality but as a legislative function to which all manmade rules and regulations necessarily refer.

Of basic importance is therefore the nature of the relationship between Dharma and Karma or, in other words, that of causality. In Hindu doctrine, this concept is called "apûrva"; it is synthetically expounded in the Karma-Mîmânsa and finds its application in the Karma-Sutrâs. Accordingly, any deed, or cause, is deemed to necessarily and simultaneously contain, be it only virtually, its necessary effect; otherwise, a completed action, something no more existing, could produce something not yet in existence, an absurd proposition in Hindu cosmogony. Within the framework of the fundamental Law of Harmony according to which the sum of imbalances constitutes the total Equilibrium, any deed of man is equivalent to a temporary departure from his own natural balance and, as a cause, is bound to produce a corresponding effect which will re-establish the original equilibrium.[14] Accordingly, man is necessarily and directly liable for the reaction which his action produces. Such a concept is however devoid of any "moral" connotation and can thus not be compared with the "legal sanction" of western legal systems.[15]

It follows that every deed of man constitutes a participation in, or a departure from the total Order and that the individual, or the collectivity, cannot be regarded as having "rights", but only "duties" towards himself and the community. This is why every single act constitutes properly a "rite" (rita), or sacred deed, and that the concept of lay versus religious behaviour is totally absent in Hinduism.

Rather than expounding rules of law, the Dharma-Shâstras basically outline the principles of organization of Hindu society, its hierarchy and the corresponding functions and duties of its members. As at the level of the cosmic order in which everything revolves around Brahma, the immutable Principle, Hindu society is organized around the King[16] who, subject to the Spiritual Authority, detains the temporal power of government. His essential function is thus to maintain harmony and peace, or Justice and Order.[17] Similarly, the Prince, or Raja, the corporation, the village, or Panchayat,[18] the head of the kin group and the family head exercise a similar authority within their own recognized domain of jurisdiction.[19] The law of Manu therefore provides for specific rules of conduct and for the necessary means enabling the ruler to correct infringements to the established order.[20]

3. THE "SUBAK" OR CUSTOMARY WATER MANAGEMENT SYSTEM OF BALI

3.1 Definition

A "Subak" consists in a community of rice field (sawah) irrigators; the "Subak system" covers the management and distribution of surface water within a Subak, or irrigation command area. It thus constitutes a socio-hydro-agrarian complex.[21]

Originally, the Subak system sprang from the desire of farmers to bring land under irrigation, a purpose for which they organized themselves into a mutual and self-help association. All farmers possessing land within a reasonable distance from a stream jointly undertook to construct a diversion weir or intake thereon, together with a network of canals and feeders to bring the water to their fields. In doing so, all participants automatically become members of the Subak, the area of which usually averages a 100 hectares. The smallest Subak in Bali is of 3,545 ha and the largest one of 799,175 ha. Large Subak are sub-divided into smaller units (Tempekan). Both the Subak and its subdivisions constitute comprehensive hydrological units.

The chief characteristic of the Subak is that whereas its members may belong to several villages (Desa) holding land within a given irrigation unit, Subak management is fully independent from Desa administration. In fact, the Subak constitutes the central water management unit which supplies dependent villages with the water they need for other than irrigation purposes. As to the Desa, it constitutes the smallest administrative, or local government unit; it is organized into a popular legislative body called the Desa Peoples' Assembly which elects the village chief, or Kepala Desa, from among its members. The basic needs of water in villages usually cover domestic and sewerage purposes. Whereas drinking water is traditionally supplied from one or several village wells, the flushing of village sewers is periodically ensured with water made available from the Subak upon request of the various Kepala Desa.

As to the internal organization and life of the Subak, they are governed by particular rules of customary adat law known as Awig-Awig.

These were subsequently codified between 1939 and 1940 by order of the then Raja (Prince) of Bali in his capacity as Provincial Governor within the then Dutch local government administration. Although differing in practice from Subak to Subak, especially with respect to financial matters, all Awig-Awig are based on identical principles the purpose of which is to ensure the most equitable sharing of Subak water among irrigators in relation to crops, soil conditions, the two monsoons, the location of individual fields, Desa requirements and other relevant factors.

3.2 The organizational set-up

The affairs of each Subak are directed by the community of its members organized into a Subak Meeting which has sovereign jurisdiction over all water management and related matters within the Subak area. Subak Meeting decisions are implemented by the Kelian Subak, or Chief Water Master, who is selected from among the members of the community of irrigators and elected by the Subak Meeting. This charge, although not in law, is hereditary in practice provided the designated heir shows the required qualifications. In the discharge of his functions, the Kelian Subak is assisted by deputies (Kelian Tempek) responsible for the various sub-units (Tempekan) of the irrigation network, by assistants (Kesinoman) controlling end of network diversions, and by criers (Saya) whose functions are to inform individual irrigators of their water turn and to survey the agreed operation thereof.

The Subak Meeting convenes once a month under the chairmanship of the Kelian Subak in order to discuss water management and related financial affairs. The date of the meeting is carefully selected among conspicuous days of the month. The Subak Meeting also approves the various Awig-Awig which regulate, among others, the obligation of members to cultivate paddy, second and third crops on time; waterworks operation and maintenance; the settlement of disputes; penalties; and the date and performance of ritual ceremonies. In this connection, it is customary for each farmer to have an altar built on his irrigated field, as well as for the community to construct altars or temples at the various diversion points of the irrigation network. As to the Subak temple at the intake or main diversion on the river, it is usually dedicated to the TrimÛrti[22] as a sign of the community's will to conform the whole life of the Subak to the Law of Universal Harmony.

3.3. The legal regime of water resources

As in all traditional doctrines, water is looked upon in Hinduism not only as a natural element but, because of its eminently fluid or plastic nature, as the prototype of the Universal Substance[23] and Mother of Existence. In this acceptation, the Primordial Waters (Nâra) appear as the support of the Lotus or seat of Brahmâ (Brahmâ-Loka), the mean between Heaven and Earth.[24] Hence the sacred character of water which, because of its plastic substance, appears as the intermediary element between the corporal and subtle components of the Cosmos while participating at the same time in both through its liquid and gazeous modes of

existence. At the cosmogonic level, water (ap) is one of the 5 elements (bhûtas) which, together with fire, air and earth as productions of Ether (âkâsha), or the non-corporal element-Principle, constitute the origin and substances of corporal Existence (bhâva).[25] Water is thus symbolically equated with Life, corporally as the sustainer of plant, animal and human life, and spiritually, as the support of those divine influences befalling man, as illustrated by rainwater which, having collected in streams, drains to discharge into the non-differentiated waters of the Sea at the end of its specific cycle of existence. Similarly, the Subak can be symbolically compared with the human body and the water of its irrigation network as the blood which necessarily irrigates all its limbs.

Because of its fluid, transient and purifying nature, water was declared as "indivisible" by the Dharma-Shâstras and has therefore always escaped the legal definition of "thing" or "res", whether movable or immovable;[26] water could thus never become an object of appropriation. This principle of nonappropriation is similarly expressed in Moslem doctrine as "Pasture land, water and fire are a gift of God"[27] or, in the Pre-Columbian traditions of North America for instance, as "Land cannot be bought and sold, anymore than water and fire can".[28] As a consequence, water may be subject to rights of use exclusively, a faculty which is then specifically regulated by law.

The same principle is present in Indonesian adat law which knows a whole series of rights to use both land and water either separately or jointly. As regards land, the fullest and most exclusive use right is called hak milik.[29] While it has all the apparent characteristics of an ownership right, it has never been considered by Indonesians as effectively incorporating ownership (nuda propriatas) which virtually rests with the Community, but possession and usufruct only. The same applies to the right to use water known as hak guna air.

The dual system of public and private land ownership (eigendom) was however introduced in Indonesia by the Dutch in the XIXth Century along with the concept of "public waters" for surface springs, flowing and still waters whereon the existence of "private" rights could not be demonstrated or which were not exclusively intended for use by public institutions.[30] Other waters, and groundwaters in particular, were thus made to fall into the exclusive dominion of the private landowner, a concept unknown to traditional adat law.

With the promulgation of the Constitution of the Republic of Indonesia in 1945, provision was expressly made for land and water resources, together with the natural riches contained therein, to become subject to State control and to be used for the benefit of the people.[31] At the same time, provision was made for the national economy to be organized as a common endeavour based upon the principle of the family unit[32] which not only reinstated a fundamental principle of adat law, but which clearly opposes the western individualistic appropriation of natural resources. Subsequently, the Agrarian Law of 1960 specified that the State is empowered to regulate all matters regarding the possession and use of land, water, air space and other natural resources in its capacity as the representative of the Indonesian people to whom these resources have been

given by God.[33] Furthermore, adat law was formally recognized as the agrarian law in force for the whole of the Indonesian territory,[34] thereby reinstating in Java and in the other islands the traditional legal regime for land and water resources[35] as had in fact always continued to apply in Bali.

3.4 The right to use water or water rights

3.4.1 Mode of acquisition

Membership in the Subak carries the right to use water, or hak guna air. Water rights are however never definitive, be it quantitatively or in time, but allocated as established monthly by the Subak Meeting on the basis of individual needs and in proportion to the available water.

In addition to Subak members, neighbouring villages make periodic requests for water to the Subak Meeting, or to the Kelian Subak, through their Desa Peoples' Meeting, or through their Kepala Desa. Such requests may not be ignored by the Subak which is bound to supply the requested water as circumstances permit. Within each Desa, such water is used as a public service for domestic and sewerage purposes and is therefore not subject to individual, but to collective water rights.

The same principle applies to the use of drinking water in villages which is supplied from community wells in which everyone enjoys a right of use.

Finally, farmers who are not members of a Subak are equally entitled to make individual requests for irrigation water from the Subak network. In this case however, Subak members may refuse to let the needed water cross their fields unless or until the Subak Meeting has decided the case. If settled affirmatively, the outsider automatically becomes a member of the Subak and his field is incorporated into its irrigation command area.

3.4.2 Modification of water rights

Under such a centrally planned system of water management, irrigation water rights are subject to periodic modifications, both quantitatively and in their time-space relationship, in order to accomodate established cropping patterns and production objectives.

The misuse, waste and non-use of allocated water is correspondingly subject to temporary reduction, suspension and re-allocation or termination. In all cases, the final decision is made by the Subak Meeting.

3.4.3 Water uses and water quality

The major water use in Bali is for irrigation purposes and is regulated in detail at the Subak level. Associated with this use are those of watering animals and of fishing and fish-breeding.[36] The right to water animals is free, but their owner is responsible for damages caused thereby to the banks of watercourses, to waterworks and to fields and crops.

In planted fields, the casting of palms or sticks vertically into the ground constitutes however a prohibition to trespass which is fully respected. The same applies to fishing and fish-breeding in irrigated fields; the exercise of this right is however unrestricted in water-courses. As to artificially constructed fishponds, these are subject to protected collective fishing rights.

In the Desa, special rules govern the protection of drinking water quality. Unlike in the other Indonesian islands, there is an absolute prohibition to use surface water bodies of whatever nature for human or domestic waste disposal because of the sacred nature of water which is furthermore constantly used for ritual purposes. Similarly, individual households are required to be equipped with the necessary waste disposal pit or pits which may not be sunk close to any surface or underground source of water. Domestic waste water is however disposed of into the village drains which are flushed twice a week with the water allocated from the nearest Subak for this purpose.

In addition to numerous hotsprings spread throughout volcanic Bali and which, like all other major water points or crossings, are considered as sacred places (tîrtha), natural springs are used as sources of ritual bodily and spiritual purification. Most famous is the Tampaksiring Holy Spring which emerges from the flank of Mount Batur, a volcanic cone filled by a natural lake of which this spring constitutes the major among its only spring outlets. The site is fitted with springhead basin and three public pools, one for men and two for women,[37] overlooked by a temple dedicated to the holy turtle, symbol of Man as the mean term between Heaven and Earth which together form the "Great Triad" (Tribhuvana),[38] or symbolic representation of the Cosmos.

3.4.4 Order of priorities

The general priority rule in the use of water throughout Bali is that of the general or public interest overriding that of the individual. Whereas the use of water for drinking and for animal watering has first priority, in case of fire, preference is given to fire-fighting over drinking purposes. Similarly, irrigation uses have priority over dry field or orchard watering and, within an irrigated area, first crops are given preference over second and third crops provided such is the general interest. This rule further regulates the special priorities of the Subak water distribution system.

3.5 The water distribution system

3.5.1 Basic principles

The basis of the water distribution in the Subak area is the individual Sawah. Individual water rights are measured in Tek-Tek (literally "cut into pieces"), or the width of a Tembuku, a log placed across an irrigation canal with cuts releasing water to a corresponding number of feeders. The quantity of water released to each field is in proportion to crop needs and expressed in Tek-Tek per Tenah, or bundle of paddy seed. One Tenah

is equivalent to 25-30 Kg of seed. Where there is not enough water for a continuous supply, water is distributed by turns.

3.5.2 Mode of distribution

The basic rule of water distribution is expressed as "Desa-Kâla-Patra" wherein Desa indicates the non-agricultural needs of the village or villages, Kâla is time and refers to dry season irrigation priorities for crops planted during the wet season, and Patra, or circumstances, covers water/soil/crop relationships.

Kâla, itself, has two dimensions. The first, or time dimension, concerns the priority given in the dry season to the irrigation of crops planted in November/December, then to those planted in January/February and, lastly, to these crops which were planted in March/April. The second, or spatial dimension, is in turn expressed as "Ulu-Baong-Sep", or Head, Neck and Foot. It ought to be remembered in this connection that the Subak area is envisaged as a body and its irrigation network as the circulatory system feeding its limbs down to their extremities. Accordingly, fields close to the intake have Ulu-Ulu priority and are watered first while fields having Baong and Sep priority respectively receive their water once the needs of the preceding category have been satisfied. The combination of these two principles of Desa-Kâla-Patra and Ulu-Baong-Sep thus allows for a perfectly flexible system of water allocation consistent with time-space as well as with water/soil/crop relationships and requirements.

At an early stage of development, where there were only a few fields near the main intake, there was no need to establish upstream and downstream priorities. Such a system, called "Nyorog", became however necessary when the Subak area reached its full extension and the total water supply did not allow anymore all fields to be irrigated simultaneously during the dry season.

Each field is normally supplied with water continuously, day and night, until the turn passes to the next category of fields. Since each sawah is fed from an individual feeder or ditch, there is usually no problem of water conveyance, or right of way, from one field to another. As to the land on which feeders and ditches are located, it constitutes community land not subject to exclusive individual use rights.

3.6 Financial aspects

The traditional, and fundamental principle on which the whole of the Subak organization rests is called "Gotong-Royong", or principle of mutual help among the members of a given community, which has been constitutionally institutionalized as the second of the five pillars (Pantja Sila) after that of the belief in one God.[39]

Accordingly, the financial and other material resources needed for Subak management and operations are contributed by all members. Subak membership is however divided into Active and Inactive membership. Active

members are those farmers who cultivate between 0.3 and 0.5 ha of paddy fields. Farmers possessing more than 0.5 ha of paddy fields are considered active for 0.5 ha and inactive for the rest. Inactive members are usually government officials and social institutions[40] possessing paddy fields but who are not in a position to cultivate personally, as well as farmers possessing less than 0.3 ha of paddy fields. Active membership only entitles one to vote in the Subak Meeting.

Active members contribute their labour for normal Subak and waterworks construction, operation and maintenance, and in kind or case for exceptional works. Inactive members contribute in kind or cash for both normal and exceptional works.

The Kelian Subak is paid by the Subak Meeting either in a land grant (Tenah Bukti, or land use right), a salary in kind or cash, or in an exemption from active membership contributions. In case he is granted a land use right, his sawah is usually located at the end of the Subak network in order to ensure an equitable water distribution. The Kelian Subak in turn compensates his deputies and assistants.

3.7 Water law implementation

There is no register of water rights which are re-allocated for each irrigation period. There is however a register of individual sawah allocated water within the Subak. Water rights are then allocated on the basis of a cultivation plan drawn-up by the Subak Meeting for each crop season.

It is the Kelian Subak, together with his crew of deputies, assistants and watchmen/criers, who is responsible for the implementation of the cultivation plan, as well as for the control of the adequate operation and maintenance of the irrigation network.

As a general rule, disputes among members of a Subak must be settled internally and by compromisory procedure. The wrong committed by a member of the community is not considered as an offence, but as a disorder (adharma) which the whole community is bound to correct. At the limit, the wrongdoer may be expelled from the Subak, a measure corresponding to his virtual death vis-a-vis the community. The Kelian Subak and, in last resort, the Subak Meeting, thus have an arbitration function.

4. THE STATUTORY SUBAK AND ITS EVOLUTION IN JAVA

4.1 The Statutory Subak of Bali

Whereas water resources management in Java has been, and is still largely operated within the framework of the earlier Dutch water legislation and administrative organization,[41] the customary Subak system of Bali continued uninterferred with until the early 1970's. It is only in 1972 that a Provincial Water Regulation[42] patterned on the 1936

General Water Regulation for Java and Madura, was finally promulgated in order to administratively reconcile the Subak system of Bali with the existing central government legislation.[43]

As one of the 26 autonomous Indonesian Provinces, Bali is headed by a Governor who, in line with the constitutional principle of peoples' sovereignty in Indonesia, holds the dual functions of central government representative at the provincial level and of provincial peoples' representative at the central government level. The Governor is assisted by a Provincial Peoples' Assembly with which he formulates and approves provincial policies. He is both administratively depending from the Department of Home Affairs and subject to the technical guidance of the other central government departments.

The Provincial government administration is correspondingly subdivided into separate administrative units and technical services. Administrative units are of two types: the Kabupaten, or Regency, and the Municipality. The Kabupaten is headed by a Bupati or Regent, flanked by a Regency Peoples' Assembly and subdivided into Districts headed by Assistant Regents who control groups of Desa, or rural communities. The Municipality is headed by a Mayor flanked by a City Peoples' Assembly; the Mayor is assisted by Assistant Mayors, or District Officers, who control urban communities (Kampong). As to the technical services, which are decentralized offices or branches of central government departments, they are subdivided on the one hand into Provincial, Regency and Municipal Services and, on the other hand, into Regional and Sectional Services.

The Provincial Public Works Service of Bali is thus under the administrative authority of the Governor and subject to the technical guidance of the Department of Public Works and Electricity, the main water resources agency in Indonesia. This Service has provincial-wide jurisdiction; it is administratively decentralized into Regency, District and Municipal Services as well as into Regional and Sectional Public Works Services which, under its authority and in cooperation with the Regency, Municipal, District and Desa administrative authorities, hold responsibilities respectively for larger and smaller zones or areas irrespective of administrative boundaries.

Water resources matters at the provincial level are coordinated by a Provincial Irrigation Commission chaired by the Governor and consisting of representatives from the relevant technical services and from the police forces, together with those of interested water user communities and estates. The Chief of the Provincial Public Works Service functions as the Secretary of the Commission which, in fact, covers all water resources matters and not only irrigation as its title would seem to indicate.

The Governor further maintains the provincial water resources inventory and the register of concessions he issues for provincial water uses and water-works. He is also called upon to settle administrative matters and disputes referred to him by the lower administrative units of government.

At the Kabupaten level, the Regency Public Works Service, along with other technical services, advises the Bupati on the water resources programme and projects which it implements under his administrative authority and subject to the technical guidance of the Provincial Public Works Service. On his side, the Bupati is assisted by a Regency Irrigation Commission organized and functioning on the pattern of the Provincial Irrigation Commission.

It is at the Kabupaten level that the Subak system has been institutionalized and integrated into the Indonesian government administration. The essential impact of the 1972 Provincial Water Regulation for Bali has been to introduce government control over intakes on the main river and over the major part of the irrigation network originally constructed and operated by the Subak. Similarly, the leadership in the water distribution system has been largely transferred from the Subak Meeting to the Regency Irrigation Commission as had, since 1936, been the practice in other Indonesian islands, and in Java in particular.

As a result, Subak water distribution is now based on integrated cultivation plans drawn-up by the Regency Irrigation Commission under the chairmanship of the Bupati and with the assistance of the Regency Public Works Service whose head, the Chief Irrigation Officer, functions as the Sedahan Agung,[44] or Chief Water Master, of the Kabupaten. In the discharge of his functions, the Sedehan Agung is assisted by the relevant Regional and Sectional Public Works Services within their respective areas of jurisdictions.

Operating under the Sedahan Agung are the various Sedahan, or District Irrigation Officers who, as Water Masters, control groups of intakes on the main river and corresponding primary canals down to, and including, their respective secondary canal diversions. Tertiary canal intakes on the secondary canals are operated and controlled by a number of Sedahan Yeh, or Assistant Water Masters and Tax Collectors, down to 50 metres on each tertiary canal. From that point, the Kelian Subak, or Subak Water Master, takes over water management responsibilities under the authority of the Subak Meeting (See Fig. 1)

The Subak water management system proper has however not been modified and continues, as in the past, to operate according to its own Awig-Awig, or customary rules. Full integration between Subak and Kabupaten water resources management has thus been achieved by subjecting individual Subak cultivation plans and the corresponding water distribution to Kabupaten cultivation, or master water plans, and by ascertaining the effective participation of each Subak in the formulation and implementation thereof through the Kelian Subak and the chain of government water masters up to the Regency Irrigation Commission and Bupati level. Conversely, and although the community of Subak members is basically responsible for network operation and maintenance only up to the 50 metres limit set on the tertiary canal below the corresponding intake on the secondary canal, the Sedahan may, in special circumstances request the Subak to assume such an obligation up to, and including the primary canal of the corresponding network.

The statutory Subak system of Bali can thus be said to have basically maintained its original characteristics, in particular that of full independence from Desa administration, and may therefore be labelled a system of "joint Government and Subak administration".

4.2 The Desa Irrigation of Java

Ever since Indonesia became a part of the Moslem World in the 14th Century, her local government administration was gradually organized along the lines of the remarkably centralized Islamic Law system which the Dutch inherited and institutionalized during the colonial period in the 19th Century. As Buddhism, unlike Hinduism, does not incorporate a social organization system, Buddhist populations became easily integrated into the Moslem framework of government administration which, based on the principle of peoples' participation, always maintained local settlements in a relative degree of internal autonomy.

The smallest local government unit in Indonesia, the Desa, or autonomous community grouping up to six or seven rural settlements, is internally regulated by Hukum adat, or Indonesian customary law. It is headed by the Kepala Desa, or Village Chief,[45] flanked by a Desa Peoples' Assembly which holds legislative powers. The Desa is however integrated into the Provincial administration through the Deputy Bupati, or District Officer, who controls, the various Desa in his District.

As regards water resources management, the characteristics of the Desa irrigation system are, contrary to the full autonomy of the Bali Subak, its full subjection to Desa administration and the fact that, since 1936, it has been centrally regulated by the provisions of the General, and corresponding Provincial Water Regulations[46] promulgated during the Dutch colonial administration.

Desa water management affairs are thus decided by the Desa Peoples' Assembly and executed by the Ulu-Ulu or Desa Water Master, who is selected from among the community of irrigators but appointed by the Kepala Desa. In the discharge of his duties, the Ulu-Ulu is assisted by Deputies and Assistant Ulu-Ulu who are responsible to him and to the Kepala Desa.

Water for the Desa and for Desa irrigation is fed from tertiary canals under the control of the District Irrigation Officer who operates tertiary diversions down to 50 metres from the corresponding intake wherefrom water distribution is taken over by the Ulu-Ulu. The District Irrigation Officer also controls secondary canal diversions into tertiary canals and operates under the supervision of the Regency Irrigation Officer, himself the head of the Regency Public Works Service, who controls main river intakes (See Fig. 2).

Water use for irrigation has basically remained a community affair in Java, a concept legally translated as a water distribution system aiming at satisfying the needs of all while taking into consideration the surface of irrigated land, water conveyance losses and crop/soil requirements in the establishment of "optimum" and "minimum" water use criteria.[47] Such criteria are formulated on the basis of 24 hours continuous water supply units.[48]

Provincial water regulations provide for the types of land to be irrigated, the formulation of cultivation plans for both west and east monsoons where required, together with an indication of those fields entitled to permanent water for paddy during the east, or dry monsoon, the time when west and east monsoon irrigation begins, irrigation turns and waterworks maintenance periods.[49] Such norms and specifications are set and controlled by the relevant Irrigation Commissions.[50]

Cultivation plans are established where there is not enough water for the full satisfaction of all needs or where agro-technical conditions so require and irrespective of private agreements among beneficiaries, unless provided otherwise.[51] One cultivation plan covers each irrigation zone or region wherein water distribution is planned on a one week minimum basis.[52]

Irrigation water distribution is divided into two consecutive periods following the occurance of the monsoon. While paddy constitutes the primary crop during the west monsoon, polowijo, or fruit crops, have priority during the east monsoon.[53] West-monsoon water is allocated for a fixed period with priority to rice, fish-breeding and east-monsoon planted crops.[54] East-monsoon priority water allocations are for west-monsoon planted paddy still needing water, west-monsoon crop preparation, polowijo or fruit crops and, if there is enough water, according to west-monsoon priorities.[55]

A special feature of Javanese irrigation practices is related to the existence of sugar plantations which, as from the colonial period, have been subject to the concession regime. Their water needs are however included in the cultivation plans and, to this effect, sugar planters inform each year the Chief Irrigation Officer of their next plantation programme. During the east, or dry monsoon, sugar plantations enjoy a preferential status. While they hold simultaneous water rights with other crops during the day, they have priority water rights from 6 a.m. until 17 p.m. unless, due to shortage of water, a separate supply is to be organized.[56] In practice, however, other than sugar crops are to be irrigated during the night.

At the Desa level, water distribution is to follow the requirements of the cultivation plans formulated by the Regency Irrigation Commission in consultation with interested Desa administrations; irrigation officials are however entitled to modify distribution patterns, in which case water right claims thereagainst are referred to the Sectional Public Works Service. If government waterworks have been damaged, for instance, the Chief Irrigation Officer is empowered to stop the water supply in tertiary canals and, in consultation with the competent Irrigation Commission, to arrange for users to be compensated, as far as possible, with a subsequent or alternative water turn.[57] Similarly, if conditions so require and, in particular, in order to avoid unduly frequent variations of supply during the irrigation period, individual users may be compelled to take their water allocation in one day.[58] As to non-irrigational needs of the Desa, these are satisfied either from nearby streams or from individual and community wells.

Finally, other provisions regulate the transfer of dry land into irrigated land and vice-versa, which requires the prior approval of the Bupati or of the Regional Public Works Service, in which case the Bupati is entitled to object following consultations with the Irrigation Commission and users concerned;[59] the obligation for farmers, since unlike in the Bali Subak the same feeder supplies all inter-connected sawah, to let water flow to neighbouring fields and to refrain from changing the existing water flow except in accordance with established local practices;[60] the prohibition to divert irrigation water for unauthorized crops or outside established time-tables, in a different way or in excess of the authorized amount failing which the supply may be stopped in time or space in order to compensate fields having sustained losses;[61] for all irrigators to join in waterworks operation and maintenance according to the principle of Gotong-Royong failing which water rights may be suspended;[62] and for similar measures to sanction withdrawals of water from unauthorized places.[63]

As compared with the Subak system of Bali from which it differs more in its form than in its substance, the Desa Irrigation System of Java, which restrictively incorporates the sawah of a single Desa under the authority of which it operates, may therefore be labelled "Full Desa administration" under integrated provincial government control.

4.3 The Dharma Tîrtha of Central-Java

With the development of the Desa irrigation system to full capacity, water disputes had arisen among irrigators, in particular with respect to the regime of upstream and downstream priorities. Furthermore, as from the early 1950's the need had been felt for water users to be able to organize independently from the Desa Peoples' Assembly in order to settle their water management affairs on the pattern of the Subak system of Bali which was gradually being revived in Java.

Such events prompted in 1968 the authorities of the Sragen Regency in Central-Java Province to institutionalize such a water users' association which was then given the name of Dharma Tîrtha and subsequently regulated in 1970.

4.3.1 The Dharma Tîrtha[64]

The basic organization and lines of authority of the Dharma Tîrtha system have remained by and large the same as in the Desa Irrigation System. The innovation has been to reorganize the water distribution at the irrigation field level by splitting the sawah of the Desa Irrigation System into 3 or 4 Blok, or units, themselves sub-divided into Kelompok grouping a number of individual sawah (See fig. 3).

At the same time, individual irrigators have seen their interests better identified at the Kelompok level and have been given the opportunity to designate their own water master from among themselves. That water master functions as the Assistant Ulu-Ulu, under the control of the Deputy Ulu-Ulu, himself in charge of the water distribution at the Blok level.

The community of irrigators is then organized into a general meeting, the Dharma Tîrtha, independently from the Desa Peoples' Assembly. The Ulu-Ulu is designated by the Dharma Tîrtha and appointed by the Lurah, or Village Chief, with the endorsement of the Desa Peoples' Assembly. The Ulu-Ulu therefore acts in the dual capacity of Dharma Tîrtha member and of Desa official.

As to the water supply from the government network, it remains under the same distribution pattern formerly applied to the Desa Irrigation system. Intakes on the main river are controlled by the Sinder, or Regency Irrigation Officer, who is assisted by several Mantri in charge of secondary and tertiary diversions and canals down to 50 metres from the tertiary intake. At that point, the Ulu-Ulu takes over the water distribution under that authority of the Lurah and the Desa Peoples' Assembly. In allocating water to the various Blok however, the Ulu-Ulu is subject to the decisions of the Dharma Tîrtha.

As to the Dharma Tîrtha members, they remain responsible for irrigation network construction, operation and maintenance according to the principle of Gotong-Royong. In addition, they are under an obligation to pay a fixed water use rate established at 15 Kg of paddy per ha for east-monsoon crops and at 10 Kg per ha for west-monsoon crops.

Irrigation rates are paid into a central fund operated by the Dharma Tîrtha and out of which 75 per cent are allocated to the Ulu-Ulu and his crew of deputies and assistants as salary, 12.5 per cent are to cover Dharma Tîrtha operating expenses, and the remaining 12.5 per cent are kept as a reserve fund.

This water management system which, except for its peculiar organizational structure, remains regulated by the provisions of the 1936 General Water Regulation and of the 1960 Provincial Water Regulation for Central-Java, may therefore be labelled "Joint Desa and Dharma Tîrtha administration".

4.3.2 The Groundwater Dharma Tîrtha

The Dharma Tîrtha system of water management has recently been used in the Pirang Kanan area of Central-Java Province for a groundwater-fed irrigation system. Instead of the usual surface water intake, a deep well equipped with a diesel pump feeds water into a diversion pit from which two main canals convey metered irrigation water into a network of secondary and tertiary canals.

Individual farmers are organized into groups of 8 to 10 irrigators who elect their own water master to control the water distribution from the relevant tertiary canal into their fields which form one Blok. These water masters convey the farmers' requests for water to the Pump Operator who organizes the water distribution accordingly and on the basis of the relevant Cultivation Plan.

The particularly interesting feature of the Groundwater Dharma Tîrtha system is the fact that, because of the great flexibility in the location of the supply well, it can, and does in fact feed the sawah of more than one Desa.

In this case, all irrigators similarly participate in the Dharma Tîrtha Meeting which designates the Ulu-Ulu who is then appointed by his own Lurah. In order to prevent conflicts among interested Desa, the Ulu-Ulu operates both under the authority of the Dharma Tîrtha which includes irrigators from all interested Desa, and under the control of all Lurah concerned under the surveillance of the competent Regency government administration.

Groundwater is fed into the irrigation network on the basis of 9 hours of day pumping. Since 24 hours of continuous supply are needed to irrigate one hectare, water is distributed by turn. Priorities and the order of turns are regulated by the provisions of the 1936 General Water Regulation and of the 1960 General Water Regulation for Central-Java.

Since water is not subject to appropriation and, therefore, cannot be sold, it is the service of making water available which is subject to a fixed rate established at 110 Rupiahs[65] per pumping hour. Neither the Ulu-Ulu nor his 26 Assistants and field inspectors are remunerated. The Pump Operator receives however a salary in cash paid out of the collected irrigation rates which provide as well for pump operation and maintenance costs.

4.4 The Bina Tîrtha of East-Java[66]

In parallel with the progressive integration of the customary Subak system of Bali into the provincial government administration, which ultimately led to the promulgation of the Provincial Water Regulation for Bali in 1972, the Desa Irrigation system of Java had furthermore given rise to water disputes among Desa depending on the same source of supply, chiefly because the institutionalization thereof into micro government controlled units had overlooked the unity of the hydrological area of which such systems are constitutive elements.

Although in East-Java Province the Subak system had been revived in the 1950's and had since developed more extensively there than in the other provinces, similar water distribution problems among Subak fed from the same river prompted the Bupati of Kabupaten Bojonegoro to take over the management of Subak Stelsel in 1967. In this case, however, a further step in Government integration was achieved.

Instead of organizing irrigated fields as a tertiary canal system as was done in Bali, these are grouped at the secondary canal level into a Secondary Subak which is sub-divided into a number of Tertiary Subak grouping irrigated fields depending from tertiary canals, themselves organized into Desa Subak supplied from a main feeder and further subdivided into Cottage Subak receiving their water from secondary feeders (See fig. 4).

The water distribution within each Secondary Subak is directed as a Government scheme by an inter-departmental meeting, or Bina Tîrtha, which gave its name to the system and which, in fact, functions as an Irrigation Commission.

Each sub-unit of the system is organized under a water users' meeting which elects its respective water master and assistants who represent the farmers at the Bina Tîrtha Meeting. That Meeting includes as well the representatives of the Regency Public Works Service, of the other technical services and of the Regency, District and Desa administrations concerned who formulate the corresponding Cultivation Plan, organize water distribution and irrigation network management, administer financial matters and advise farmers on agricultural and water use practices. Subak Stelsel includes 7 Desa, or villages.

The decisions of the Bina Tîrtha are implemented by a Chief Water Master, or Secondary Subak Water Master, under the supervision of the Wakil, or Deputy Bupati who controls several intakes on the main river. The primary canal and secondary diversion are operated and controlled by the Chief Irrigation Officer, or Bina Tîrtha Water Master.

The primary advantage of the Bina Tîrtha irrigation system is that, in view of its size and direct dependence on a secondary canal intake, it can ensure a constant irrigation water flow during both the west and east monsoons and coordinate water turns on an integrated basis. It also allows for the direct participation of all water users of the system in the formulation and implementation of the corresponding Cultivation Plan.

To this effect, all Tertiary Subak water masters are to be present at the Secondary Subak intake together with the delegated Bina Tîrtha official, usually the Chief Irrigation Officer, who allocates water to each Tertiary Subak in accordance with Cultivation Plan requirements. Water quotas are noted on an official board at the site of that intake. During the east, or dry monsoon, priority water turns are allocated a) to domestic (Desa) and animal watering purposes, b) to those sawah with low west-monsoon output, c) to middle (Baong) sawah, d) to second crop (Polowijo) fields and e) to fields under the concession regime (sugar plantations) if there is surplus water. The latter priority aims, in particular, at putting sugar plantations, which traditionally received more and better water, on an equal footing with paddy and other crops.

While the Bina Tîrtha system remains basically regulated by the provisons of the 1936 General Water Regulation and of the 1939 Provincial Regulation for East-Java, it has nevertheless managed, on the model of the Bali Subak, to largely re-dimension water management areas into more extensive hydrological units. Furthermore, the Provincial Public Works Service of East-Java Province has recently undertaken a full internal re-organization which will ultimately see its technical and administrative divisions patterned on the basis of administrative areas of jurisdiction made to coincide with the hydrological boundaries of the river basins of the Province.

In the meantime, the Bina Tîrtha water management system has already achieved a noteworthy degree of integration into what may be labelled a "Mixed Government-Subak administration".

5. CONCLUDING REMARKS

The interesting features of the Bali Subak in particular, and of the Indonesian water resources management experience in general, are many. The context itself of this experience is particularly illustrative of the confrontations which can be observed between different immemorial, though still living traditions and the necessities of a modern unitary society, between a subsistance and a developing market economy, between customary water management practices and an evolving administrative framework for the rational management of water resources, and between traditional customary law and a modern system of codified legislation, all within the ambit of a single developing nation with thirty years of experience as a modern independent State.

The last out of some seventeen centuries of Indonesian history is also illustrative of what the ultimate six centuries or so of our present World history may represent in regard to the origin of man's existence. Whatever the civilizations, living or dead, be they the Hindu, Chinese, Egypto-Babylonian, Hebrew, Pre-Colombian or the Buddhist, classical Greek, Roman, early Christian and Moslem civilizations, and whatever their particular forms of expression, they all did, and those which have survived still do look upon man and water resources according to the same fundamental concepts. Even if in the early ages of the Christian era man could, at Roman Law, assert in a limited way his private dominion over certain waters, it is only with the Humanistic current of the Renaissance in the XVth Century that he could think of acquiring a private and exclusive ownership right on water, as later made possible through the French Revolution of 1789, and subsequently institutionalized in the Code Napoléon of 1804. Until then, man's harnessing, control and use of water had not necessitated the assimilation, by means of a legal fiction, of water with a mere commodity, although relationships between man and water did certainly not lack appropriate regulation.

The emergence of the principle of nationalities towards the end of the Upper Middle Ages in the XIIIth Century also greatly contributed to the subsequent creation of the legalistic concept of the Public Domain and to the corresponding disappearance of the vacant (res nullius) and community (res communis) land and water resources concepts which had been maintained at Roman Law. It is also from that time that a feudal structure of society, in the negative sense of the term, became established and made it possible for the legal regime of water resources to later become fully assimilated with that of the land resources, and for the right of ownership thereon to acquire its absolute and individualistic character as sanctioned by the maxims "ius utendi, fruendi et abutendi" and "..... usque ad coelum, usque ad inferos" which gave birth to the Riparian Doctrine on the Continent, in the eastern United States and subsequently, to the Prior Appropriation Doctrine of the western United States.

Ever since the Industrial Revolution in the late XVIIIth Century however, such a private and exclusive ownership right has constituted a fundamental constraint to both economic development in general and to the rational management of water resources in particular. It has

therefore progressively been restricted in its content and continues to be further limited in its exercise to the extent that this theoretically fullest right is said to have become the most limited among all private rights.

Basic limitations introduced by legislation have been the institutionalization of the public-cum-private water dichotomy with the centralized regulation of the prior authorization system for public water uses, and the introduction of the regime of easements and servitudes in connection with private water uses. The Riparian Doctrine has then been assorted with the principle of "rights in natural waters" whereas the Prior Appropriation Doctrine has been limited by the "beneficial use" criterion. In Latin America, private land ownership rights have been given a "social function", whereas in the Soviet Union private water owners have been expropriated in favour of the State. In such a system based on the State Ownership Doctrine, irrigation water users for instance have been reduced to the status of mere tenants of the State, a proposition which has shown its drawbacks in terms of agricultural output. The same doctrine, as applied in France for instance where all water resources are being progressively incorporated into the Public Domain, has not allowed for the costly procedure of public interest expropriation to be dispensed with, thereby making its implementation a rather uneconomic proposition while maintaining the State in the position of a competitive owner in regard to individual water users.

Recent trends in water legislation are going towards the general institutionalization of what is now usually referred to as the State Control Doctrine according to which all water resources are considered as forming part of the Wealth of the Nation which the State is made responsible for as a trustee and in the interest of the whole community. While generally following the Riparian Doctrine as in England for instance, Common Law countries which have always ignored the concept of Public Domain will undoubtedly experience less difficulties in introducing such a new concept which they have themselves propounded; but the reaction of individual users in trying to maintain their vested rights is likely to remain an almost insuperable problem, given the present status of that doctrine. Various techniques have been used in this connection; the most significant ones have been through water pollution and environment control legislation. Individual water users continue however to largely look upon such techniques as make-shift arrangements aiming at introducing further limitations to their private rights and fail to understand that such a new trend is not only absolutely necessary, but in their own interest if naturally limited water supplies are to remain both quantitatively and qualitatively available to satisfy an ever increasing demand.

What the various legal systems of the industrialized world are correspondingly aiming at with so much difficulty constitutes in fact the immemorial practice of the traditional civilizations of the East. The Subak system of Bali illustrates well how all that which separates the western and eastern worlds is a matter of motivation rather than of legal and institutional forms or techniques. Whereas the industrialized world has "discovered" a new concern for the human environment, the Subak system has always been regarded as what environmentalists would call

today a "micro-ecosystem". Although outside Bali this system fell into disuse for some centuries, the Javanese have recently remembered it and have now revived it into larger shapes.[67] Of fundamental importance in this connection is the fact that this basically Hindu-inspired water management system is evidently not disrupting the Buddhist, Moslem and other non-Hindu communities of Indonesia which are freely implementing it. The reason is that such a system constitutes an expression of something conceptually identical to their own way of understanding the relationships between man, water resources and the environment. It has thus indeed been possible for the Indonesian State to simply abolish the earlier and imported system of public-cum-private water ownership and to reinstate its customary water use right which does not follow from a superior public or private ownership right, but which rests upon the concept that water resources are a common good in the use of which all members of the community have equal rights which can be freely exercised as long as the natural limits of the community interest are respected.

This water management system has now been institutionalized among others in Indonesia and will be further regulated accordingly. To this end, the Indonesian Governemnt is currently considering how to make each river basin or major hydrological area into a single water management unit. Should such a development take place, these units would function as large Subak systems, thereby realizing what could be called the passage from a micro- to a macro-ecosystem. An experience of this kind would then demonstrate how it is possible, and easy for a developing country to promulgate a water legislation satisfying all the requisites of a modern resource-oriented, or rational water resources management approach, without refuting any of her traditional concepts or customary practices.

ANNEX I

Law No. 11/1974 on Water Resources Development*

(Unofficial translation)

BY THE GRACE OF ALMIGHTY GOD
THE PRESIDENT OF THE REPUBLIC OF INDONESIA

Considering that:

a. water, water resources and the natural riches contained therein are a gift of Almighty God and that, given their overall beneficial character, they are required by man for economic, social and related cultural purposes;

b. soil, water resources and the natural riches contained therein shall be controlled by the State and utilized for the optimum welfare of the People in a just and equal manner;

c. the utilization of water and water resources shall be in the interest and welfare of the People so as to promote at the same time economic growth, social justice and the ability of the People to form a just and prosperous Community based on the Pantjasila;

d. the 1936 "Algemeen Water Reglement" has not been implemented throughout Indonesia and that other legislation relating to water resources development is no longer in conformity with the present situation;

e. in order to achieve these purposes, a national water resources development law is needed which shall be in conformity with the economic, social as well as technological development of Indonesia and which shall serve as the basis for further regulations;

and considering further:

1. Articles 5(1), 20(1), 27 and 33(3) of the 1945 Constitution;

2. The Decree of the People's Consultative Assembly No. IV/MPR/1973 on Guidelines of State Policy;

3. The Basic Agrarian Law No. 5/1960 (Govt. Gazette No. 104/1960 and Supplement No. 2043);

4. The Basic Health Law No. 9/1960 (G.G. No. 131/1960 and Supplement No. 2068);

5. Law No. 11/1962 on General Hygiene (G.G. No. 48/1962 and Supplement No. 2475);

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*Published in Government Gazette No. 65/1974.

6. The Basic Law No. 5/1967 on Forests (G.G. No. 8/1967 and Supplement No. 2823);

7. Law No. 6/1967 on Cattle Breeding and Animal Health (G.G. No. 22/1967 and Supplement No. 2824);

8. The Basic Mining Law No. 11/1967 (G.G. No. 22/1967 and Supplement No. 2831);

9. Law No. 5/1974 on Local Government Administration (G.G. No. 38/1974 and Supplement No. 3037);

With the assent of Parliament

HEREBY PROMULGATES

THE LAW ON WATER RESOURCES DEVELOPMENT

CHAPTER I

Definitions

Article 1

In this Law, the following terms shall have the following meaning:

1.	State:	the State of the Republic of Indonesia;
2.	Government:	the Government of the Republic of Indonesia
3.	Water:	any water found in or originating from surface as well as underground water resources, excluding the waters of the high sea;
4.	Water resources:	natural water bodies and man-made reservoirs, whether surface or underground;
5.	Water resources management:	the control and administration of water and water resources, either in their natural state or as exploited by man and including the natural inorganic riches contained therein;
6.	Regulations:	all legal provisions governing the right of use, the control, management, utilization, processing and policing of water and water resources, including the natural inorganic riches contained therein, for the optimization of benefits with a view to satisfying the vital needs of the People;
7.	Water management area:	a water resources basin of area, including all structures and networks therein, the management whereof shall be in accordance with special regulations;
8.	Hydrogeological area:	a water resources basin or area, including surface and underground waters;
9.	Water resources development:	the development of water and water resources for the utilization thereof through project plans, designs and technical specifications made in accordance with the relevant general development plan and intended to optimize benefits and to satisfy the vital needs of the People;

10. General planning: all activities and undertakings aiming at the formulation of basic guidelines for large scale development programmes to be implemented in accordance with defined general and particular objectives, and taking into consideration the suggestions, project ideas, available knowledge and experience as well as prevailing conditions and circumstances;

11. Project planning: all activities and undertakings intended to serve as guidelines, designs and specifications for the implementation of specific small scale projects of a technical nature.

CHAPTER II

Nature and Purpose

Article 2

Water and water resources, including the natural riches contained therein, as defined in Article 1, paragraphs 3,4 and 5 of this Law have a social function and shall be utilized for the welfare and prosperity of the People.

CHAPTER III

Right of Control and Competences of the State

Article 3

(1) Water and water resources, including the natural riches contained therein, as defined in Article 1, paragraphs 3, 4 and 5 of this Law shall be controlled by the State.

(2) State control as referred to in paragraph (1) of this Article shall empower the Government to:

a. manage and develop the utilization of water and water resources;

b. authorize or license water uses on the basis of the relevant general and project plans and in accordance with corresponding regulations;

c. regulate, authorize or license the utilization, purpose of use and supply of water and water resources;

d. regulate, authorize or license the exploitation of water and water resources; and

e. determine and regulate legal acts and relationships among individuals and/or corporations in respect of water and water resources uses.

(3) The provision of paragraph (2) of this Article shall be subject to the existing rights of the local adat communities in so far as such rights are not contradictory to the national interest.

Article 4

The powers of the Government, as specified in Article 3 of this Law, may be delegated to its agencies at the central or regional level or to specific corporate bodies in accordance with conditions and procedures as specified by Government Regulation.

Article 5

(1) The Minister in charge of water affairs shall be responsible and is hereby empowered to coordinate all matters relating to general and project planning and to the supervision, exploitation, maintenance, conservation and utilization of water and water resources, subject to the interests of the Departments and agencies concerned.

(2) The administration of underground water resources and of hotsprings as mineral and geothermal resources shall not fall under the competence and responsibility of the Minister referred to in paragraph (1) of this Article.

Article 6

In the case of an emergency, or in the likelihood that an emergency would occur, the Government shall be entitled to take precautionary measures and to regulate protection or relief activities in departing from the provisions of this Law.

Article 7

The functions and powers referred to in Articles 4, 5 and 6 of this Law shall be further specified by Government Regulation.

CHAPTER IV

General and Project Planning

Article 8

(1) Water regulations, water management areas and water resources development shall be based on general and project plans intended to serve the Community interest.

(2) General and project plans governing water management areas and water resources development as referred to in paragraph (1) of this Article shall be subject to the interest of the People for all purposes and in accordance with established priorities.

(3) General and project plans referred to in paragraph (2) of this Article shall aim at water resources development in conformity with the basic framework of National Development and shall be implemented in accordance with national, regional and local interest purposes.

Article 9

Water resources planning, development and utilization shall be based on the survey and inventory of water and water resources in terms of National Wealth.

CHAPTER V

Management

Article 10

(1) In accordance with its statutory functions and powers, the Government shall formulate specific water resources management policies, in particular with respect to:

a. The determination of the conditions and procedures for general and project planning and for water and water resources utilization, exploitation, policing and licensing;

b. The permanent regulation and implementation of water and water resources development as well as of waterworks management, including main structures and networks, with a view to the optimization of benefits;

c. The prevention of pollution harmful to water uses and to the environment;

d. The control of, and protection against harmful effects of water;

e. The survey and inventory of water resources; and

f. The procedures for, and implementation of information and special training programmes in the field of water resources.

(2) The implementation of the policies referred to in paragraph (1) of this Article shall be subject to Government Regulation.

CHAPTER VI

Utilization

Article 11

(1) The central and local governments shall hold primary responsibility in ensuring that water and water resources are used beneficially.

(2) Corporations, associations and individuals shall obtain a government license in order to utilize water and water resources.

(3) The provisions of this Article shall be further subject to Government Regulation.

CHAPTER VII

Operation and Maintenance

Article 12

In order to ensure the adequate functioning and operation of water management and hydrogeological areas, waterworks and related structures shall be operated, maintained and repaired in accordance with the following provisions:

a. In the case of waterworks or structures directly benefiting a particular community, corporation, association or individual, the beneficiary shall participate in these works; such a participation shall be further subject to Government Regulation;

b. In the case of waterworks or structures intended to serve the public interest, these works shall be undertaken by the central or interested local governments.

CHAPTER VIII

Conservation

Article 13

(1) Water, water resources, waterworks and structures shall be permanently conserved and protected in order to maintain their social function as specified in Article 2 of this Law. To this end, the following shall be undertaken:

   a. Soil and water resources conservation;

   b. The control of harmful effects of water on water resources and on the environment;

   c. The control of water pollution harmful to water uses and to the environment; and

d. The conservation and protection of waterworks and structures in order to ensure their permanent operation.

(2) The provisions of paragraph (1) of this Article shall be further subject to Government Regulation.

CHAPTER IX

Financing

Article 14

(1) The financing of all activities within the framework of water and water resources control and development shall be subject to Government Regulation.

(2) Communities directly benefiting from existing waterworks and structures either for their subsequent or immediate use may be required to share related management costs.

(3) Corporations, associations and individuals directly benefiting from existing waterworks and structures either for their subsequent or immediate use shall share related costs in the form of a contribution payable to the Government.

(4) The provisions of paragraphs (2) and (3) of this Article shall be subject to Government Regulation.

CHAPTER X

Penal Provisions

Article 15

(1) Imprisonment up to 2 years and/or a fine up to Rp. 5,000,000 (five million Rupiahs) shall be inflicted upon anyone who:

a. Intentionally makes use of water and water resources not in accordance with general or project plans or water resources development as defined in paragraph (1) of Article 8 of this Law;

b. Intentionally makes use of water and water resources without a prior licence as specified in paragraph (2) of Article 11 of this law;

c. Having obtained from the Government a water or water resources use license as specified in paragraph (2) of Article 11 of this Law, intentionally refrains from undertaking, or from participating in activities relating to the conservation of soil, water and water resources or to the protection of waterworks and structures as specified in paragraph (1), items a, b, c and d of Article 13 of this Law.

(2) Offences specified in paragraph (1) of this Article shall be considered as crimes.

(3) Anyone who, by negligence, infringes the provisions of Article 8, paragraph (1), Article 11, paragraph (2) and of Article 13, paragraph (1), items a, b, c and d, of this Law shall be liable to detention up to 3 months and/or a fine of up to 50,000 (fifty thousand Rupiahs).

(4) Offences specified in paragraph (3) of this Article shall be considered as minor offences.

CHAPTER XI

Transitory Provisions

Article 16

All provisions of the existing water legislation not contradictory to this Law shall continue in force as long as, and until new regulations are issued as provided for in this Law.

Chapter XII

Final Provision

Article 17

This Law shall enter into force on the date of it promulgation.

In order that everyone shall know thereof, this Law shall be published in the Government Gazette of the Republic of Indonesia.

Promulgated in Jakarta

on the 26th of December 1974

The President of the Republic

of Indonesia,

SOEHARTO

Published in Jakarta

on the 26th of December 1974

The Minister/Secretary of State

S.H. SUDARMONO

ANNEX II

The 1972 Provincial Water Regulation for Bali

(Unofficial translation)

THE PEOPLE'S ASSEMBLY

OF THE PROVINCE OF BALI

Do hereby enact: THE PROVINCIAL REGULATION OF BALI ON IRRIGATION

CHAPTER I

General Definitions

Article 1

Water resources consist in natural water bodies, both surface and underground, such as rivers, lakes, swamps, springs and underground water layers.

Article 2

Water resources development consists in all activities relating to the utilization of water and water resources.

Article 3

Irrigation consists in all activities relating to the utilization of water and water resources for agricultural purposes.

Article 4

A Subak consists in a traditional socio-agrarian-religious adat law Community in Bali which has developed into an organization of landowners having for purpose the management of water and related matters in connection with the irrigation of rice fields with water originating from within a given water resources area.

Article 5

The Awig-Awig or Sima Subak consists in written as well as unwritten regulations governing the internal affairs of a given Subak.

Article 6

The Kelian Subak or Pekaseh is the chairman of the Subak.

Article 7

The Krama Subak is a member of the Subak.

Article 8

The Sedahan, Sedahan Yeh or Pengelurah is an officer of the Regency administrative authorities in charge of irrigation water management and control in the various Subak under his jurisdiction.

Article 9

The Sedahan Agung is an officer of the Regency administrative authorities in charge of the orderly management and control of irrigation within the Regency; he shall be appointed as a Government adviser and administrator in matters relating to irrigation.

CHAPTER II

Article 10

Water and water resources constitute part of the National natural Wealth which shall be controlled at the regional level by the Provincial administrative authorities of Bali.

Article 11

The power of control referred to in article 10 shall carry the right to manage everything relating to the utilization of water for the optimum welfare of the People.

Article 12

The power of control vested in the Provincial administrative authorities of Bali shall be based on the national interest and on the principle of national unity.

Article 13

Subject to the national interest and to the provisions of the laws and regulations in force, the power of control vested in the Provincial administrative authorities of Bali may be delegated to the regional administrative authorities (Regencies, etc.), to corporations and adat law communities, public agencies and their officers.

CHAPTER III

Obligations of the Subak, Sedahan and Sedahan Agung

Article 14

(1) The Subak shall organize its own internal affairs with a view to making water available, as well as to managing the orderly and effective distribution thereof among the irrigated rice fields of all Krama Subak within its area of jurisdiction.

(2) The Subak shall take all appropriate measures in order to protect and maintain the irrigation network with a view to ensuring an orderly and uninterrupted irrigation within its area of jurisdiction.

(3) In organizing its internal affairs, the Subak shall apply the provisions of the existing regulations, Awig-Awig or Sima Subak.

(4) All disputes arising within its area of jurisdiction shall be settled by the Subak.

(5) Breaches of the law and offences shall be prosecuted in accordance with the provisions of the laws and regulations in force.

Article 15

(1) The Sedahan shall be in charge of the water distribution in the group of Subak (Pasedahan) within his area of jurisdiction in accordance with the time, volumetric and crop-system established on the basis of the data collected from among the various Subak within his Pasedahan.

(2) The Sedahan shall control the use, discharge and management of irrigation water as well as the maintenance of the irrigation network in the various Subak within his Pasedahan.

(3) The Sedahan shall settle water disputes arising among the various Subak within his Pasedahan and shall prosecute breaches of the law and offences in accordance with the provisions of the laws and regulations in force.

(4) The Sedahan shall seek the approval of the Regency administrative authorities in order to extend irrigated rice field areas or to set-up any new Subak within his Pasedahan.

(5) In the implementation of his tasks, the Sedahan shall be assisted by the Sectional Public Works, Agricultural and other Services and Officers, as designated by the Regency administrative authority concerned.

Article 16

(1) The Sedahan Agung shall control the use, discharge and management of irrigation water as well as the maintenance of the irrigation networks in the various Pasedahan within a Regency.

(2) The Sedahan Agung shall control the distribution of irrigation water in the various Pasedahan within his area of jurisdiction in accordance with the established time, volumetric and crop-system of the various Subak concerned.

(3) The Sedahan Agung shall settle water disputes arising among the various Pasedahan under his jurisdiction; disputes involving irrigation water matters arising outside the Regency shall be referred to the Regency administrative authorities for settlement.

(4) The Sedahan Agung shall require the approval of the Regency administrative authority for matters concerning:

a. The reclamation of rice fields and the setting-up of any new Subak;

b. The extension of the irrigated rice field area with existing Subak;

c. The modification of existing irrigation networks; and

d. The construction of new irrigation structures and networks.

(5) In the implementation of his tasks, the Sedahan Agung shall be assisted by the Sectional Public Works, Agricultural and other Services and Officers, as designated by the Regency administrative authority concerned.

CHAPTER IV

Obligations of the Regional Administrative Authorities

Article 17

The Regency administrative authorities shall supply water and regulate the use thereof in the various Subak for the irrigation of rice fields within their area of jurisdiction in accordance with established time, volumetric and qualitative requirements for the optimum benefit and welfare of the People.

Article 18

(1) The Regency administrative authorities shall settle irrigation water disputes referred to them by the Sedahan Agung and other Regency Officers, and shall refer to the Provincial administrative authorities of Bali all matters involving irrigation water disputes with other Regencies.

(2) The Regency administrative authorities shall require the approval of the Provincial administrative authority for matters concerning:

a. The reclamation of rice fields and the setting-up of any new Subak;

b. The extension of the irrigated rice field area in existing Subak; and

c. The settlement of irrigation water disputes among Regencies.

(3) Each year, the Regency administrative authorities shall formulate draft plans for the rehabilitation, construction and maintenance of irrigation structures and networks with a view to obtaining corresponding financial assistance either:

a. from the central budget;

b. from the provincial budget;

c. from the regency budget; and/or

d. from "gotong royong" contributions.

(4) In the implementation of their task, the Regency administrative authorities shall be assisted by the Sectional Public Works, Agricultural and other Services and Officers it designates.

Article 19

(1) The Provincial administrative authorities of Bali shall control the management and use of irrigation water within the Regencies in accordance with established time and volumetric requirements for the optimum benefit and welfare of the People in conformity with the national interest and with the principle of national unity.

(2) The Provincial administrative authorities of Bali shall settle irrigation water disputes referred to them by the Regency administrative authorities or by the Provincial agencies with a view to ensuring that the use of irrigation water conforms with the national interest.

(3) Each 8 years, the Provincial administrative authorities shall formulate draft plans for the rehabilitation, construction and maintenance of irrigation structures and networks with a view to obtaining financial assistance either:

a. from the provincial budget;

b. from the central budget; and/or

c. from other sources.

(4) In the implementation of their tasks, Provincial administrative authorities shall be assisted by:

a. The Provincial Public Works Service (Irrigation Division) of Bali;

b. Other Provincial Services and Agencies as necessary; and by

c. Agencies and Officers designated to this effect.

(5) The Provincial administrative authorities shall be the highest judiciary authority for the settlement of irrigation water disputes; their decisions shall be binding and final.

CHAPTER V

Final Provisions

Article 20

Any matter not provided for in this Regulation shall be regulated by the Governor of the Province of Bali.

Article 21

This Regulation shall be called "The Irrigation Regulation of the Province of Bali" and shall enter into force on the day it is issued.

Issued at Denpasar

as Regulation No. 02/PD/DPRD/1972

on the 13th of December 1972

signed: I Gusti Ngurah Partha

Approved by the

Acting Governor of the Province of Bali

signed: SOEKARMEN

THE SUBAK

Kabupaten (Regency) level

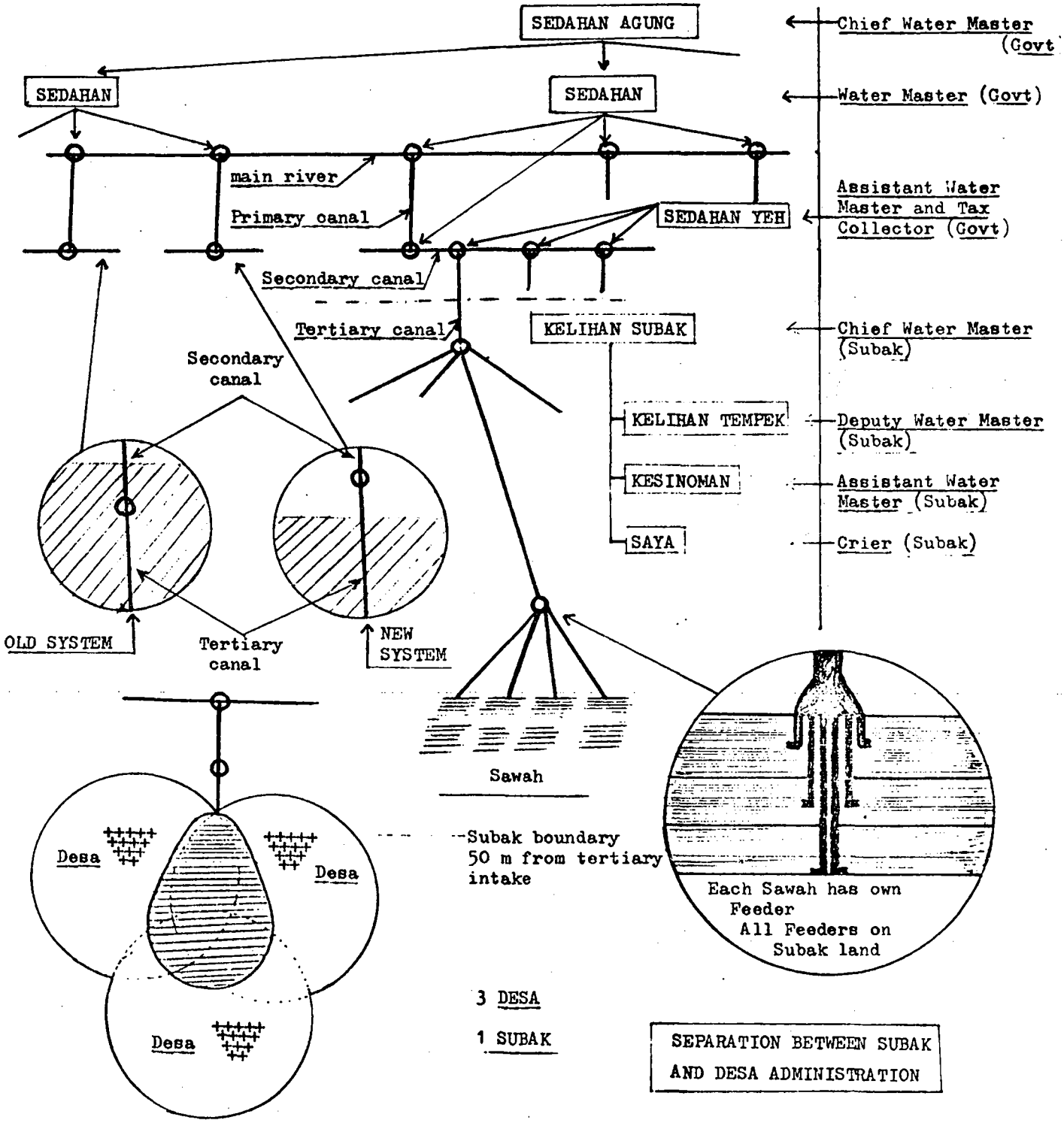

Fig. 1

THE DESA IRRIGATION

Kabupaten (Regency) level

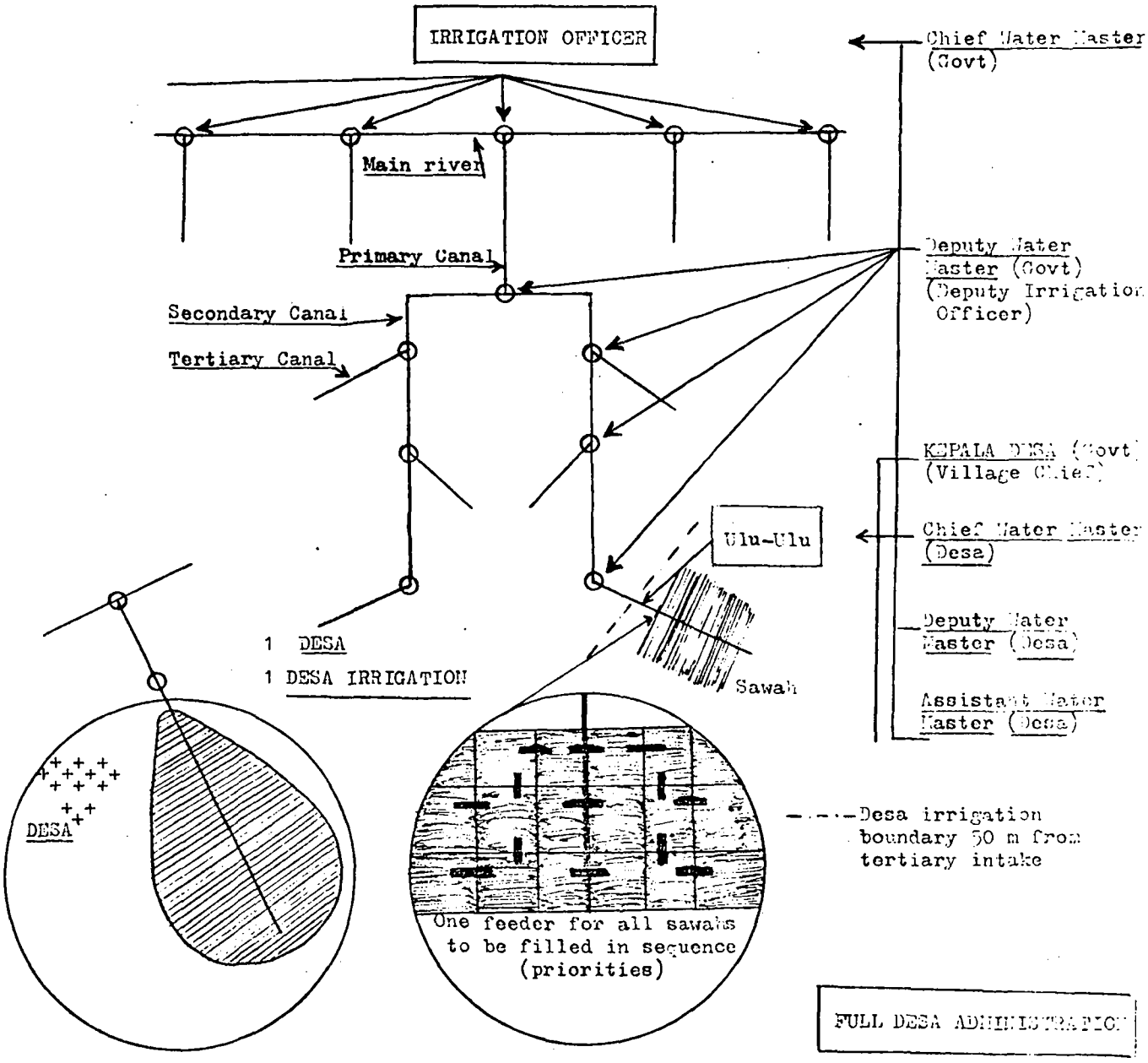

Fig. 2

THE DHARMATIRTHA
(Central-Java)

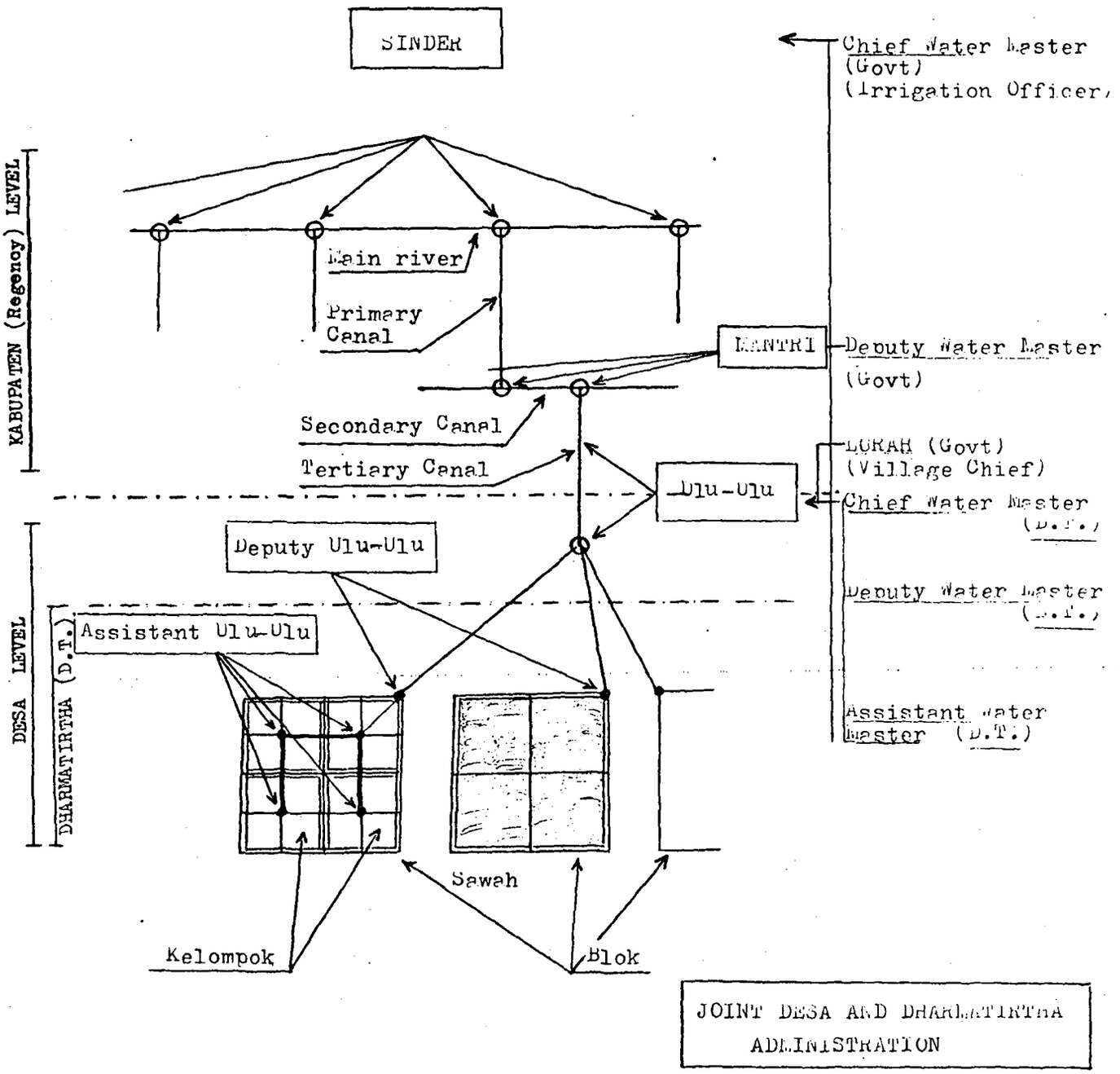

Fig. 3

THE BINATIRTHA

(East-Java)

Kabupaten (Regency) level

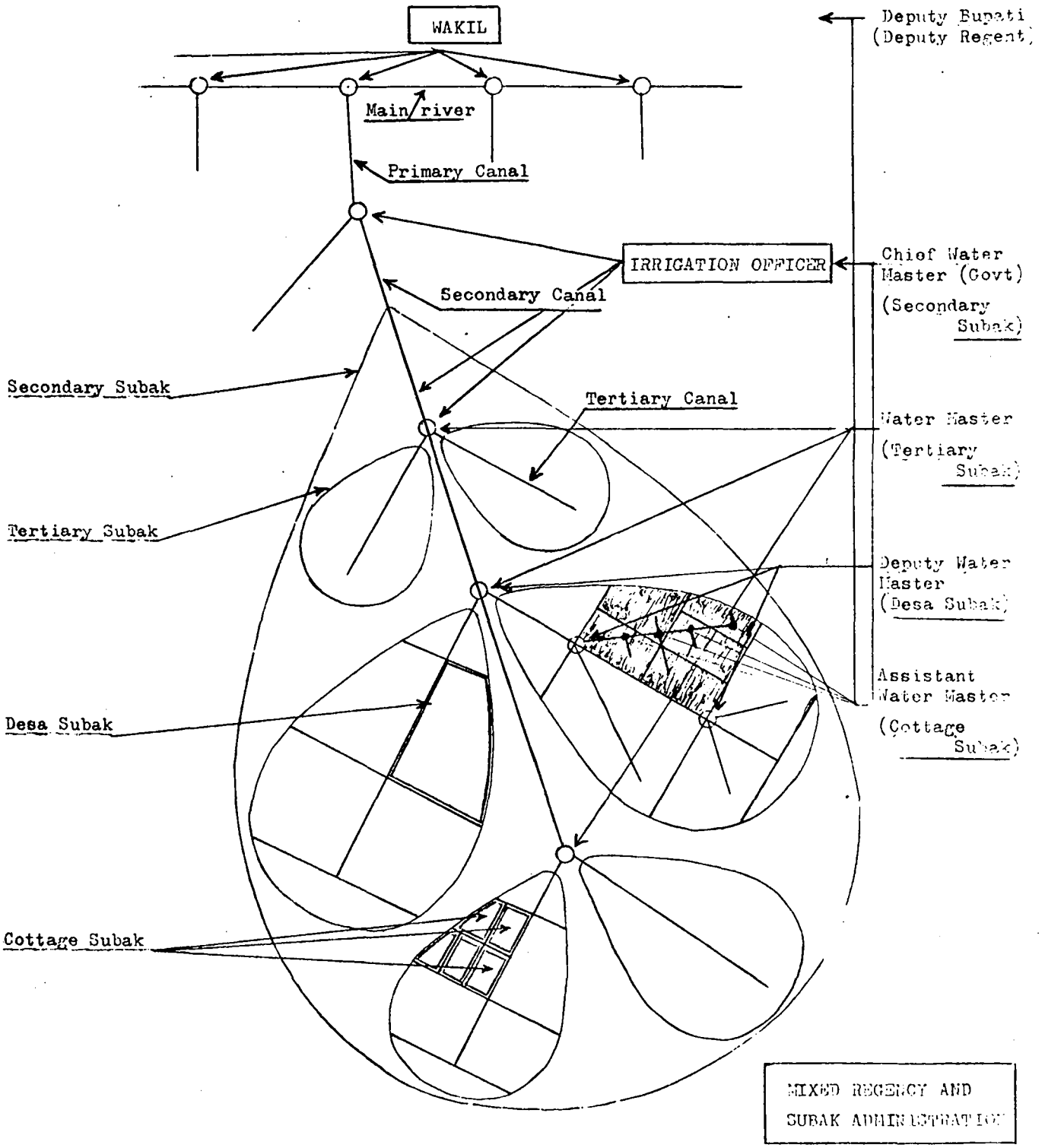

Fig. 4

EVOLUTION OF THE SUBAK FROM BALI INTO JAVA

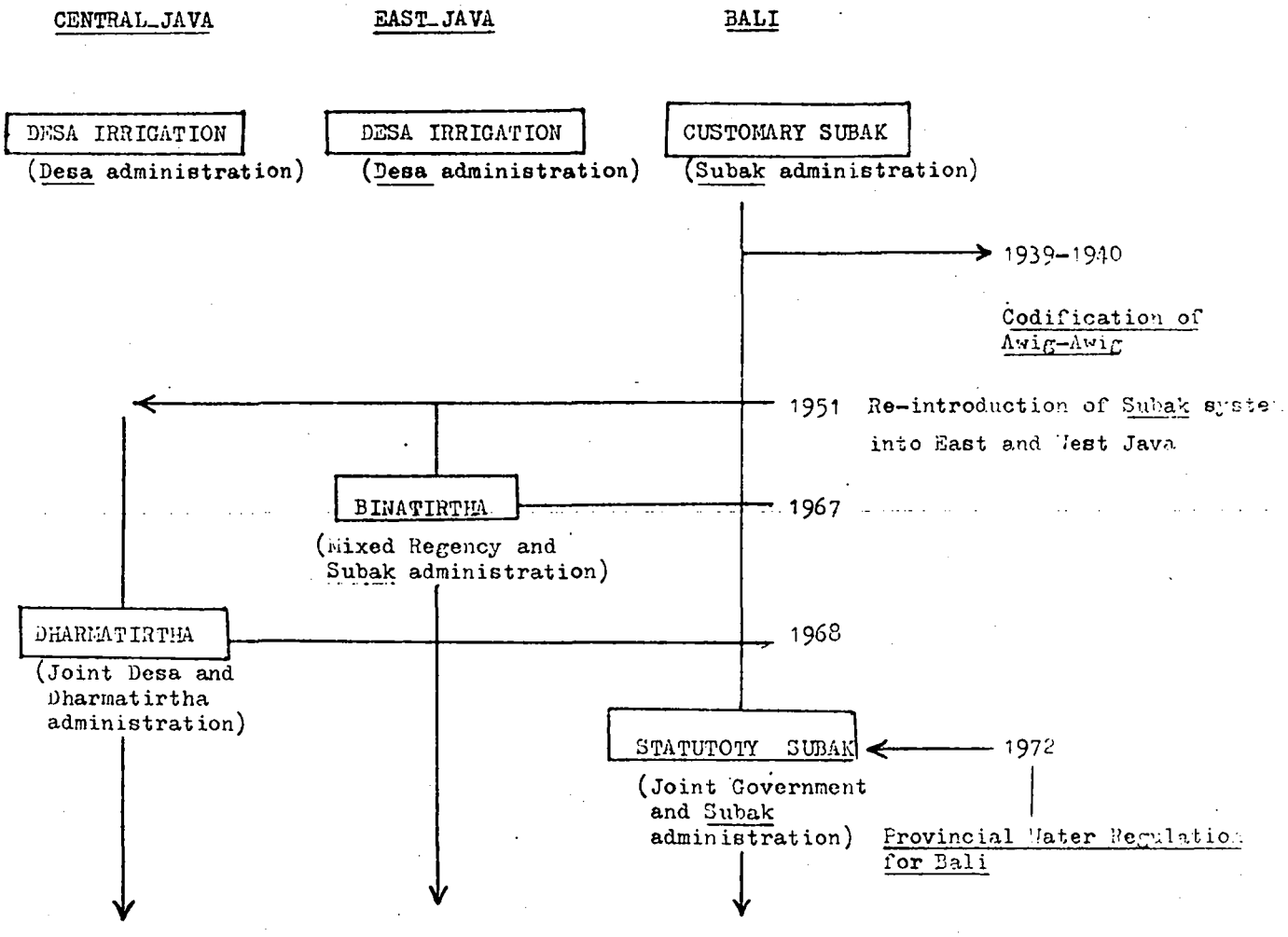

Fig. 5

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FOOTNOTES

1. Express provision was however made for derogations to adat law in cases where the provisions thereof would be in contradiction with those of the 1960 Agrarian Law, the principles of national interest and Indonesian socialism, special legislation and precepts of the Shari'ah, or Islamic Law (art. 5).

2. The concepts outlined here are among those contained in the Sacred Books of Hinduism, as illustrated in the traditional Hindu Commentaries. In the impossibility of providing all the necessary references in the footnotes, the reader is invited to refer to the general sources listed in the Bibliography and to which the whole substance of this chapter has been, however imperfectly, borrowed. As to the transliteration of Sanscrit terms, the system followed here is that used in those sources.

3. In the Rasâil Ikhwân es-Safâ,cited in R. Guénon, Formes traditionnelles et Cycles cosmiques, p. 130.

4. Or as the "Universal Man" in the Hebraic and Islamic doctrines, and as the "King" (Wang) in Taoism.

5. Or the "Invariable Mean" (Tchoung-young) in Taoism. In the Occidental tradition, the same principle was illustrated by Aristoteles as the "Motionless Motor" which, still, presides over the cosmic movement.

6. Or Dhamma in the Pâli scriptures of Buddhism.

7. The closest correspondence in the Occidental tradition would be the "Philosophia Perennis" of the Scholastics with the meaning of the Greek classical "Sophia"; it effectively corresponds however to the "Tao" of the Far Eastern doctrine. (Akaliko Dhamma in Pâli).

8. Or "Rectitude" as the "Te" of the "Tao-Te-King" in the Chinese tradition.

9. As the "Thorah" in the Hebraic doctrine and the "Shari'ah" in the Islamic doctrine, for instance.

10. "SÛtra", verse or stanze in which the doctrine is scripturally formulated.

11. "Shâstra", codification or code.

12. The relationship between the essence of the Dharma-sûtras and the substance of the Dharma-shâstra can be somehow compared to the "li" and "fa" of the Chinese doctrine and to the "Usūl-alFigh" and "Furu'al-Figh" of Islam. For further developments, see Dante A. Caponera, Water Law Principles in the Chinese Legal System, p. 240-244, and Water Laws in Moslem Countries, p. 1.

13. The concept of Brahma may however not be equated with that of God in the Occidental meaning of the term. It is in fact the impersonal Supreme Norm or Principle which is beyond any qualification. As a determination, or specification, the "divine personality", or God, is designated as "Ishwara" who is himself envisaged after a triplicity of fundamental aspects forming the "TrimÛrti", or "Triple Manifestation". Accordingly, Ishwara is Brahmâ as the Producer, Vishnu as the Animator and Keeper, and Shiva as the Transformer of all produced beings. Here again, such determinations are not to be seen as separate individualities, but as the essential functions of Ishwara. (It should be noted that the term "Brahma" is neutral whereas "Brahmâ" is masculin).

14. This corresponds to what is defined in Taoism as the "concording actions and reactions".

15. It would somehow correspond to the legal notion of "objective liability" at the exclusion of any "subjective responsibility".

16. The "Caliph" in Moslem society.

17. Manu, 1886: 229, 396 and ff. cited in Karl A. Wittfogel, Oriental Despotism, Yale University Press Inc., Fifth Ed., New Haven, Connecticut, February 1964, p. 126.

18. For a review of Hindu water law and the corresponding social organization in India see, Ludwik A. Teclaff, Abstraction and Use of Water: A comparison of Legal Regimes, p. 45-49, and Handa and Desai, India, in Water Legislation in Asia and the Far East, Part 2, ECAFE Water Resources Series No. 35, United Nations Document ST/ECAFE/SER.F/35, New York, 1968.

19. Manu, 1886: 260 and ff., cited in Wittfogel, op.cit., p. 123-124.

20. Manu, 1886: 218-220, Ibidem, p. 138.

21. See, Provincial Public Works Service, The System of Subak in Bali (A Brief Description)

22. See, footnote 13.

23. Or "Materia Prima" in Scholastic terminology. C.f. "We made from water every living thing" in Moslem doctrine, Holy Koran, XXI, verse 30, cited in Caponera, Water Laws in Moslem Countries, Op. cit. p. 11.

24. As expounded in the Bhagavad-Gîta, Mahâbârata (Smriti).

25. Hindu cosmology is expounded in the 2nd Darshana, or Vaishêshika, which contains 6 Padârthas, or categories, of which the 3rd constitutes the Karma-sûtras. In addition to the 5 elements (bhûtas), the Padârtha enumerating the substances and attributes of the Cosmos mentions 2 corporal attributes (dravyas) which are "time" (Kâla), to be associated with Shiva, and "space" (dish), to be associated with

Vishnu, as well as 2 other non-corporal elements which are the "intellect", or mental faculty (âtmâ), and the "mind", or soul (manas).

26. Manu: IX, 219 in F. Max Müller, The Sacred Books of the East, Vol XXV, p. 379, cited by D.A. Caponera, Water Laws in Hydraulic Civilizations, Wittfogel Festschrift (to be published in The Hague).

27. See, Caponera, Water Laws in Moslem Countries, op. cit., p. 13.

28. See, Lips, Julius E., "Government", in General Anthropology, Ed. F. Boas: 487-534, 1938, cited by Wittfogel in Oriental Despotism, Op. cit., p. 232 note a) quoting the Tradition of the Iroquis Indians.

29. See, Sudargo and Hornick, An Introduction to Indonesian Law: Unity in Diversity.

30. Indonesia, 1936 General Water Regulations, art. 1.

31. Indonesia, Constitution, art. 33(3)

32. Ibidem, art. 33(1)

33. Indonesia, Agrarian Law of 1960, art. 2 (This Law abrogated not only the Dutch Agrarian Law and Public Domain Declaration of 1870, but Book II of the Civil Code of 1848 governing land, water and natural resources, and the Royal Decree of 1872 which had established the right of "agrarian ownership" (eigendom) and provided for the conversion of hak milik into eigendom through registration.

34. Ibidem, art. 5.

35. A basic Water Law was promulgated on 26 December 1974 to regulate water resources and to place the regime thereof on the par with that of land rights. An unofficial translation thereof is given in Annex I.

36. Hak pemeliharaan dan penangkapan ikan

37. One of which is reserved to women having menstruations.

38. Or "Tien-ti-jen" in Taoism.

39. Constitution of Indonesia, Preamble; 1960 Agrarian Law, Art. 5.

40. Or religious endowments (wakf) in Islamic Law.

41. 1936 General Water Regulation for Java and Madura; 1937 General Regulation on Water Management in Java and Madura. See also, Boedidarmo B., Some Aspects of Water Resources Administration in Indonesia.

42. 1972 Provincial Water Regulation for Bali. An unofficial translation thereof is given in Annex II.

43. The Provincial Government administration system in Indonesia is currently in a rather unsettled situation. A 1965 Law on Principles of Local Government was repealed in 1969 and different laws and regulations promulgated before 1965 thus govern the local government administration of the various provinces which hold varying degrees of autonomy and of competences, including in the water management field.

44. It may be noted in this connection that the word "Agung" , also given to the Supreme Peoples' Assembly of the Republic of Indonesia, means "head", "origin" or "centre", the name given to the Sacred Mount Agung of Bali, itself considered as the local representation of Mount Mêru, symbolizing the axis of the Universe in Hindu Cosmology.

45. Called "Lurah" in Central-Java.

46. 1939 Provincial Water Regulation for East-Java; 1956 Provincial Water Regulation for Jogjakarta; 1960 Provincial Water Regulation for West-Java; and 1960 Provincial Water Regulation for Central-Java. Although Provincial Water Regulations were codified at later dates, the 1936 General Water Regulation had, in fact, been implemented throughout Java as from the late 1930's.

47. 1936 General Water Regulation, art. 16.

48. 1939 Provincial Water Regulation for East-Java, art. 21.

49. 1936 General Water Regulation, art. 7; 1939 Provincial Water Regulation for East-Java, art. 36.

50. 1936 General Water Regulation, art. 8.

51. Ibidem, art. 21.

52. Ibidem, art. 10; 1939 Provincial Water Regulation for East-Java, art. 9.

53. 1939 Provincial Water Regulation for East-Java, art. 14.

54. 1939 Provincial Water Regulation for East-Java, art. 27.

55. Ibidem, arts. 30-32.

56. 1936 General Water Regulation, art. 12.

57. 1939 Provincial Water Regulation for East-Java, arts. 13, 16-17, 19-20.

58. Ibidem, art. 12.4.

59. Ibidem, art. 7.

60. 1936 General Water Regulation, art. 50.

61. Ibidem, art. 24.

62. Ibidem, art. 25; 1939 Provincial Water Regulation for East-Java, art. 54.

63. 1939 Provincial Water Regulation for East-Java, art. 55.

64. See, Frans Budikahono, Dharma Tîrtha (Water Management at the Rural Level in Kabupaten Sragen). It is interesting in this connection to note the association of the terms "Dharma" (Law) and "Tîrtha" (sacred water place).

65. One US dollar was equivalent to approximately 415 Indonesian Rupiahs in April 1975.

66. See, Regency Public Works Service, Subak Stelsel in Kabupaten Bojonegoro (It's called Bina Tîrtha).

67. See Fig. 5.

LEGAL AND ADMINISTRATIVE ASPECTS OF THE WATER LAWS IN ISRAEL

by

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PART I - SUBSTANTIVE LAWS

1. INTRODUCTION INTO LEGAL PHILOSOPHY AND FRAMEWORK OF WATER LAW SYSTEM

1.1 General Background

Israel extends some 500 km in the north-south direction and averages 60 km in width, its area being little over 20,000 square km (excluding the occupied territories).

The only effective source of surface water supply to augment the rainfall is Lake Kinneret (the Sea of Galilee) in the north east corner of the State. It covers an area of 165 square km and holds nearly 4,000 million cubic meters of water. It is fed by the Jordan River. The total annual inflow from these and minor tributaries and from direct rainfall on the lake averages 600 to 650 m c.m. per year. Of this amount, 320 m c.m., or about one half, has been diverted by channel and pipeline to the west and south via the national Carrier system.

Of the total known water resources, 25 per cent are surface water from the Jordan River, 60 per cent is ground water, 5 per cent is intercepted storm runoff and 10 per cent is brackist. Over 90 per cent of these resources are already being utilized.

Israel's current water requirements are 1675 m c.m. per year and the estimate for 1985 is around 2000 m c.m. The increase of 325 m c.m. is far in excess of the available additional resources, even allowing for the inclusion of lower quality saline ground water in the supplies, and the gap will be bridged by reuse of water and by sea water desalination.

Israel is semi-arid in the north and arid in the south, and is mostly dependent on irrigation for agriculture. The arable land and the water resources are extremely scarce. Out of a total of 2 million hectares, about one quarter only is arable.

The total potential water resources (about 1,700 million m^3 per year, including brackish water) is sufficient to irrigate not more than 40 per

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cent of the arable area. Rain falls only between the months of November and March, and mostly in the northern part, whereas the majority of the arable land and the rural and industrial population are concentrated in the central and southern parts of the country. Such climatic conditions make irrigation capable of considerably increasing agricultural production, and since the early years of this century, water consumption for irrigation purposes has increased year after year.

Since the State of Israel was founded in 1948, water development and consumption have grown rapidly, and the amount of water utilized today exceeds 90 per cent of Israel's entire feasible water potential.

1.2 Introduction into the Legal Framework

Israel has always suffered from serious and constant water shortage. The natural resources of the country hardly suffice for meeting everyday consumption and great effort is necessary for developing new water resources and increasing the efficiency of water use, in order to catch up with the mounting pace of consumption, brought about by the burgeoning urban, industrial and rural growth.

As water is one of the most important factors in the development of a country, the State of Israel, ever since it was established in 1948, has faced the challenge of judicious and equitable water management and allocation, in a way that will ensure the use of the available water resources and at the same time safeguard the interests of the State, as far as this scarce natural resource is concerned.

A challenge of this kind could be met only through the promulgation of a system of laws which could serve, in the hands of the State, as a means for establishing rules and provisions aimed at regulating water use.

With the establishment of the State of Israel, the existing legal principles concerning this subject were examined and found most unsuitable to the needs of a fast-developing country.

These conditions gave rise to the need for putting the regulations of water management in the country into a new and entirely different system of laws, which takes into consideration the existing water problems and the planning of water utilization, in a way that will bring maximum benefit to all inhabitants.

Since the pre-State period did not boast adequate water legislation, the "legacy" also lacked the proper administrative framework, necessary for dealing with such a weighty subject. Such a framework had to be created, taking into account the needs of the country which, by then, had set about forming its own life patterns.

The first step was to establish the state ownership of the water resources, while at the same time starting to plan a suitable legal system.

The drafting of the Water Laws of the State lasted for more than seven years. During this period, particularly in the years 1955-1957, a number of separate laws were enacted, as it was impossible to wait for the final legislation.

The legislative framework of the water laws system today constitutes these laws:

1. The Water Metering Law, 1955
2. The Water Drilling Control Law, 1955
3. The Drainage and Flood Control Law, 1957
4. The Water Law, 1959, which is the basic and most important law in water legislation.

Attached to each of the laws is an extensive system of regulations and orders, the purpose of which is to implement the provisions of the laws.

2. THE POLICIES OF THE WATER LAWS

The basic idea underlying the water law is that water is a means of production which, owing to its shortage, should be utilized for the benefit of the public and used in the best and most efficient way, for the development of the country. In order to ensure this, it was necessary to abrogate the private ownership of the water resources, and to concentrate all dealing with these resources in the hands of the State. This conception finds expression in the first clause of the Water Law, which states that:

> "1. The water resources of the State are public property, under the control of the State and intended for the needs of its residents and the development of the country."

The control of all the various kinds of water is in the hands of the State, which acts as the trustee of the public as a whole, and whose duty is to ensure the proper distribution of the water, for the needs of the inhabitants, as well as for the development of the country.

The water ceased to be subject to private ownership rights. The right to use water is a right extended to every person and to every inhabitant in the State, by law, but is subject to the provisions of the law.

The basic tenet of Israel's water policy was that in order to ensure the maximum benefit to the nation, the plan for the development of the country's limited water resources is to be based on maximum water conservation, optimum management of the water resources and carefully considered water allocation. It was necessary to ensure that the authorities will be vested with adequate powers to control the water resources, to prevent their deterioration by contamination and pollution and to advance their development for the benefit of the country as a whole.

The administrative system was so designed that the parliamentary responsibility in all matters pertaining to water has been entrusted to the Ministry of Agriculture which, under the provisions of the Water Laws, is in charge of the enforcement of the said laws.

While the ministerial responsibility falls on the Minister of Agriculture, the executor of the provisions of the law is the Water Commissioner, appointed by the government to manage the water affairs of the State. An extensive network of legal powers has been entrusted to the Water Commissioner, so as to provide him with discretion on all matters concerning the allocation of water, control of water use, planning of water supply schemes and their operation, imposition of sanctions in case of violations of the law, etc.

In order to enable the Water Commissioner to exercise his powers under the provisions of the Water Laws, an administrative system has been established - the Water Commission.

The said administrative system derives its very existence and all its authority from the provisions of the law, and its sole purpose is to serve the requirements of the State's system of water laws. Without this legal basis, the administration has no right to exist. This principle is of far-reaching significance, as all the activities of the administration are moulded by the law and limited by it. That is to say, every act of the administration is considered and examined in the light of the law, and only if it is found to be in accordance with that law and meets its demands, can it then be carried out.

Because of Israel's unique forms of settlement (Kibbutzim, Moshavim) in addition to all the problems of a water scarce country, in which water resources are maldistributed, the water policy of Israel has special features, not to be found in any other country.

In addition, ideas like public participation; public hearing; Water Board; Planning Committee; Water Tribunal, etc., can be found in the legal system. All these ideas safeguard the public from any unreasonable, unjustified and uncalculated act of the administration.

In many ways, Israel must be viewed as a laboratory or model, trying to solve the complicated problems of production, optimization and preservation of the quality of water and the environment at the same time, under arid and scarce water conditions.

3. STATUS OF THE SUBSTANTIVE LAWS REGARDING:

3.1 Classification of Waters

One of the first principles set in the Water Law is a very broad and comprehensive definition of the water resources. Waters of all kinds are included in the definition of water resources and all provisions of the Water Laws operate on them. The definition of water resources includes

springs, streams, rivers, lakes and other flows and confluences of water, whether surface or ground, whether natural, regulated or installed, whether the waters rise, flow or stand, always or intermittently, and including drainage water and sewage water.

The issue of this definition is that all kinds of waters, from sewage water and drainage water to springs, streams and rivers' waters, wherever they are, surface or ground, for whatever purpose they are used, are subject to the control of the Water Law.

The sea is an exception, and the Water Law is not employed on it. Sea-waters are controlled by different laws.

3.2 Concept of Ownership

As reviewed at length in the preface, water resources in their broadest definition, are public property, subject to the control of the State and intended for the needs of its inhabitants and the development of the country. This is the underlying concept of the Water Laws. The State owns the water in all its resources and it acts in this matter as a trustee of the public as a whole and assigns the water for the needs of its inhabitants and the development of the country.

Private ownership of water has been expropriated and today there is no private ownership of water resources, unlike pumping, production and supply equipment, which can be in private hands. The public has been given the right to use the waters. Water from resources belonging to the State are supplied by organizations, companies and individuals, most of them public and a few private.

There is no legal possibility of acquiring ownership of water, but only the right of use. In order to eliminate doubts, the water law provides that a person's right in any land does not give him the right to the water resources situated thereon or crossing it.

As to the right of use, another basic principle in the Water Law provides that everyone has the right of use of water, subject to the provisions of the Law.

Every right to use water which has been recognized and stipulated in a way which will be reviewed below, is linked to one of the purposes of the waters defined in the Law - domestic, agriculture, industry, handicraft, commerce, services and public services. The right to water is abrogated upon the expiration of said purpose. Moreover, the right to use water is not personal but pertinent. As long as the purpose of use prevails, changes of ownership, for example, do not affect the right to water. A plantation for which the right to water has been recognized, will continue to be entitled to the quantity of water it needs, even though it has changed owners.

The right to use water can, from time to time, be changed, minimized or broadened, at the Water Commissioner's discretion and in case there is

a fundamental change in circumstances or in the condition of water in the country. The right of use can even be abrogated.

The right to use water is, in any case, not linked to a specific water resource. The right is only to a specific quantity of water. The Law provides that a person's right to receive water from a specific water resource stands as long as there is no hazard in exploiting the said resource. If there is danger of depletion of the water resource, or if operational reasons relating to the water-system justify it, the Water Commissioner has a legal authority to change the water resource from which a person gets the water. But, the Law ensures that the water from the other resource will be suitable to the use for which it is intended.

3.3 Manner of Allocation and Control (i.e., permits, water rights, etc.)

3.3.1 Production Licence

The Water Law stipulates that water cannot be produced, supplied or consumed otherwise than according to a licence, issued by the Water Commissioner. This licence includes provisions pertaining to production, supply and consumption of water, but is referred to, for short, as "production licence".

A production licence is required for all types of consumption and for every water purpose, without exception.

The authority to issue production licences gives the Water Commissioner control over the entire system of production, supply and consumption of water and enables him to implement the national water policy of the government.

The authority to issue production licences gives the Water Commissioner control over the entire system of production, supply and consumption of water and enables him to implement the national water policy of the government.

Every right of use of water finds expression in the production licence. The licence includes the naming of the producers, suppliers and consumers, where alongside each name the quantity he is allowed to produce, supply or consume is specified, all according to the matter. The licence also specifies the purpose of consuming the waters (domestic, agriculture, industry, etc.); the water resource and its location; the quantity of water allowed to be produced, supplied or consumed according to the months and seasons of the year. The year is divided into three seasons (season A - April-June; season B - July-October; season C - November-March). A deviation from the monthly allocation is permitted in each season, provided that the seasonal total is preserved, but deviation from the set quantity for each of the seasons is not permitted.

The licence includes a long list of detailed provisions pertaining to arrangements of production, supply and consumption; to the preservation of water resources; to ensuring efficient and economical use of water, etc.

The Water Commissioner may stipulate in the licence any condition he deems necessary to preserve the water resources and to ensure efficiency in production, supply, storage, conveyance and distribution of water.

(A sample of a production licence, including its conditions, is given in the appendix - Table 1.)

A production licence is issued once a year and within this period its provisions are re-examined, enabling thus closer control and guidance.

This fact distinguishes also the production licence which is in force in Israel from water concessions customary in other countries. In Israel there is no such concept as water concessions, as the waters are owned by the State and the public, and only the right of use is granted to whoever is entitled to it.

The production licence is the principle basic document, in which the various rights to water find expression and according to which the various statutes are established. A producer is one who has been permitted, by a production licence, to produce water from a specific water resource, either for his own consumption or for supply to others. A supplier is one who has been permitted by a production licence to supply water to others. A consumer is one who has been permitted, by a production licence, to consume a specific quantity of water and has been named for this purpose in the licence, which includes the quantity of water allocated to him.

A production licence creates the frame of obligation and the binding legal relation between suppliers and their consumers. The obligation of the supplier to supply water to the consumer, as well as the connection of a consumer to a specific supplier, finds expression in the production licence, including the entire web of relationship arising from this basis.

Whoever produces, supplies or consumes water contrary to the specifications of the production licence, or acts contrary to the conditions of that licence, risks cancellation of the production licence, a measure which means prohibition to produce, supply or consume water. The Water Commissioner is empowered with the authority to cancel a production licence permanently or temporarily, or to make changes in it, whenever he finds that the holder of the licence has acted contrary to the provisions of the Law which bind him or contrary to the licence and its conditions, and has continued to do so after having been warned by the Water Commissioner in writing about it and having been given reasonable time to make amends.

3.3.1 The Water Register

Every right to water enters the water register. The water register is a book, in which are entered the provisions and the rationings, according to the provisions of the Law and the rights to use water recognized by the Law. The relevant details are entered in the water register according to special regulations existing for this purpose, which prescribe giving advance notice to the holder of the right, regarding the intention to register and its details, providing ample opportunity to

voice comments and object to the registry, to correct it, etc. The entries in the Water Register are open for examination to the public.

3.3.2 Ways of Allocating Water

As aforesaid, the authority to issue a production licence and to stipulate its provisions, including the allocated water quantity, and the authority to refuse to issue such a licence, lies exclusively with the Water Commissioner. The Law itself does not define exactly, but only in a most general way, the criteria and standards guiding the Water Commissioner in the matter, but there are regulations which complement and give substance to the general frame.

When the Water Law was validated in 1959, it stipulated that the Water Commissioner must issue a production licence to whoever produced, supplied or consumed water on the day the law became effective and for the same quantities which were used. That is, the law freezed and "photographed" the existing situation, subject to the authority of the Water Commissioner to examine, in due course, the actual needs and their compliance with standards set for the use of water. And in fact, the rights to water which were valid when the law was publicized, have, in due course, been restricted and adjusted to the actual needs and there is now no difference between these rights and the rights of use recognized after the publication of the law.

Following the validation of the law, regulations regarding the use of water in rationing areas were issued, and these constitute the frame of discretion and include the criteria and standards for the allocation of water in the country.

A rationing area is an area where the water resources are insufficient for the maintenance of the existing water consumption and the Minister of Agriculture, having consulted the Water Board, has declared it to be an area where water consumption is to be rationed. Most of the areas in the country have been declared as rationing areas and the whole country can be regarded now as one rationing area.

In order to regulate the water supply in rationing areas, the Minister of Agriculture, having consulted the Water Board, may issue regulations, prescribing the maximum consumption quantities (norms) for the various uses of water and the order of priority of water purposes in case of a serious water scarcity, etc.

In order to protect the public interest, the law states that prior to issuing rationing regulations, a detailed draft arrangement be prepared and available to the public for examination in public and communal places and be advertised in the press. Anyone considering himself aggrieved by the draft arrangement, including anyone who will have to pay a higher price for the water as a result of the rationing arrangements, may lodge a written objection with the Water Commissioner. Every such objection is brought before a supply committee of the Water Board. Only after the public's objections are heard, then the rationing regulations are issued. Until recent years, the rationing regulations were renewed yearly, not out of legal obligation to do so, as such regulations

can be issued for several years in advance, but out of a public orientation and willingness to provide the public with an opportunity to express its opinions from time to time, concerning the provisions prescribed in the rationing regulations.

Thus maximum consideration for the needs of the public and its opinions has been achieved in the implementation of the rationing regime of water which, as unpopular as it may be, as any other rationing is, could not be avoided under the conditions prevailing in the State of Israel.

As mentioned above, the rationing regulations prescribe maximum quantities of consumption (norms) for the various uses of water. These norms are based on the most economical and efficient use of water, while making use of all the available measures in the matter. The norms are the basis for the allocation of water by the Water Commissioner.

3.3.3 Allocation for Agricultural Use

The norms for agricultural use have been set on the basis of every agricultural crop, according to the ecological conditions prevailing in the various regions in the country. The table attached to the rationing regulations specifies in detail the types of crops and the norms set for each cultivated dunam in the various regions. The total water quantity allocated to a person for agricultural use in the multiplication of the appropriate norm by the cultivated area.

(The table of norms for agricultural use is given in the appendix - Table 2.)

In addition to the table of norms, there are special provisions which have to be taken into consideration, such as additional water for adult citrus orchards; additional water for lemons, table and wine grapes, which need supplementary irrigation in certain areas; minimum quantities for tiny areas, etc.

A unique kind of agricultural consumer are the typical Israeli settlements - Moshavim, Kibbutzim, etc. These operate as a consumer-corporation and receive a water ration, which is then distributed among its members.

The rationing regulations set special provisions for these settlements. Their quantity of water is determined according to their main farming operations, according to their economic development and according to their ability to utilize the water. This quantity varies from time to time, according to the developments and possibilities of supply.

3.3.4 Allocation for Industrial Use

The rationing regulations prescribe a table for industrial use which specifies in detail the norms for the consumption of water for each production unit, according to the types of the various products. The quantity of water allocated to an industrial plant is the multiplication of the appropriate norm by the turnover of production. In this context it should be pointed out once more, that the water must be used in the most

economical and efficient manner, while making use of all the devices and technological innovations which are available in the market. Where a plant does not follow this rule, the allocated quantity of water, calculated in the aforesaid manner, will not be sufficient.

3.3.5 Allocation for Urban and Domestic Use

The quantities of water allocated to the municipalities for urban consumption include the use of water under their jurisdiction for domestic use, for gardens, auxiliary farms, services, handicraft and commerce. The quantity is determined on the basis of 80 c.m. per person per year, and according to the number of people in that municipality. The quantity of 80 c.m. has been calculated on the basis of research, conducted to examine the actual needs of the residents and various services of the municipality. It should be noted that of late, steps are being taken to change the form of allocation of water to the municipalities, in order to arrive at greater accuracy and a more comprehensive control.

3.3.6 Application for the Allocation of Water

As aforesaid, the rationing regulations give expression to the frame of discretion and the criteria guiding the Water Commissioner in allocating water. These regulations do not, in themselves, bestow rights to water. Only when the right to water has been recognized, then the regulations ensure the determination of the quantity according to the criteria set in these regulations.

In order that a person's or a body's right to water be recognized, an application must be submitted to the Water Commissioner, in which the desired water quantity, the purpose thereof, the area where the allocation is wanted, the suggested source of supply, and other relevant details, must be specified. Every application is examined by the Water Commissioner and considered in the light of the general water policy in the country, including the possibility of adding new consumers to the entire system and to the regional system in particular; in the light of the development plans, the hydrological situation in the region under discussion; in the light of the possibilities of supply and the conditions of the water resources; in the light of the economic aspects of the purpose for which the water are required and with the aim of reaching the most efficient use of water.

If the Water Commissioner decides to grant the request for the allocation of water, the quantity is determined on the basis of the provisions of the rationing regulations, as specified above.

The right to water will find expression in the production licence and will be entered in the Water Register. A decision to deny a request for the allocation of water is subject to the right of appeal to the Tribunal for Water Affairs.

3.3.7 Additional Licences and Permits

For the sake of order and integrity it should be mentioned that the system of licences and permits in the Water Laws includes several other various types of licences and permits, the principle ones being:

(a) Drilling Licence

The Water Drilling Control Law stipulated that no well for the production of ground water be drilled, except under a licence from the Water Commissioner and in accordance with the conditions of that licence. The Water Commissioner may stipulate various conditions, technical or pertinent, to the said drilling.

Where an application for a drilling licence has been submitted, the Water Commissioner shall publish a written notice, specifying the name of the applicant and the location of the proposed drilling. The notice shall be deposited in public places, in the region where the well is proposed to be drilled. Any person opposing the grant of the requested drilling licence, may lodge a reasoned objection with the Water Commissioner. This objection is examined by the Water Commissioner and, having done so, the Commissioner decides whether to grant the licence or to deny the request. The Commissioner's decision is subject to the right of appeal to the Tribunal for Water Affairs.

A drilling licence remains valid for 3 months, and if by the end of that time drilling has not yet started, the validity expires and must be renewed. However, a drilling licence is not a licence to produce water from the well. This requires a production licence, which is issued after the completion of drilling and the fitting of the well.

The Water Commissioner may cancel the drilling licence if he learns that a well is being drilled otherwise than in accordance with the licence and its conditions, or the provisions of the Law thereon, or when it turns out that the drilling is likely to cause the depletion or salination of water resources.

(A sample of a drilling licence is given in the appendix - Table 3.)

(b) Recharge Licence

Recharging of water is defined in the Water Law as a planned introduction of water into the subsoil from any water source, including floodwater, drainage water and sewage water, and in any manner, whether by direct recharging of wells, cisterns or borings, or by causing water to percolate from the surface to the subsoil.

Recharging of water is permitted only by a recharge licence, issued by the Water Commissioner and in accordance with the conditions of that licence. A recharge licence is granted for the duration of one year only, and each year an application for renewal must be submitted.

A recharge licence is granted on the basis of a detailed application for recharge, deposited in public places in the region where the recharge

is proposed, for the examination of the public. Every producer, supplier or consumer in the area of the planned recharge, may lodge his arguments and objections to the recharge scheme. Each such application is considered by the Water Commissioner and upon deciding to approve it, a recharge licence is issued, which is also deposited for public examination, and anyone who considers himself aggrieved by it, may appeal thereon to the Tribunal for Water Affairs.

(A sample of a recharge licence is given in the appendix - Table 4.)

(c) Permits

Various operations are prohibited according to the Water Law, without advance permit from the Water Commissioner. The types of operations are principally:

Entry and crossing of a protective strip - The Water Commissioner may decide upon a protective strip around a water source, installation for producing, supplying, storing or conveying water, if he deems it necessary to do so for the purpose of protecting the said water source or installation from pollution or other hazards. Where such a protective strip has been established, it cannot be entered or crossed, otherwise than by permit from the Water Commissioner.

The erection of buildings, the establishment of installations and the planting of plantations within the boundaries of a water supply system - in order to protect water supply systems, the erection of buildings and installations and the planting of plantations in their vicinity is prohibited, except by permit granted by the Water Commissioner. The Water Commissioner will not refuse to grant such a permit, except when the said building, installation or plantation is likely to endanger the water system, or part of it, or interfere with the use of it, or the free access thereto. Buildings, installations or plantations, erected or planted without permit, can be removed and demolished, following an advance notice from the Water Commissioner, and the one who erected or planted them will be charged with the expenses involved therein.

The diversion of water from a drainage channel or into it, or the changing of its course, and the erection of buildings and installations, the cultivation of soil in a drainage channel or in its protective strip - all such operations need advance permit from the Water Commissioner.

3.4 Preference of Uses and Status of Preferred Use

Rights of use of all those entitled to it according to the Water Laws are basically equal, and there are no uses preferred by the law. Moreover, the law does not give preference to existing rights vis-à-vis new rights, although the policy is not to grant new rights of use of water which might prejudice existing rights and existing distribution systems, if there is no pertinent justification for it, and except when considerations of national economy necessitate it.

In this context it should be noted that when the Water Law was validated in 1959, a transitory provision was prescribed thereof, according to which the Water Commissioner must recognize the quantities produced, supplied or consumed before the effective date of the law, and allow the use of these quantities. Over the years, the said rights have been adjusted to the provisions of the law and now these water rights, which existed before the Water Law became effective, are not preferred to water rights recognized on a later date. All are subject to the restrictions and provisions of the law.

However, and without parting from the aforesaid, the regulations regulating the use of water in rationing areas (reviewed above) state, that in times of scarcity and lack of possibility of supply, the order of priority for the allocation of water will be the following: domestic and public services uses, industrial use, irrigation of plantations.

To our relief, the need to put the priority rights, in case of such as the aforementioned distress, to a test, has not yet arisen, despite the grave condition of the water economy in Israel.

3.5 Meaning and Application of Efficiency Criteria (i.e., concept of beneficial use)

Most of the water potential in Israel is used for consumption. The evergrowing scarcity in water and its implications on the economy of the country, have induced investment of great efforts intended to increase the efficiency of the use of water, by a system of legal provisions, including conditions in the licences and permits, by sound administration and control over the water economy, by developing new methods and technologies for this purpose and by establishing a fiscal system and a water metering compulsion. All these together, necessarily cause a reduction in use and prevention of waste. The legal and economic measures and the penalties have joined together to force an efficient use of water.

3.5.1 The Legal Provisions

One of the first sections of the Water Law stipulates that a person shall deal efficiently and sparingly with water coming under his control and keep any water installations under his control in proper condition, so as to prevent waste.

The Minister of Agriculture was empowered by the Law with the authority to set rules for the efficient and economical use of water. These rules, having been set, a person is under the obligation to use water only according to these rules and norms. This authority was exercised by the Minister of Agriculture in a series of rules, reviewed below, according to the purpose of use.

As reviewed at length above, the entire system of water allocation for the various uses and purposes is based on the principle that, the quantity permitted to be used is minimal and will suffice only with a

most economical and efficient use, and only if the best measures of economy are taken for that purpose. This in itself is an incentive for maximum saving.

3.5.2 Conditions in Licences

According to the provisions of the Water Law, the Water Commissioner may set, in the production licence, any condition he deems necessary in order to ensure efficiency of production, storage, conveyance and distribution of water. The Water Commissioner has exercised this authority and set several conditions thereof in the production licence, which bind the users of water. On the other hand, there is, in every licence, an affirmation, assuring that the rights of those who manage their water policy efficiently and sparingly, will not be derogated. This is done in order to encourage the tendency of economy, without derogating from the right itself. Every licence includes a clause stating that if a person has not used the entire quantity allocated to him in a certain year, this fact will not derogate from his right to receive the full quantity he is entitled to in following years, if he needs it.

3.5.3 The Influence of the Fiscal System and the Water Metering

At the base of the task to increase efficiency of the use of water lies the notion that water must have a price, that water is a commodity that must not be given free of charge. The cost of water must be a factor deterring inefficient and wasteful use. That is, water must cost more the more it is used. The economic incentive has always been one of the most powerful incentives to efficient use and saving.

Water must be charged for according to metering, separate from other payments, in order to emphasize the conception that water has a value and price and is not a gift of nature, free of charge.

And indeed, water metering in Israel, for all kinds of uses, is compulsory, according to the provisions of the Water Metering Law, 1955. Today there is no production, supply or consumption of water without metering.

All producers, suppliers or consumers of water must meter water by using such measuring devices as are certified, in accordance with the said law and the regulations attached to it, and bring the results of the metering to the knowledge of the Water Commissioner every month, in accordance with the provisions of the regulations. The information thus received, facilitates systematic follow up and control of the quantities of water produced, supplied and consumed, and makes it possible to take deterrent measures against, as well as impose sanctions on those who use water in excess of the allocations. The data enables also to prescribe and bring up-to-date the norms for the use of water in agriculture and industry.

Water prices, which have an important role in this context, are so calculated, that they rise when consumption increases and deviates from the minimum quantity required for the purpose of the use.

By making use of a system of levies and subsidies (see below - the fiscal system), a situation has been achieved, where the rates of levies rise as the quantity of water consumed increases, and the rates of the subsidies fall respective to the increase in this quantity. Thus, the marginal water quantity becomes costlier. In agriculture for example, in order to save the use of the last 15% marginal quantity of the yearly allocation, this quantity has been loaded with the entire adjustment levy, while the basic 85% of the allocated water quantity are free from any levy. This has caused the rise in cost of the last 15% which, in turn, is an incentive to economic considerations concerning the profitability of using this quantity. In this context we must not forget the "special payment", which is an administrative fine that the Water Commissioner may impose on whoever uses water in excess of the quantity allocated to him lawfully, in the production licence. The rates of the "special payment" are much higher than the cost of water, and they are paid as penalties to the Treasury of the State, in addition to the cost of water paid to the supplier. This penalty makes the excess use economically unprofitable, and serves as a financial buffer and an incentive to greater efficiency in the use of water.

Water charges are collected, as aforesaid, on the basis of water metering and according to bills, based on the reading of water meters. Special regulations oblige each supplier to read the water meters at least once in two months and to inform the consumer about the reading and draw the bill of payment for the water according to the said reading. This fact illustrates to the consumer the direct connection between his use of water and the price he pays, and it can influence his behavior in this matter.

3.5.4 Efficient Use of Water in Agriculture

The agricultural sector as a whole is the greatest consumer of water. It is therefore here that most of the efforts and objectives of increasing efficiency in the use of water are concentrated, and where most of the technological and financial resources are invested.

We have already discussed in detail the system of the allocation of water in agriculture, by way of setting norms and maximum quantities of consumption for the various agricultural crops, and the calculation of the allocated water quantity as a multiplication of the appropriate norm by the cultivated area. The norms are calculated on the basis of a most economical and efficient use, and whoever is not particular about it, cannot sustain his agricultural farm with the yearly water quantity available to him.

That is, the basis of the efficient use of water lies in the allocation itself.

In addition, the Minister of Agriculture, by power of his legal authority mentioned above, has issued regulations restricting the use of water in fish-ponds, poultry-houses and plantations. The purpose of the regulations concerning the use of water in orchards for example, is to encourage and promote the adoption of methods and devices which bring about economic and efficient water utilization in orchards. A follow-up

study of water consumption in orchards has indicated that the implementation and use of various economic and efficient methods and devices result in saving considerable quantities of water. In order to provide the incentive for this form of water saving, the regulations stipulate, that water saving achieved through the use of the said methods and devices, shall not derogate from the right of the consumer to receive the full quantity of water allocated to him. In addition, the said consumer shall be permitted, subject to the approval of the Water Commissioner, to utilize the amount of water thus saved for the planting and irrigation of additional grove areas, irrespective to whether the said areas adjoin the area wherein the water is being saved, or are located in another site.

The co-operation of the farmer in these efforts to increase efficiency and saving in water can be secured by bringing about an increase in his income, as a result of the use of new and efficient methods and devices. For this purpose, the farmer must be given guidance and information, and even financial incentives. He must be induced to improve his systems of irrigation, and thus save money and labor, in addition to water.

The activities of the Water Commission in this programme consist of developing efficient irrigation methods and systems, and fostering the introduction of these methods and systems by the farmers, granting loans at attractive interest rates, reducing market prices of water saving appliances, education, pilot projects, etc.

3.5.5 Efficient Use of Water in Industry

The system of allocating water to industry is also based on maximal norms and quantities, set in regulations, according to the various industrial products. The calculation of the allocated quantity of water is based on the multiplication of the norm by the turnover of production of a certain product. Special production conditions deserve special consideration. In this case as well, the norms are based on the most efficient and economical use in the production process, and whoever is not particular about it will not be able to manage with the quantity of water available to him lawfully. On the other hand, the norms are set so that they will not affect the quality of the products, the turnover of production and the planning of production for the future. These norms change from time to time according to the know-how and the water saving devices available in the market.

The basis of the efficient use lies therefore, in the industrial sector as well, in the allocation itself.

There are regulations setting provisions concerning the manner of use of water in industrial plants, including the manner of sewage disposal from an industrial plant. These regulations are also part of the goal to ensure a most economical and efficient use in the production processes, as well as in services, in the industry.

Among the measures taken to reduce water consumption in the industrial sector, the following can be mentioned: the introduction of drier industrial processes; reclamation of industrial effluents and the use of marginal waters for industry; treatment of wastes and reduction of pollution hazards, etc.

These aims are achieved by the Water Commission by participation with the industry in research and development; application of processes, which have been developed in other countries; loans at a relatively low interest for purposes of investments; separation of water metering in the production process, in order to locate the section which wastes water; carrying out common Pilot Projects, etc.

3.5.6 Efficient Use of Water in the Urban and Domestic Sector

This sector is of the most difficult and complicated ones to handle, with regard to this subject, because it bears upon the individual at his own home, it interferes with his ways of life and forces him to change these ways and co-operate. Here the elements of education and information are of great influence, alongside the compulsion by law to use certain devices and the strengthening of the economic motivation by setting progressive water prices, which rise respective to the increase in use.

The yearly quantity of water available to a municipality is the multiplication of the number of people in that municipality by 80 c.m. per person. This quantity is based on the assumption, that the municipality must install, within its jurisdiction, devices for saving water, and manage its water policy and water system with the greatest efficiency, otherwise the yearly water quota allocated to it will not be sufficient. This quota includes the use of water under the jurisdiction of the municipality for domestic use, gardens, auxiliary farms, services and public services, handicraft and commerce.

It follows therefore, that the basis of the efficient use of water lies in the very allocation of the quota of water for domestic and urban use.

In order to ensure the use of water-saving devices, the Minister of Agriculture has issued regulations, prescribing the types of these devices which must be used in the municipal water system. The types of these devices vary and are brought up-to-date from time to time.

No building can be connected to the municipal water system unless the existence of the certified devices in it has been checked. In this context, regulations prescribing the manner of use of water for car-washing in garages and service stations, can be mentioned. These regulations compel the introduction of devices, ensuring greatest economy in water for such services.

In this sector, the regular water metering for each apartment, and the submission of bills on the basis of the reading of the water meters, are of great importance, so as to illustrate to every citizen, at his own home, the direct connection between the manner he uses water and the payment for it, and so as to give him the feeling that he can, by his own conduct, reduce the financial burden at this point. The system of prices must, of course, be progressive in an upward direction, the more consumption increases.

The municipalities themselves, bound by force of regulations of the Water Law to remain within the limits of the quantity of water allocated

to them, express in their by-laws the said purposes, both by maintaining apartment metering, and by setting various provisions and prohibitions, and mainly by setting progressive water prices. The municipalities also contribute to education, publicity and information, concerning the efficient and economical use of water.

3.6 Treatment of Ground, Surface and Other Classes of Water

The rate of use of ground water in Israel is 65%, and of surface water - 35%. The ground waters are of good quality and require almost no treatment, except chlorination. Surface waters are also of such quality, which usually requires chlorination only in order to meet the Israeli and international standards. It must be pointed out, that in Israel there is almost no such phenomenon as drinking water from surface resources, except the water drawn from lake Kinneret to the National Carrier, which undergo special treatment in this sophisticated plant. All water consumers in Israel have pressure sand filters. In several places in the country, saline waters are used for local needs. These waters undergo a process of desalination or distillation, so that they can be used as drinking water (in the city of Eilat, for example).

Lately, the use of reclaimed wastewater is increasingly becoming widespread in agriculture and for cooling in industry.

A pilot project, for the study of the practical potentialities embodied in this water resource, has been operating for a number of years, in the vicinity of Tel-Aviv, intended to reclaim for reuse the sewage water of the whole metropolitan area of Tel-Aviv, which includes urban and industrial sewage water. The project operates on the base of tertiary treatment of sewage water and their recharge into the sub-soil, with the aim of attaining water of potable quality. The operators of the project hope to reach final conclusions in the early eighties.

As to the reference of the Water Laws to the problems of treating water of all its classes, as already mentioned at length above, no drilling or production of ground water and no drawing of surface water of any class or kind is permitted without licences by the Water Commissioner and in accordance with the conditions of these licences.

This fact enables supervision and the stipulation of conditions, both for the prevention of damage or pollution of ground and surface water and for their treatment.

And indeed, the conditions of a drilling licence require of the holder of the licence, following the provisions of the existing regulations regarding this matter, to carry out a test drawing in every drill, in the presence of a representative of the Water Commissioner. This test drawing enables to take water samples, to hold tests and to conduct surveys and other research activities, important to the collection of data and to the control of ground water, their quantity and quality.

There are also regulations, the provisions of which require of every well-owner, to enable the Water Commissioner to conduct surveys in the well, when the water level is at rest. For this purpose the well-owner must, upon advance notice, discontinue altogether the operation of the well, for a period of time specified in the notice, in order to make possible the conduct of a survey of the water level, in the state of rest.

The production licence, whether the one referring to the production of ground water or the one referring to surface water, includes provisions requiring of the owner of the licence to conduct, from time to time, quality tests of the water produced and supplied by him, and to report the findings of these tests to the Water Commissioner. He must also enable the representative of the Water Commissioner to take samples of any water resource, for the purpose of quantity and quality tests.

3.6.1 Recharging of Water into the Sub-soil

During the last decade, while searching for new technological ways of enriching ground water and increasing the possibilities of utilizing and producing from ground water resources, the recharging of water into the sub-soil began to be growingly in practice. A suitable legal, administrative and financial system was prepared and was added in 1965 as a chapter to the basic Water Law.

Recharging was defined as every planned introduction of water into the sub-soil, from any water resource, including flood-water, drainage water and sewage water, and in any manner, whether by the direct recharging of wells, cisterns or borings, or by causing water to percolate from the surface to the sub-soil.

The law further stipulated, that recharging shall only be carried out for specific purposes, defined by the law and the regulations thereof. The principle purposes are the following:

(a) artificial replenishment, as an addition to natural replenishment, for the purpose of a satisfactory production of water from the water resource;

(b) seasonal and perennial storage of water, that is, the use of the sub-soil as storage space for quantities of water;

(c) dilution of water in ground water, both for improving the quality of the recharged water and for improving the quality of the ground water;

(d) removal of water containing salts, toxic effluents, industrial effluent, etc.;

(e) filtering of water, such as flood-water, for the purpose of increasing the potentialities of production and utilization;

(f) activities of research and experimentation, for the development of additional recharging methods, and for studying the manner of conduct of the recharged water in the sub-soil.

Recharging of water is permitted only by a recharge licence, issued by the Water Commissioner, and in accordance with the conditions of the licence. A recharge licence is issued for the duration of one year only, and each year an application must be submitted, in order to obtain a new recharge licence.

A person applying for a recharge licence, must submit to the Water Commissioner a recharging scheme, specifying the purpose of the proposed recharging, its location, the boundary area of its affect, a technical description of the recharging operations, the follow-up measures for periodical testing of the effect of the recharging on the water resources in the area, and a list of producers and suppliers in the area, who are likely to be affected by the recharging.

Every application for recharging is made known to the public and is deposited in public places in the area where the recharging is proposed. It is also advertised in the press.

Every producer, supplier or consumer of water in the area of the recharging, may state his proposals, arguments or objections regarding the recharging scheme, and the Water Commissioner must consider these, before issuing the recharge licence.

The Water Commissioner examines each application for recharging with view to its purpose, its effect on the ground water and the benefit that the water economy will derive therefrom. The Water Commissioner does not endorse, for whatever purpose, the recharging of water of a quality which might cause the pollution, salination, deterioration of quality of the waters, or might impair in any other way the useable water resources.

The Water Commissioner examines also the control measures taken by the recharger, paying special attention to measures intended to prevent sanitary nuisances and to preserve the quality of the water resources used for drinking.

Having decided to grant a recharge licence, the Water Commissioner sets and defines the purpose of recharge, the quantities of water allowed to be recharged, the technical conditions of the manner of recharging, the location and times of recharging, the quality of the recharge water, the conditions ensuring constant control of the recharging operation, and its effect on the surrounding area of the recharging, etc.

The names of the suppliers and producers, intended to benefit or likely to be adversely affected by the recharging operations, are also indicated in the licence.

In order to further preserve the public interest, the law stipulates that every recharge licence, the same as with an application for recharging, will be publicized and deposited in public places, in the area where the recharging is to be carried out, and in the press as well. Whoever considers himself aggrieved by the decision of the Water Commissioner to grant a recharge licence, to refuse to grant it or by any particulars and conditions set in it, may appeal to the Tribunal for Water Affairs.

(See a sample of a recharge licence in the appendix - Table 4.)

As aforesaid, while carrying out the recharging, in accordance with the recharge licence, the recharger is obliged to carry out periodical tests of the effect of the recharging operations on the water resources in the area and the quality of water thereof. The law stipulates that the results of these tests be put in writing and open for public inspection. If the results render that the recharging of water has caused damage, or that there is reasonable apprehension that the water in the resources of the area will no longer be fit for their intended use, the Water Commissioner may, either on his own motion, or according to a request of anyone considering himself affected by it, order the recharging of water to be discontinued or reduced.

The law further stipulates that if damage has been caused to a person by the recharging operation, this person will be entitled to compensation from the State Treasury, unless the need for recharging arose from the depletion of the water resources from which he produced, supplied or consumed water.

The chapter in the Water Law concerning recharging has created an administrative-financial frame, which enables people to obtain water from a recharger against payment.

In such case, there is need for adjustment of the production licence pertaining to the matter, where the quota of water to which a person is entitled to, without utilizing the recharged water, will be stipulated and so will the quantity, which comprises the use of recharged water, to which he is entitled.

A person may surrender his right to recharged water, but upon doing so, he will only have the right to the quantity of water to which he is entitled, without recharging, as specified in his production licence.

The amount of payment for recharged water can be fixed by a tariff by the Minister of Agriculture, or by agreement between the parties.

It will be noted that in fact, the financial provisions of the Recharge Chapter are not used. To this day, the Treasury of the State finances all the recharging operations, carried out by Mekoroth Cor. (see part II) on behalf of the State.

No charges are collected for the recharged water and, in any case, the process of obtaining water from rechargers has not been put into motion.

Private recharging operations, carried out by non-governmental bodies, are local and are carried out on a small local scale. Here as well, the provisions relating to charges for obtaining recharged water and payment for them, are not in force.

3.7 Implementation Provisions;

3.8 Types and Extent of Enforcement Provisions and Procedures

The thorough and deep involvement of the managers of the water economy and of those empowered with the authorities regarding the Water Laws - the Minister of Agriculture and the Water Commissioner - finds expression, throughout the Water Laws, also in all matters pertaining to the implementation and enforcement of carrying out the provisions of the Law.

It has already been mentioned above that the drilling of wells, production, supply and consumption of water, recharging of water, establishment of water and drainage projects, etc., all are subject to licences, issued by the Water Commissioner. No action relating to water or water resources can be taken without advance permit. The control over the licencing measures which enable the issuing of a licence, the stipulation of conditions in it, as well as its cancellation, ensure control over the enforcement and implementation of the provisions of the law on whoever must abide by them.

A production licence can be cancelled or changed where a holder of such licence has produced or supplied water otherwise than in accordance with the provisions of the licence, or contravenes any of the provisions of the law or of regulations made under the Water Law, and after having been warned, in writing, by the Water Commissioner and given reasonable time to make amends. The cancellation can be permanent or temporary. Whoever considers himself aggrieved by the cancellation of, or variation in a production licence may, of course, appeal to the Tribunal for Water Affairs.

Where, as a result of the cancellation of a production licence, consumers, who are dependent on the supplier, are affected, the Water Commissioner may, with the approval of the Minister of Agriculture, appoint a manager to the water resource, the licence for which has been cancelled, and empower him with the executive authority, in order to ensure the rights of those dependent on the licence.

Where the Water Commissioner finds that a well is being drilled otherwise than in accordance with the licence or its provisions, or the provisions of the Law thereof, or where it becomes apparent, after a test-drawing, that the drill is likely to cause the depletion or salination of the water resources, etc., the drilling licence may be cancelled.

The Water Laws permit the Water Commissioner, or anyone authorized by him, to enter any place, at any time, in order to check the observance of the provisions of the Law and of the provisions of the conditions of the various licences, and to take any action necessary to control the water resource, to protect the water and prevent their pollution, to uncover water resources, measure their output and properties, examine the local conditions, carry out excavations or drillings. etc.

The Water Commissioner may also enter any place where there is a well, or where installations for the production, storage, conveyance, distribution or metering of water are located, in order to check the observance of the provisions of the law pertaining to them.

Had the provisions of the law not been observed, the Water Commissioner may, in addition to cancelling the pertinent licences, as mentioned above, order the rectification and restoration of the former condition. Until amends are made, the Water Commissioner may order the discontinuance of production, supply or consumption of water or its restriction, all according to circumstances, until the amends are made.

If amends have not been made, upon the demand of the Water Commissioner, the latter may do everything necessary to make these amends, restore the situation to its former condition and prevent its recurrence, and charge the person who had been ordered to make the amends and has not done so, with the costs involved thereof. These costs can be collected by the enforcement measures and procedures of the Tax Collection. These powers to make amends extend across the entire complexity of subjects pertaining to activities in water resources, to the drilling of wells, prevention of water pollution, drainage operations, water metering and the like.

The Water Commissioner's powers of enforcement include also powers to order the restriction of production from a water resource, the regulating of production, the adoption of emergency measures in order to ensure regular water supply, the opening and closing of water carriers, the regulating of the flow of water in them, the operation of wells or water installations or the discontinuance of that operation, the transferrance of consumers from one water resource to another, etc.

The Water Commissioner may also order owners of pipelines and installations for conveying water to convey water to others, to order the holder of a production licence to supply water to others, etc.

The exercise of all these said powers is, of course, subject to the right of an aggrieved person to appeal to the Tribunal for Water Affairs.

The Water Commissioner has powers of implementation and enforcement in the financial sphere as well. The extent of control in the hands of the Minister of Agriculture and the Water Commissioner in fixing tariffs, levies and subsidies, and the authority of the Water Commissioner to settle disagreements with regard to the cost of water, (all these have been reviewed separately), make possible complete and extensive control over the entire system of water charges, and the instruction of government policy in these matters.

One of the most efficient financial sanctions available to the Water Commissioner, which serves him as an instrument for implementing the provisions of the law and for ensuring strict compliance with them, is the "special payment". The "special payment" is an administrative fine, imposed by the Water Commissioner on whoever uses water in excess of the quantity allocated to him lawfully in the production licence, on the

supplier of water to consumers who are not entitled to it, according to the licence, or on a supplier of water to those who have the right, in excess of the quantity they are entitled to, as aforesaid.

The "special payment" is an effective instrument for promoting pedantry in the use of water, within the limits of the quantities allocated in the production licence, and with no deviation from these quantities.

The rates of the "special payment" are much higher than the cost of water and they are payed as a fine to the Treasury of the State, in addition to the water charge, payed to the supplier. The intention of the fine is to make the deviation economically unprofitable, and thus serve as a financial buffer. The imposition of the "special payment" is a substitute to the cancellation of the production licence because of the said offence. That is, a producer or supplier, on whom the "special payment" has been imposed, is not punished again by the cancellation of his production licence. (On the means of imposing the "special payment" and its collection, as well as other details, see below in the review of the financial system.)

Finally there is, of course, the system of punitive authorities, the judicial system.

The violator of one of the provisions of the various Water Laws, the Water Law, the Water Metering Law, the Water Drilling Control Law and the Drainage Law, the violator of an order or a provision, lawfully issued to him by the Water Commissioner, the one who interferes with the Water Commissioner or anyone acting in his name, in carrying out their actions according to the provisions of the law, is liable to be prosecuted and brought to justice. Criminal claims for violations of the Water Laws are heard before the magistrate's court, as distinguished from the Tribunal for Water Affairs, where appeals, lodged by citizens against the Minister of Agriculture and the Water Commissioner, are heard. The Tribunal for Water Affairs does not serve as a criminal, but only as a civil instance.

The rates of fines, specified in the various laws, are up to 6,000IL or six months imprisonment, with a possibility of raising them, in case of repeated offences.

3.9 Impact of Law on the Environment;

3.10 Relevance to Both Quantitative and Qualitative Problems

In Israel, which suffers from an ever growing scarcity in water, and is mainly fed by ground-water resources, there is vital importance and over sensitivity to the prevention of the pollution of water resources and the protection of the quality of water. Any pollution or deterioration of the quality of water reduces the exploitable water potential and may endanger the water economy in particular, and the development of the State in general.

Human action constantly causes the disruption of the equilibrium in the cycles of life and elements in nature. Compared to the systems of air and soil, the water system is the most sensitive to the results of the disruption of this equilibrium, especially since it relies mainly on ground water, where any penetration of pollution might affect the water reservoirs of the country and is irremediable. The basic danger to the ground water is this process of their pollution being irreversible.

There is at present no technological-economic possibility, at a reasonable cost, to remove undesirable and pestilent soluted components from the ground water systems.

The principle sources of water pollution are domestic and industrial sewage, solid waste, petrols, chemicals, salts and agricultural pesticides.

In recent years, when local and world attention was drawn to the increasingly more acute problems of environmental pollution, and practical, administrative and legal measures were taken to forestall the danger, the Israeli government reached the conclusion, that the subject of protecting the quality of water and preventing their pollution cannot be separated from the overall management of the water economy, and has therefore added legal powers to the Minister of Agriculture and the Water Commissioner, which enable them to control the issue of the prevention of water pollution as well.

Thus, the overall treatment of all the aspects of the water economy in the country is centered in the hands of the Minister of Agriculture and the Water Commissioner.

This state of affairs is unlike what is usual in some countries in the world, where the matter of preventing water pollution, either within the general environment or in itself, lies in the hands of agencies.

A special chapter dealing with the prevention of water pollution and control of water quality was added in 1971 to the Water Law. All the powers given to the Minister of Agriculture and the Water Commissioner are concentrated in this chapter where, for the first time in Israeli legislation, the concepts of "Water Pollution" and "Factor of Pollution" are defined clearly and precisely.

"Water Pollution" means every change in the properties of water in a water resource, in a physical, chemical, organoleptic, biological, bacteriological, radioactive or other respect, or a change as a result of which water is dangerous to public health or likely to harm animal or plant or be less suitable for the purpose for which it is used or intended to be used.

"Factor of Pollution" means every industrial or agricultural undertaking, building, installation, including sewage installation, machine or means of transportation, the operation, maintenance or use of which cause, or are likely to cause, water pollution. The law unequivocally forbids pollution of water by whatever action, either directly or indirectly. Even a polluted water resource is also not to be polluted. The powers given to the Minister of Agriculture in the said chapter, are in

the area of subsidiary legislation, and include the authority to prescribe regulations concerning all matters pertaining to the prevention of water pollution and protection of water resources from pollution, including subjects relating only indirectly to pollution, such as the location of undertakings, which might be a factor of pollution; the use of certain materials in the production processes, in the process of agricultural cultivation, fertilization and spraying; production, import, distribution and marketing of certain products; regulation of traffic over water resources or in their vicinity, etc.

The Minister of Agriculture is also empowered with the authority to prescribe in the regulations provisons concerning the quality of water for the various uses, including flood and sewage water.

The Water Commissioner is empowered with far reaching and substantial authorities, the like of which cannot be found in other laws. These powers enable the Water Commissioner to take action to forestall water pollution, as well as to handle the situation created after pollution has been caused.

These authorities include the power to oblige to submit for advance approval of the Water Commissioner, schemes of sewage disposal from plants; to oblige the causer of pollution of water to make amends, to restore the situation to its former condition and to prevent the recurrence of pollution; to order the causer of pollution to discontinue production, supply or consumption of water; to take, in case of emergency, all the necessary measures required to instantaneously stop or prevent the serious pollution found in the water, including the exercise of reasonable force for this purpose; to bring to justice the violators of the provisions of the said law, etc.

It should be noted, that failure to comply with orders issued by the Water Commissioner, as aforesaid, might lead the Water Commissioner to do himself everything required, while the person ordered to comply with the order and has not done so, shall bear the costs. These costs are to be collected in the same manner that taxes are collected.

In order to assist the Water Commissioner in exercising his powers concerning water pollution, a staff unit has been established in the Water Commission, which is subordinate to the department for the efficient use of water (see part II). This department is responsible for the protection of the quality of water and the prevention of their pollution; for the establishment of a system of supervision and control and for preparing the technical and professional basis for standards and regulations thereof.

All the other departments in the Water Commission (see part II), including the Hydrological Service, the Industrial Water Department, the Councelling Bureaus, etc., assist in the said task, each in its field.

The Kinneret authority is also active in all matters pertaining to the prevention of pollution in the Kinneret (see part II). It is an administrative system of management, research and operation, the main task of which is to protect from and prevent pollution in the watershed

of Lake Kinneret and in the lake itself, which is the main and greatest reservoir of water in the national water system.

The application and implementation of the said law requires an extensive framework of regulations to assist in the enforcement of the law on the public. The most important regulations are those prescribing criteria and standards for the quality of water in the water resources. These criteria are essential and constitute the base for every professional, instructive, legal and judicial activity in the matter. The policy of the Water Commission is, that for all the vital importance of the matter, no hasty and speedy action should be taken, and that a professional and scientific foundation must be laid, in the best and most thorough way, even at the cost of speed. For unreliable rulings might lead the State to heavy and impossible investment, the profitability of which is doubtful. Therefore, the slow and more thorough approach of deep study of problems and careful examination of criteria, suitable to the conditions in the country, has been adopted, along with the drawing of conclusions from the know-how and experience of other countries, experiments and use of mathematical models, etc., prior to prescribing compulsions which require heavy investments and are likely to cause damage to the national economy, which will have to live, operate and develop within the bounds of the prescribed restrictions.

Professional committees, composed of the best professionals in the country, assist the Water Commissioner with regard to setting criteria of water quality in the various water resources, and criteria and standards for the quality of sewage flowing into the sewarage system. Presumably, within another year it will be possible to reach the stage of issuing legal regulations thereof.

While preparing the said system of criteria, great and complex efforts are being invested in setting designations for the streams of the country and their classification. The intention is to classify every water resource, or part of it, according to the desired degree of quality of that water resource.

As to the prevention of water pollution by transport and storage of petrols, regulations are about to be issued in the near future, prescribing detailed provisions for the prevention of water pollution by storage, installation and transport of petrols in the country, a problem where the risk involved is great and is likely to be critical to the water resources.

Scientific work, the purpose of which is to examine the subject of pollution of water by agricultural pesticides, which are one of the main causes of pollution, is in progress. On the basis of this scientific work, restrictions on use will be set, which will find expression in regulations.

Regulations already issued, pertaining to the prevention of water pollution, are those concerning the prohibition of irrigation, and of washing animals in Lake Kinneret, which is the main reservoir of drinking water in the country. Other regulations were issued, concerning the prohibition to use hard detergents. The hard detergents are insoluble

in water; they pollute the sewage and interfere with its reuse. There are today substitutes for these detergents, which do not cause these undesirable phenomena in the water. Therefore, a prohibition was prescribed in the regulations, forbidding the manufacturing, import, distribution and marketing of products for washing or cleaning which consist of hard detergents. As a result of these regulations, all the manufacturers in the country adjusted their production to soft and soluble detergents.

The provisions of the chapter concerning prevention of pollution, empower the Minister of Agriculture, as aforesaid, with the authority to prescribe qualities of water for the various purposes, but this authority is restricted with regard to the sanitary quality of drinking water. The authority to prescribe the sanitary quality of drinking water was given to the Minister of Health. About a year ago, the Minister of Health issued regulations pertaining to the sanitary quality of drinking water, and these regulations include criteria and standards, intended to ensure the quality of drinking qater and their compliance with Israeli and international standards thereof. The regulations prescribe provisions concerning the standard of soluted salts permitted in drinking water, standard of nitrates, chlorides and fluor, provisions concerning the microbiolic quality of the water, taste, odor, etc. The regulations also prescribe the ways and means of taking samples and carrying out tests in the water resources used for drinking, in order to ascertain their compliance with the set criteria, and the measures which can be taken with regard to water which was found to be unpotable.

The provisons of the chapter concerning prevention of water pollution imposed on the Water Commissioner the legal duty to grant permission to produce, supply and consume water for the various purposes and uses, but only in accordance with the regulations concerning quality, which have been prescribed either by the Minister of Agriculture or by the Minister of Health. The Water Commissioner may prohibit the production, supply or consumption of water, which do not meet the criteria set by the regulations, as aforesaid. Hence, the Water Commissioner stipulates, in every production licence issued by him, the condition that production, supply and consumption of water, and particularly of drinking water, are not to be carried out otherwise than in accordance with the prescribed regulations concerning the quality of water.

The said chapter gives the Minister of Agriculture and the Water Commissioner another authority - to stipulate conditions, concerning prevention of pollution, in the licences and permits issued by them, according to the Water Laws.

And indeed, the Water Commissioner includes in every production licence issued by him, provisions obliging the holder of the licence and his consumers to refrain from any act which causes, or is likely to cause, directly or indirectly, pollution of water of any resource; to take every reasonable measures to prevent pollution of water by installations of production, supply, transport or storage of water; to notify the Water Commissioner, without delay, of any pollution detected in the water or of any act which is likely to cause pollution, whether in their resource of production, supply or consumption of water, or in any other resource.

Every holder of a licence must enable the Water Commissioner to carry out water quality tests, to take samples of water from the water resource, and to carry out himself, upon the Water Commissioner's demand, water quality tests and report their results to the Water Commissioner.

Actions intended to prevent water pollution cannot be taken in a vacuum, but only as an integral part of the overall administration of environmental control.

This requires cooperation and coordination with government ministries and other bodies, in order to avoid duplicity, conflict of authorities and waste of financial, professional and manpower potential and in order to coordinate actions, for the benefit of the entire national economy.

Part of the said coordination was prescribed in the provisions of the chapter concerning water pollution, but it was achieved mainly by means of good-will and cooperation. The coordination prescribed in the provisions of the law includes the duty to consult, in advance, with the Minister of Health, on subjects pertaining to public health and to obey the provisions of the said Minister in all matters pertaining to the sanitary quality of drinking water; the duty to consult the Minister of Commerce and Industry on all matters relating to the imposition of restrictions on production, import, distribution and marketing of pollution-causing material; securing the approval of the Minister of Transport to traffic restrictions on means of transportation in the vicinity of water resources or over them; the duty to report, in advance, to the Economic Committee of the Knesset (the Israeli parliament) before setting any restrictions on the location of factors of pollution, etc.

In addition, reality has dictated coordination arrangements in various areas. The area of effluent treatment and the regulation of the sewerage problem are examples. Sewage water are a principal potential pollutor. On the other hand, they are an alternative water resource, hence they are of great interest to the Water Commissioner, in his capacity as the one in charge both of the field of water as well as the prevention of pollution. And indeed, the Water Commissioner has a decisive role in this subject and presides over the national sewerage project, which is financed with the aid of the World Bank, and is now at advanced stages of planning and execution.

The interministerial cooperation between the Water Commission and the Ministries of Interior, Health and Finance, finds expression in this area.

The installation and maintenance of sewerage is carried out mainly by the municipalities, as one of their main functions, according to their system of laws. Legal provisions prescribe the duty of the local authority to install sewerage within its jurisdiction, according to schemes which must be approved by the Ministries of Interior, Health and Agriculture (through the Water Commissioner). The legal provisions prescribe the manner of connecting property to the municipal sewerage system and the arrangements for collecting rates and levies for the installation and maintenance of sewerage.

In order to prevent the damaging effects of sewerage, especially the urban and industrial ones, on water resources, the Water Commissioner, supported by his legal powers, directs the execution schemes of the World Bank project afore mentioned, so as to prevent pollution of water resources by effluent. At the same time, the Water Commission conducts surveys of effluent flow, research on the subject of effluent and its utilization for re-use, etc.

Special attention is devoted to solving problems of industrial effluent which, because of its toxic components, is the most dangerous to the water resources.

In order to make the best use of the frameworks of action and staff of the various bodies acting in the various fields, the Water Commissioner was authorized, in the provisions of the chapter on prevention of water pollution, to delegate powers given to him under the said chapter, to a water authority, drainage authority, local authority or an association of towns. These powers will assist them with respect to all matters relating to the prevention of water pollution under their jurisdiction. Authorities, as referred to above, which have a common interest in the prevention of water pollution in their bounds, may join together in a body corporate, in order that it be granted the powers to prevent water pollution.

Before such powers are delegated, as aforesaid, the Water Commissioner examines the administrative and professional formation of the authority or corporate, and having found it so organized that it can exercise the powers delegated to it, and use them to the advantage of the purpose, the said powers are then delegated. It should be mentioned, that whenever such delegation of powers involves a local authority, the consent of the Ministry of Interior must be secured.

The delegation of powers to existing bodies, operating in the area and maintaining, in any case, a mechanism of control and supervision in various subjects, to which the subject of prevention of water pollution can be added, saves resources and staff and is of great assistance to the Water Commission.

The same stands with regard to various professional bodies, with whom the Water Commission reaches an agreement on the use of the know-how at their disposal, the laboratories under their control, the scientific staff centered in them, the control operations they maintain, etc.

Examples to the above said are the existing arrangements with the Nature Reserves Authority, on the subject of control and supervision of the prevention of water pollution, which its staff maintains, among their other activities of supervision, throughout the country; utilizing scientists in the Technion, the Vulcany Institute for Agricultural Research and in the various universities and institutes of science; the cooperation of the Petrol Institute and its experts on the problems of preventing water pollution by petrols, etc.

To conclude this chapter, it should be noted that an Environmental Protection Service has been recently established in Israel, in the Prime Minister's Office. The function of this service is to advise, guide and

coordinate between the State institutes on the subject of the environment in general, including the subject of the protection of the quality of water and the prevention of their pollution. However, the actions of the Environmental Protection Service do not derogate or impair the exclusive responsibility of the Minister of Agriculture and the Water Commissioner, regarding the subject of the prevention of water pollution, as part of the overall management of the national water economy.

3.11 Constraints to Rational Water Allocation and Management (i.e., appurtenacy doctrine, prevention investment opportunity)

The most restricting constraint, which prescribes and dictates the entire water policy and the management of the water economy, is the scarcity in water, which becomes more acute the more the country develops and its needs grow.

Israel has reached the end limit in utilizing her water resources, and the development of alternative resources, such as desalination of sea water, is getting out of reach, because of the rising cost of energy.

Such a stage of affairs obliges the state, which is the owner of the water resources, to manage the water economy with full responsibility and discretion, while carefully weighing the optimal allocations of water, so that the greatest benefit to the national economy is derived from them. The situation obliges the users of water, in the various sectors and for the various purposes of consumption, to use the quantity of water to which they are entitled with the utmost efficiency and economy, while making the economic calculations necessary to provide their needs and to extract the greatest marginal output from the water.

The constraints, arising from the scarcity in water, have brought about the creation of a complex system of licences and permits for the various water actions - for drilling wells, producing water, supply and consumption of water, recharging of water, etc.

The acute scarcity in water has also given rise to the need to declare rationing areas and to prescribe rationing regulations, which are the basis for the allocation of water to the various sectors, and at the base of which lies the idea of a most efficient and economical use of water, without which the allocated quantity of water will not be sufficient.

The need to save as much water as possible, brought about the provision of the compulsion to meter water in production, supply and consumption, and the basing of an extensive financial system of water charges on the data obtained from the above mentioned metering. The financial system is composed, as detailed above and below, on water charges rising gradually in accordance with the increase in consumption, of adjustment levies and subsidies from the Adjustment Fund and of the "special payment" which is a penalty for excess use.

The financial system is a constraint and a guiding and urging factor for saving water and for efficient and economical use of it.

The State's control over rational management of the water economy, by its agents for that matter - the Minister of Agriculture and the Water Commissioner - is secured by the existence of public and parliamentary bodies, which must be consulted prior to taking various actions concerning the water economy, to whom reports must be submitted concerning the water policy, and the opinions of whom must be heard.

These bodies are the Water Board, the Drainage Board, the Planning Committee, the Supply Committees, the Adjustment Fund Board, the Finance and Economic Committees of the Knesset, etc. Contributing to the above mentioned public control is the legal compulsion, prescribed by the Water Laws, to deposit schemes, applications and licences for public examination and for receiving the public's comments and objections, before their approval, as for example, schemes for a water project or for drainage, applications for drilling or recharging, motions for rationing regulations, for tariffs or adjustment levies, etc.

The supreme control over the manner of management of the water economy and the decisions it takes, is in the hands of the judicial system, which supervises the exercise of the legal authorities, and primarily in the hands of the Tribunal for Water Affairs, the special judicial Tribunal of the water economy, before which an aggrieved citizen can bring any act and exercise of authority, according to the Water Laws, by the Minister of Agriculture and the Water Commission, for examination and inspection.

Nothing can ensure punctuality in rational and proper management of the water economy and a discrete and pre-tested exercise of powers, as this judicial control does.

3.12 Other Particulars of the System: Relation of Water Law to Taxes, Subsidies, Public Project Implementation and Financing, and Land Use.

3.12.1 The Financial System

The system of water charges in Israel is quite unique, and should therefore be dealt with in detail.

The fact that Israel, despite its limited geographical bounds, is distinguished for its great variety of regions, leaves its mark on the system of costs and charges of water.

As water is regarded in Israel as a means of production, the charges have to be equalized in the various regions, in parts of which the cost of production and supply of water is relatively low, as in the northern part of the country, in the vicinity of the water resources, and in other parts, as in the south and in the Negev, is very high. It should be mentioned, that most of the investments in water projects in Israel are

public-governmental. In order to perform the tasks involved in establishing a just and fair system of water charges, the Water Law gave the Minister of Agriculture and the Water Commissioner many authorities in the matter.

3.12.2 Tariffs for Water

The Minister of Agriculture, having consulted with the Water Board, may fix tariffs for water. These tariffs can be general, or apply to specific regions, to specific purposes of use, etc. A tariff, having been fixed, obliges the suppliers to supply water only in accordance with the tariff, and abrogates the validity of all agreements conncerning water charges which are not identical with the tariff.

It should be emphasized, that the Minister of Agriculture, in view of the aim to involve the public and hear its arguments, must publish his intention to fix a tariff, and give the public the opportunity to voice arguments, suggestions and objections to the proposed tariff, before it is fixed.

3.12.3 Water Charges Adjustment Fund

The Water Law has founded a special fund - the Water charges Adjustment Fund, the purpose of which, as defined by the law, is to reduce the difference between water charges in the various parts of the country. The Adjustment Fund is an independent corporation, managed by the Water Commissioner, and is not permitted to serve any other purpose, except the one set for it in the law.

The greater part of the budget of the Adjustment Fund comes from the State budget, and the smaller part from levies, imposed as will be reviewed below.

Side by side with the Water Commissioner, operates the Board of the Adjustment Fund, composed of representatives of the government and of the producers and suppliers of water. The function of the Board is to discuss and advise on matters of management and operation of the Adjustment Fund, including its budget. The Board of the Fund renders the Fund its public aspect.

The Adjustment Fund is an indirect instrument for fixing and directing the charges of water, by means of the levies it collects and the subsidies it grants. By imposing on the producer and supplier, whose cost of production or supply is relatively low, the compulsion to pay the adjustment levy, and by granting subsidies to those whose cost of production and supply is relatively high, the adjustment between the prices of water in the various regions in the country is maintained.

3.12.4 Adjustment Levies

The compulsion to pay the adjustment levy is prescribed by the Minister of Agriculture in regulations, after consulting the Water Board, and after the proposed levy has been brought to the attention of the public, which has been given the opportunity to voice its arguments,

proposals and objections to the levy, which is liable to fall on him. The amount of the adjustment levy must be approved by the Finance Committee of the Knesset.

3.12.5 Subsidies from the Adjustment Fund

The Minister of Agriculture decides also who are those entitled to subsidies from the Adjustment Fund, and the rate of these subsidies.

This is also prescribed in regulations, after consultation with the Water Board.

It should be emphasized that the levies and subsidies are imposed and granted to the producer and supplier, and not directly to the consumer. A supplier, on whom an adjustment levy has been imposed, must pay it directly to the Adjustment Fund, and he may, by force of the provisions of the law, collect from the consumer, together with the water charges, an amount which is equal to the adjustment levy, proportionate to the quantity of water supplies to that consumer; a supplier who has been granted a subsidy, must, by force of the provisions of the law, deduct from the water charges he collects from the consumer, an amount equal to the amount of subsidy, proportionate to the quantity of water supplied to that consumer. Thus, the effect of the system of levies and subsidies on the consumer's water charges is ensured.

As aforesaid, the Adjustment Fund, by means of levies and subsidies, serves as an instrument of guiding the desirable policy of the water economy. In order to illustrate, it will be noted, that while in the past the adjustment levy was loaded on the entire allocated quantity of water, since 1973 it has been attempted to save the marginal quantities of water and to load all of the adjustment levy in agriculture on the marginal quantity of water - the last 15% of the allocated quantity. The first 85% of the allocated quantity of water for agriculture are free of the levy charge. Thus, the marginal quantity of water becomes costlier, as against the basic quantity of water which is free of any levy, and the users of water must calculate the economic profitability of using the remaining 15% of the allocated quantity of water before they actually do so. The rate of subsidy granted to the marginal 15% of the quantity of water is also much lower than the rate granted to the basic 85% of the quantity, thus the cost of the marginal quantity becomes higher, with all the implications involved.

3.12.6 Ways of Calculating the Cost of Water

The objective fixing of the cost of production and supply is at the base of the above detailed levy charge, and the determination of the right to a subsidy.

The law empowers the Minister of Agriculture with the authority to prescribe in regulations the way of calculating the cost of water. This way of calculation is based on the most efficient conditions of operation and use possible, and on an efficient and economical management of water projects.

Any expense which is not recognized by the said regulations or which is not made with the utmost possible efficiency, is not taken into account with respect to calculating the cost of water. Not every expense made for production or supply of water is recognized and taken into account with respect to levies and subsidies, only those expenses calculated by ways, methods and restrictions set from time to time in the regulations for calculating the cost of water, are considered.

The main details of costs, mentioned in the said regulations, are: energy costs, wages costs, transportation and communication costs, maintenance and repair costs, capital costs, amortization, taxing, etc.

3.12.7 Reporting Economic Data

Such a complex network necessitates relying on accurate data, furnished continuously. The law has prescribed for this purpose the compulsion to report to the Water Commissioner, upon his demand, all the data concerning costs of production and supply, and concerning water charges, collected from consumers and the ways these are calculated. Standing orders of the Water Commissioner compel to submit these data annually.

These data serve the Water Commission both with respect to current control over the financial system, as well as with respect to forecasting the demand for water and its use, analysis of costs and charges and drawing conclusions for the future. In order to reinforce the compulsion to report the said data and its reliability, it has been recently stipulated, that if a person does not report the data, or submits incorrect data to the Water Commissioner, he shall be charged with the highest levy, and his claim that he owes a lower levy or that he does not owe any levy at all, shall not be heard. Furthermore, no subsidy shall be granted to a person who has submitted unreliable data, or has not submitted it at all, and his claim that this subsidy is due to him, according to the cost of his production or supply, shall not be heard.

3.12.8 Water Charges in the Local Authorities

The water laws do not refer directly to water charges in the local authorities. However, the muncipal charging system of water charges is greatly affected by the overall system.

Actually, the local authorities fix the charges of water under their jurisdiction in by-laws, where the water charges are specified, according to the consumed quantities and the various uses. The water charges rise gradually in accordance with the rise in the consumed quantity. The municipal by-laws specify also the charges for the various services which the local authority supplies, such as the installation and maintenance of water meters, laying of pipelines, connection to the water system, etc.

The by-laws of the local authorities have to be approved by the Minister of Interior. In reality, the Minister of Interior does not approve municipal by-laws relating to water, before they have been censured by the Water Commission. Thus, cooperation on the ministerial level, with respect to the policy of water charges and its actual implementation within the bounds of the local authorities, is secured.

3.12.9 Settling Disputes with Regard to Water Charges

The Water Metering Law has created a mechanism for settling disputes, arising between suppliers and consumers, with regard to water charges. The law stipulates that each of the parties to the dispute may appeal to the Water Commissioner and ask him to settle the matter. The Water Commissioner may appoint another person to settle the dispute on his behalf. The Water Commissioner must give all the parties concerned an opportunity to voice their contentions and bring their evidence. The Water Commissioner is empowered, with respect to this matter, with the authority to compel witnesses to appear before him and submit various documents.

The decision of the Water Commissioner in the matter is final and is regarded as an agreement between the parties, but it is subject to the right of appeal to the Tribunal for Water Affairs. It should be noted that the above mentioned authority cannot be exercised with respect to water charges which are fixed in by-laws of the local authorities, the purpose being to preserve the independence of the local authorities in the matter.

3.12.10 "Special Payment"

The "special payment" is one of the administrative sanctions stipulated in the Water Law and its purpose is to ensure strictness with regard to the use of water, within the limits of the quantities of water allocated in the production licence, without exceeding these bounds.

The "special payment" is an administrative fine, imposed by the Water Commissioner on whoever exceeds the quantity of water allocated to him lawfully in the production licence; on the producer or supplier of excess quantities of water; on the supplier of water to those who are not entitled to it according to the production licence, or on the supplier of excess quantities to those who have a right.

The rates of the "special payment" are presecribed in regulations, after consultation with the Water Board and the approval of the Finance Committee of the Knesset. The rates of payment can be graded according to the quantity of water produced or supplied in excess of the permitted quantity, and in the ratio of the said excess quantity to the allocated quantity of water, and according to the intended uses of the water.

The rates of the "special payment" are much higher than the water charges, and they are paid as a fine to the Treasury of the State, in addition to the water charge, which is payed to the supplier. The purpose of the fine is to make excess use economically unprofitable.

The "special payment", the same as the adjustment levy, is imposed directly on the producer and the supplier, who must pay it to the Water Commissioner. However, the supplier, on whom a "special payment" has been imposed, may collect from his consumers, who have consumed the quantity of water with respect to which the "special payment" was imposed, their share in the payment imposed on him. Such collection from the consumer can be done only with the approval of the Water Commissioner. The

Water Commissioner must hear the arguments of the consumer, before giving such approval to the supplier.

The "special payment" is collected as if it were a tax, and the strong measures which are available to the Tax Collection in the State, can be of assistance, including attachment of property and of bank accounts, etc.

Amounts collected from the "special payment" are transferred to the Adjustment Fund.

3.12.11 Drainage Rates

A review on the financial system will not be complete without mentioning the powers of the drainage authorities (see part II) to impose on land owners under their jurisdiction levies and drainage rates, the purpose of which is to cover, completely or in part, the cost of establishing drainage projects and their proper maintenance, and for carrying out drainage operations.

The exercise of this authority is conditional to the approval of the Minister of Agriculture. The load of costs must be divided, as far as possible, according to the extent of benefit and advantage the land owners derive from the drainage operations, with respect to which the levies and rates are imposed.

Before imposing drainage levies and rates, the intention to impose them must be published, specifying the details of the property on which levies and rates are to be imposed, and the public can submit its objections, arguments and suggestions to the said compulsions.

4. TRANS-NATIONAL WATER DEPENDENCIES (PROBLEMS OF MULTI-NATIONAL WATER SYSTEM)

The unique political situation of the State of Israel, surrounded by countries which maintain a state of continuous war with her, prevents altogether the establishment of common systems for the utilization of water resources, despite the fact that the largest surface water resources are trans-regional and trans-national. The Jordan sources, vital to the State of Israel, stem from the Golan Heights; the Litani, which is also one of the sources of the Jordan, flows in Lebanon; the Yarmuk is under Jordanian control, etc.

An improvement in the political situation in the ration would have enabled cooperation on this subject, to the advantage of all the countries of the region.

The existing situation which has been prevailing for decades, has obviously prevented the establishment of legal and judicial systems for handling the trans-regional and multi-national problems of water in Israel, and the Water Laws have no legal, administrative or judicial reference to these problems.

Nevertheless, Israel, which suffers a constant water distress and is permanently anxious about its water resources, which spring from or cross hostile countries, occasionally prepares operational plans, which could be implemented when cooperation with the neighbouring countries is achieved. As aforesaid, these plans could be beneficial to the nations and countries of the entire region, prevent waste of water which now flow uselessly in the Yarmuk, Litani and the Nile; these plans could help in establishing common hydro-electric projects, as in Naharaim, projects which can operate only under conditions of peace. The development of common water systems can thus assist in achieving progress and cooperation which are welcome in the region.

PART II - ORGANIZATIONAL AND ADMINISTRATIVE ASPECTS

1. INTRODUCTION INTO ORGANIZATIONAL PHILOSOPHY AND FRAMEWORK (i.e., NATIONAL OR FEDERATED SYSTEMS OF MANAGEMENT)

As aforesaid in the first part of this report, the Water Laws in Israel are based on the conception of State Ownership of water resources, where the waters are designated for the needs of the inhabitants and the development of the country.

In the present reality, and in a situation of acute scarcity in water existing in the country, it was obvious from the very beginning that the entire responsibility in the field of water and its resources must be centralized under one authority - in the hands of the State. Centralization of responsibility means also centralization of the administration in the hands of one entity, which will be responsible for the subject from all its aspects, starting from uncovering, developing and utilizing water resources, and concluding with protecting water and preventing their pollution, regulating the efficient use of water, water metering, fixing water charges, drainage, preventing floods, etc.

The Water Law stipulated for this purpose the framework of the Water Commissioner - a "corporation sole", appointed by the government, whose function, defined in the law, is to manage the water affairs in the country and to attend to their development and improvement.

The Water Commissioner has, therefore, the exclusive responsibility with regard to the management of water affairs in the country, and he is the one who implements the policy of the government in the field of water. His parliamentary responsibility is to the Minister of Agriculture.

However, the said centralization of authorities does not affect the second important principle which lies at the base of the Water Laws - the designation of water for the benefit of the public.

This principle is the one which dictated involving the public in the various levels of policy shaping, decision making, advising on the exercise of authorities and even on the judicial level. The manners and ways

in which the public participates in the organizational system of the water institutes will be reviewed at length below.

An extensive network of legal powers has been placed in the hands of the Water Commissioner, so as to provide him with the discretion on all matters concerning the allocation of water, control of water use, planning of water supply schemes and their operation, imposition of sanctions in case of violations of the law, etc.

A major part of these authorities has been reviewed in the first part of this report.

In order to enable the Water Commissioner to exercise his powers under the provisions of the Water Laws, and to supervise the execution of such provisions, an administrative system has been established to assist him; this body, which is a governmental institution, is called the Water Commission, and the Water Commissioner can be termed as its director-general.

2. DEFINING THE LEVELS OF ADMINISTRATION

2.1 Governmental and Public Water Organizations

2.1.1 The Water Commission

The Administrative System of the Water Commission

As has been explained, the Water Commission, headed by the Water Commissioner, constitutes the governmental body responsible for the control of water resources, for the complex network of the rights of water usage, and for the overall management of water affairs. It should be emphasized, however, that as the Water Commissioner is the legal authority, he always retains in his hands the power of making the final decision, and the complicated mechanism of the Water Commission can only act when applying and executing the decisions of the Water Commissioner.

The proposals prepared annually by the Water Commission include the allocation and distribution of water during the coming year, the designation of water rationing areas, the stipulation of maximum consumption quantities for the various uses and the determination of priorities within those areas. Such proposals include a great many factors, hydrological, economic, social and legal. The Water Commission was built in accordance with these needs and in fact, all the units and sections of the Water Commission participate in the implementation of the governmental water policy.

The main administrative bodies whose function it is to assist the Water Commissioner, and which constitute the Water Commission as a whole, are as follows:

The Hydrological Service, the task of which is to provide the Water Commissioner with hydrological and hydrometrical data, in order to help

him in the exercise of his authority. Before any decision is made, all data is checked as regards the best utilization of water resources, the development of additional water resources, the allocation of water, the prevention of water pollution, research purposes, etc.

The hydrological service has a unit which measures all the water resources of the country. These are scientific measurements which serve as a check which complements the monthly reports that every water supplier and water producer has to submit to the Water Commissioner.

The Department for the Efficient Use of Water, the task of which is to promote the increase of the efficiency of agricultural, urban, domestic and industrial water use, by way of improving methods, systems and accessories, research and policy.

Facing the permanent disparity between the growing needs for water in a developing economy and the availability of water, it is of vital importance to develop means for the best utilization of water, means by which water can be more efficiently used and assist to bridge this disparity. The methods proposed or developed by the department, after having been examined and found efficient, are applied by way of legal rights. The Water Commissioner may make their use by the water consumers obligatory.

The department of Efficient Use of Water is also in charge of water metering; industrial and domestic sewage effluents; prevention of water pollution, etc.

As the general trend is to increase the use of sewage water, a great deal of planning and instruction is needed in this field. This also comes under the responsibility of this department.

The Allocation and Licencing Department, which is the department dealing with all the administrative work connected with the various licences which are required by the law for various activities; the record of the recognized water rights; reports on water output, the supply and consumption of water, etc.

As already afore mentioned, according to the provisions of the Water Laws, almost no action whatsoever, which has to do with water, can be taken without having first received a licence from the Water Commissioner. Water production, supply and consumption, water recharge, drilling a new well, and the like, can only be carried out when an appropriate licence has been obtained from the Water Commissioner, a licence which specifies the exact conditions under which permission for the said action has been granted. These conditions relate to the quantities, the qualities, the arrangements made for the production and supply, the prevention of water pollution, and other considerations. The said licences may be cancelled by the Water Commissioner if their instructions are not carried out to the full. Therefore, the preliminary checking of the issue of licences is of great importance, as is the continuous inspection to see that the instructions are followed. All these are part of the work of the department.

The department receives also all the data concerning production and consumption, which is monthly submitted by the users of water, according

to the provisions of the law. These data are processed and screened in the department and transferred, when needed, to the other departments of the Water Commission, to be reviewed below. For example - the Adjustment Fund receives the data for the purpose of imposing levies, granting subsidies or for imposing "special payment"; the Economic Bureau gets the data in order to process it, and the Legal Bureau gets it for sending warnings and lodging legal claims, when necessary. (Examples of the various licences are given in the appendix.)

The Drainage and Soil Conservation Department, is the department responsible for proper drainage of agricultural areas, for prevention of damage resulting from floods, and for storage of flood waters. The Water Commissioner's activity in the field of drainage and protective measures against floods inclusive of the construction of impounding reservoirs, derives its authority from the provisions of the Drainage and Flood Control Law. (Regional Drainage Authorities - see below.)

The Legal Bureau. The legal system constitutes the basis and the framework of all the activity of the Water Commission, and is the source of the Water Commissioner's powers. There is therefore need for a continuous legal control of the said activities, and also for current legal advice on the exercise of authority. This is done by the Legal Bureau, the task of which is to work alongside the Water Commissioner and the administrative bodies which assist him, to advise and instruct them in the spirit of the legal system, which is, as already stated, the basis of their existence and activity.

The Legal Bureau prepares all the primary and secondary legislation and documents and checks all the legal aspects of the activities.

The Bureau of Economic Services. Economic data is very important in planning water production, supply and consumption, in developing water projects and in making forecasts for the future. The Economic Bureau is responsible for collecting and processing the said data, which governs and influences the principles and policies adopted by the Water Commissioner in managing water affairs. The Bureau deals also with all aspects of water rates, prices, water charges, tariffs, etc. The Bureau helps in setting rules for the pricing of water and for water costs calculations, in settling disputes between water suppliers and consumers over the conditions relating to the price of water and the mode of payment.

(A graphic sketch of the structure of the Water Commission is given in the appendix - Table 5.)

2.1.2 The Administrative and Quasi-Legal Bodies

In addition to the administration which assists the Water Commissioner within the Water Commission, several administrative-statutory bodies, which are in part quasi-legal and have powers and administrative frameworks, based on the law, have been created by the various Water Laws.

The majority of these bodies, which will be reviewed below, were designed to give expression to the basic legal principle, mentioned above, of public participation; the principle which obliges the authorities to

consult the public and to enable the public, in many different ways, to take part in making decisions.

The Water Board

The water board is a national board which consists of 39 members; it is appointed by the government and its function is to advise the Minister of Agriculture and the Water Commissioner on questions of water policy, including advice prior to publication of rules and regulations. The board has to be consulted before any major decisions are made. The Water Board consists of a majority of representatives of the public and a minority of government representatives, in the ration of 2/3 to 1/3.

The Minister of Agriculture is the chairman of the Water Board and the Water Commissioner is the Vice Chairman. Much of the work of the Board is carried out in committees, which study in detail the matters in question and report back to the Board.

The Board has advisory capacities only, but actually exerts a great and strong influence on the shaping of the national water policy and development. As a general rule, the Minister and the Water Commissioner do not act against the recommendations of the Board.

The Board for Drainage Affairs

Parallel to the Water Board is the Board for Drainage Affairs, based on the Flood Control Law. This board as well consists of representatives of the public, who speak for various interests connected with drainage affairs, and a minority of government representatives.

The Water Commissioner is the chairman of this board.

The functions of the board are to advise the Minister of Agriculture and the Water Commissioner on the approval of drainage schemes and any other matters of policy that are connected with the implementation of the law.

Although the powers of the board are advisory only, its range of influence is very wide, since it has to be consulted before any major decision is made, and this enables the board to play a major role in the implementation of the Drainage Law.

Technical problems are dealt with by the Engineering Committee, appointed by the board and responsible to it.

The Planning Committee

The Planning Committee is a committee formed according to the provisions of the Water Law. It numbers 11 members and is appointed by the Minister of Agriculture. Its task is to assist and advise him and the Water Commissioner regarding the construction of new water schemes or projects. This committee consists of professionals in the various fields, experts who are not dependent on the Minister of Agriculture and the Water Commissioner, and also of representatives of the public. No plan for the

construction of new water supply systems, in accordance with the provisions of the law, can be approved by the Minister of Agriculture without its having been examined and recommended by the Planning Committee. The independence of the experts who comprise the committee makes possible objective judgement in matters of new supply systems, with the sole aim of securing the greatest benefit and advantage to the public.

The Supply Committees

The Water Board, by the power of its legal authority, is permitted to appoint Supply Committees, the function of which is to discuss and advise the Minister of Agriculture and the Water Commissioner on matters relating to the use of water in each of its various aspects - water use in agriculture, in municipalities and in industries.

The supply committees consist of representatives of the public and the users of water for the said purposes, either members or non-members of the Water Board.

The Water Charges Adjustment Fund and the Adjustment Fund Board

As already discussed above, the Water Law has established a fund, which is managed by the Water Commissioner, and is called the Adjustment Fund. Its purpose is to reduce the differences between water charges in various parts of the country.

Alongside the Adjustment Fund there is an Adjustment Board, which consists of a majority of representatives of the public and a minority of government representatives, in the ratio of 2/3 to 1/3. The roles of the Board are to discuss and advise the Minister of Agriculture and the Water Commissioner on all matters concerning the management and operation of the Adjustment Fund, including its budget and the use of it.

The Tribunal for Water Affairs

The judicial Tribunal, which exercises exclusive judicial powers in all water affairs, and which was established by the Water Law, epitomizes the principles of public participation in all decisions regarding water policy.

The Tribunal for Water Affairs consists of one professional judge, and two representatives of the public, chosen from a panel nominated by the Minister of Agriculture, after consultation with the Water Board. The professional judge is the presiding member of the Tribunal.

Any person who considers himself aggrieved by the exercise of powers of the Minister of Agriculture and the Water Commissioner acting in accordance with the Water Laws, has the right to appeal to the Tribunal.

The Tribunal has the power to change, alter or annul the decision. The public takes full advantage of this right. The Minister of Agriculture, as well as the Water Commissioner, justify their actions before the Tribunal, which has exclusive judicial powers and which consists of representatives of the public, who examine, check and criticize the said

activities. Thus the public has a major role in deciding and determining action, in accordance with the Water Laws, and in safeguarding against the abuse of powers by the government.

A direct appeal on the decision of the Tribunal to the Supreme Court is allowed.

2.1.3 Public Executive Bodies

The government institutions have no executive apparatus or man-power lay-outs in order to actually execute, in the field, the functions of water production, supply or distribution, or drainage and flood protection operations. The Water Laws have, therefore, created public executive bodies which are under the supervision of the Minister of Agriculture and the Water Commissioner. The operations of these bodies are directed by force of the provisions of the law and are closely inspected by the various bodies, reviewed above.

Water Authorities

The National Water Authority

The great and central water system in Israel is the National Carrier of National Water System.

This system, which conveys water from the northern part of the country to the south, across its entire length, is managed by a national water authority. The Water Law grants the national water authority a special status, and stipulates its functions. The Minister of Agriculture, with the approval of the government, may empower a corporation to be a national water authority. The authorization is subject to the approval of the Knesset. The functions of such an authority are to manage the national water system, to supply water therefrom, to maintain it in proper condition, to improve and enlarge it, and to take all the necessary actions for supplying water therefrom.

In order to ensure government control of the national water authority, due to its importance to the public, the law stipulates that only when the majority of the controlling shares of a corporation is held by the State and the World Zionist Organization, can the said corporation be authorized to serve as a national water authority. Furthermore, the Minister of Agriculture's right of decision on all matters of administration and management of the national water authority must be secured in the memorandum of association of the said national water authority.

Actually, Mekoroth Water Company, to be reviewed below, serves as the national water authority and the Water Commissioner has been appointed by the Minister of Agriculture, to decide, in his place, on all matters pertaining to the management and administration of this water authority.

The National Water Authority must annually submit to the Minister of Agriculture a report on its current operations, and supply him or the Water Commissioner, at any time, with any information they will ask for, concerning its operations.

Regional Water Authorities

Water systems are established in accordance with the provisions of the law. Truly, there is no legal provision forbidding the establishment of water systems otherwise than in accordance with the provisions of the law. However, there is, actually, no possibility of establishing and managing a water system, except after having gone through all the stages of legal approval. As most of the water systems enjoy government and public financing, which is not given unless the schemes of the system have been lawfully approved, no projects are established otherwise than in accordance with the provisions of the law.

The law stipulates what should a scheme for a water system consist of - description of the function of the proposed system, its area of operation, an economic survey of the investments involved in its implementation, hydrological and engineering opinion, etc.

The Planning Committee (reviewed above) examines the draft scheme and if it recommends its implementation, the scheme is deposited for public examination, and the public may voice contentions and objections to the draft scheme; whoever is aggrieved by the draft scheme of the system, may voice objections, as aforesaid. The Planning Committee hears the objections and reports thereof to the Minister of Agriculture.

The Minister of Agriculture gives the final approval to the scheme, but before doing so, he consults the Water Board on the matter and brings the scheme to the consideration of the Planning and Building Committee of the district where the area of operation of the system is located. The Planning and Building Committee must approve the scheme of the system with regard to planning, and only then the final approval of the Minister of Agriculture to the scheme of the project is granted, upon which its implementation can begin.

Implementation, management, maintenance and operation of a water system, operating on a regional scale, can be carried out only by a regional water authority. The Minister of Agriculture, having consulted the Water Board, may authorize the corporation which has initiated the lawfully approved scheme of the system, to serve as a regional water authority. The functions of a regional water authority are defined in the law and these are: to establish a regional water system, to manage it, to supply water therefrom, to maintain it in proper condition, to enlarge it and to do any action necessary to supply water therefrom.

As long as the regional water authority has not been authorized, as long as the Minister of Agriculture has not given his approval to implement it, the establishment of a water system cannot begin. The Minister of Agriculture grants his approval to a regional water authority only when he is convinced that the said authority has at its disposal the amounts of money necessary for the establishment of the system, or has securities for it.

All the regional water authorities must annually submit to the Minister of Agriculture a report of their operations and supply him or

the Water Commissioner, at any time, with any information required of them concerning their operations.

The need for advance approval of the schemes for a system, the fact that the greater part of the budget of the regional water authorities is drawn from the State Budget, and only its smaller part from revenues for water, the need for current reporting of actions and the like - all ensure closest control of the government and the public over the actions of the water authorities.

Once a year the Minister of Agriculture reports to the Knesset (the Israeli Parliament) about the operations of all the regional water authorities in the country, and those of the National Water Authority.

Drainage Authorities

The drainage authorities are an instrument of implementation, in the field of drainage, which is parallel to the water authorities in the field of water supply.

The drainage authorities are established by the Minister of Agriculture, who stipulates and defines the area of operation of each drainage authority. The functions of a drainage authority are to attend to the proper drainage of its area, to establish, maintain and develop drainage projects in the area, and to attend to the prevention of sanitary nuisances. The drainage authority is an independent corporation, which may enter into contracts, acquire property, sue and be sued, and perform any act required for the carrying out of its functions.

The drainage authority may also enact by-laws in its area, with respect to all matters pertaining to the execution of its authorities.

Drainage projects can be established only in accordance with an approved scheme. The Drainage Law stipulated the details which a drainage scheme has to specify - description of the function of the proposed project and its area of operation, an economic survey of the costs involved in its implementation, an engineering opinion, etc.

Every scheme is first examined by an Engineering Committee, working sidelong the Drainage Board (reviewed above). A scheme, the implementation of which is recommended by the Engineering Committee, is deposited for public examination and the public may voice objections and contentions to the scheme. Whoever considers himself aggrieved by the proposed drainage scheme, may lodge objections. These are heard by the Drainage Authority which, in turn, reports thereof to the Minister of Agriculture. The Minister of Agriculture is the one who gives the final approval to the drainage scheme, but only after having consulted the Drainage Board and after having brought the scheme for discussion to the Planning and Building Committee in the district where the proposed drainage scheme is to be located. The Planning and Building Committee must approve the drainage scheme with respect to planning, and only then the final approval of the Minister of Agriculture is granted, upon which the drainage authority may begin to implement the said drainage scheme.

The budget of the drainage authority must be approved, in advance, each year by the Minister of Agriculture. It should be noted that the greater part of the budget of the Drainage Authorities is drawn from government sources, in the form of subsidies and loans, and only a small part of it from property taxes and drainage levies, imposed on the land owners who benefit from the drainage operations.

A drainage authority must annually submit to the Water Commissioner a report on its actions, and supply him, whenever asked to, with any information concerning its actions.

The need for advance approval of the drainage schemes and of the budgets of the drainage authorities, the need to report currently about its actions, and the engineering and technical supervision on the drainage authorities, ensure the closest control of the government and the public on the operations of the drainage authorities, as is the case with the water authorities.

The Kinneret Authority

Lake Kinneret is the biggest and most important surface water reservoir. It serves as an operative reservoir of the National Water System, and its water is used for drinking.

The lake is located in a wide watershed where the urban and agricultural activity is extensive.

The need to protect the Kinneret and prevent its pollution gave rise to the establishment of a special authority, which is part of the Water Commission, and that is the Kinneret Authority. The Kinneret Authority is the executive branch of the Water Commission in the field, and is attached to its area of operation, in the watershed of the Kinneret, in the north of the country.

The Kinneret Authority was established a few years ago, as a unique system of administration, research and operation, the main function of which is to guard against and prevent the pollution of water in the Kinneret.

The Kinneret Authority is composed of representatives of the National Water Authority, the Drainage Authorities of the Upper Galilee and the Kinneret, and is headed by the representative of the Water Commission. These authorities encompass the total population and area of the watershed from the geographical, topographical, hydrological, legal, implementative and financial aspects. In fact, the Kinneret Authority is connected to many other government and public bodies and local councils, and with them coordinates operations, aimed at preventing water pollution. The purpose of this coordination is to involve them in the realization of these projects, and to be assisted by them, so that each will do what is necessary in his field to prevent water pollution. The budgets of the Kinneret Authority are drawn from government sources, through the Water Commission, the guidance and directions of which are implemented by the Kinneret Authority. A large part of this budget is invested in research and study of processes in the region which affect the Kinneret and its watershed.

The representative of the Water Commissioner is head of the Kinneret Authority, and alongside him works a Board of Directors, composed of 13 members, representatives of the various bodies operating in the area - drainage authorities, local authorities, the National Water Authority, etc., as well as of representatives of various government ministries - Ministry of Interior, Ministry of Health, etc.

The Board of Directors guides the Kinneret Authority in implementing the dictated policy in the region and in planning its operations.

Mekoroth Water Company

Mekoroth is the largest public company supplying water throughout the country. It is a public utility, owned by the government, the Jewish Agency and the Histadruth (General Federation of Labour), in equal shares.

The company supplies water to most of the municipalities, to agricultural settlements and to many industrial undertakings. The government and the public have an almost complete control in the Board of Directors of Mekoroth Water Company. Most of its budget is covered by government subsidies and loans. The Water Commissioner plays an active role in the management of the company, which cooperates with the Water Commission in order to implement the policy of the government.

Mekoroth constructed the National Water System, operates and maintains it in its capacity as the National Water Authority (discussed above). Mekoroth was empowered to be the National Water Authority, according to the Water Law, in 1961.

The functions of Mekoroth as the National Water Authority are controlled by the Water Commissioner and the Minister of Agriculture who has, according to the Water Law, the right to decide on every matter pertaining to the management and the conduct of affairs of the National Water Authority.

Tahal - Water Planning Company for Israel Ltd.

Tahal has no function defined in the Water Laws or according to them, yet it is worth mentioning, due to the function it actually serves in the overall institutional water system.

Tahal is the government water planning agency, and acts as the government consultant for planning problems. Tahal conducts hydrological research, in coordination with the hydrological service (discussed above). The company planned Israel's major water systems and water projects. The government owns 52% of the shares of the company.

2.2 Private and Quasi-Public Use and Management Entities

Urban and Domestic Water Consumption - The water economy of the municipalities

Most of the local authorities in the country do not produce water themselves, but obtain it from production companies, such as Mekoroth. The municipalities manage their water economy under their jurisdiction and fix in by-laws the water charges, water metering, effluent disposal and the charge for it, etc. These by-laws are subject to the overall water legislation and must be in accordance with it, including with respect to water charges. Most of the municipalities own the supply and distribution water system within their bounds. In part of the local authorities the systems are owned by the water supplier.

All the provisions of the Water Laws fall on the corporation of the municipality as a producer, supplier and consumer, all according to the matter and the case. That is, the Water Laws regard the local authority in general as the entity which is responsible for fulfilling the obligations arising from the Water Laws, and as the entity entitled to the rights, according to these laws. All this does not derogate from the municipality's right to manage its water economy, within the corporation, according to the internal criteria which guide it, and which find expression in its by-laws. The two systems work side by side, at the same time, while the overall system of water laws is always superior to the municipal by-laws in the matter.

The annual quantity of water allocated to a municipality is stipulated in a production licence, as is with every other producer, supplier or consumer of water. This quantity is designated to be distributed to all the urban residents, and to those of the consumers who are listed separately in the production licence, with the specification of the quantities of water designated to them. These could be factories, farms within the urban bounds, and the like. The municipality must supply the consumers who are listed separately the entire quantity of water rationed to them, and no more. The quantity of water designated for distribution among the urban residents is fixed in the rationing regulations (mentioned above), as the multiplication of the number of people in a municipality on a certain date by 80 c.m. per person. This quantity of water must cover the urban usage of water for domestic consumption, services, handicraft, commerce, gardens, auxiliary farms, etc.

The quantity of water for urban usage, fixed in the manner mentioned above, is limited, and in most cases is hardly sufficient to cover the actual urban needs. This fact compels the municipalities to take all possible measures, economic, engineering, technological and educational, in order to save as much water as possible within their bounds.

Agricultural Water Associations

The unique form of settlement in Israel (Kibbutzim, Moshavim, etc.) brought about a situation, where most of the agricultural settlements are

associated in agricultural water associations, and each settlement gets the quantity of water allocated to it globally, with the corporation as the consumer, and not the individual settler. As is the case in the local authorities, the waters allocated to the corporation are designated for distribution among the settlers who belong to the corporation, according to internal criteria set by the corporation. The corporation is the sole bearer of responsibility with respect to the Water Laws, the obligations arising thereof and the rights granted therefrom. The quantity of water allocated to each settlement is fixed in the production licence, according to its administrative and economic development, and its ability to utilize the water on the one hand, and according to the possibilities of water supply - on the other.

Because of a general water scarcity in the country, most of the agricultural settlements do not get the allocation of all the quantity of water which is appropriate to their development and their ability to use the water. This obliges the settlements to use the water allocated to them with the utmost economy and efficiency and make use of all the existing technological measures for this purpose. And indeed, the agricultural settlements are always among the first and pioneers in adopting new methods and devices for increasing efficiency and water saving.

The method of a global water allocation, instead of treating every settler as a separate consumer, causes, indirectly, the weakening of the control of the Water Commission on the use of water by the individual settler, for lack of direct contact with him. But, in the existing state of affairs, where the agricultural settlements maintain and preserve their internal independence on the one hand, and the shortage in labour-power and instruments of control - on the other, there is no choice but accept the situation in this field, for a few more years.

Entities for the Utilization of Local Water; Sewage Water and Flood Water

The water resources, owned by the State, include all types of water, inclusive of local water, flood water and sewage water. That is, all these types of water are included when considering the water potential of the State. Nevertheless, and in order to encourage the use of marginal, still unutilized water, by entities, organizations and individuals, who are ready to invest money and seek suitable engineering and technological solutions which will enable them to use these marginal waters, the Water Commissioner used to grant the right to use the said waters in excess of the allocated quantities of water. The more so, as in most of the cases, this utilization solved also problems of disposal and pollution.

That is, the utilization of local, sewage or flood waters by those entities and organizations did not derogate from their right to the quantities of water due to them in the usual manner. Such policy caused, and actually brought about, local initiative to develop water resources which the central government was unable to reach, for budgetary or pertinent reasons.

It should not be interpreted that the use of the said types of water was permitted without licence or control. Every such use requires

specific permit from the Water Commissioner, which is granted after examination and approval of the implementation scheme. The use is subject to constant control and reporting.

At present, with the water situation in Israel becoming more serious, and with the increasing need to reduce the quantities of water lawfully due, and when it is clear, almost beyond a shadow of doubt, that in the near future clean water will have to be substituted, in agriculture, by treated effluent, and the clean water conveyed to domestic and urban use, proceedings are being adopted, and schemes are being drawn, in order to include the marginal waters within the limits of the quantities of water lawfully allocated to entities, which use marginal waters.

The Water Commission is still seeking the right, efficient and just way of doing it, while at the same time maintaining local initiative to utilize marginal waters and invest in its development on the one hand, and using the right and fair principles of distributing the limited water resources of the country among those who have a right and are interested, on the other.

SUMMARY

The grave condition of the water resources, as against the ever growing consumption and demand for this means of production, compelled the legislators of the Water Laws to provide in these laws the most rational methods of managing the limited water resources, with the aim of drawing from them the greatest advantage to the country as a whole.

This was accomplished by ways and measures reviewed in detail above, where the emphasis is laid on a central institute - the Water Commission.

Without underestimating the value of the administrative achievements attained so far, the State of Israel incessantly seeks new ways of increasing the efficiency of the systems, improving their management and adjusting them to the developing and changing conditions, and the accumulated knowledge thereof. This is carried out without neglecting the existing ways and frameworks.

The new trend which is taking shape is that of concentrating, under one administrative framework, the entire handling of the water affairs, throughout the process of production, conveyance, distribution, collection and treatment after use and restoration to the water system. That is, one administrative framework which will handle water, drainage, effluent, reclamation and reuse of water.

This will also necessitate a change in attitude toward water charges and payments. It seems that charging the users with the costs of effluent treatment and removal of polluting factors from the water, through water charges for water used by them, is imperative. The charge for water will have to include, in the future, the full expenses caused by effluent and pollution, which follow the use of water, either by urban or industrial use, or by agricultural use.

Following the direction of the said trends will necessitate a suitable administrative, economic and legislative organization, including changes in the existing system, and creation of new systems, on the basis of the know-how and experience gained in the world, under conditions similar to those in Israel.

Every change that will be made in the organizational systems will have to find its expression in appropriate legislation, as a result of which the said change will become obligatory and implementable.

APPENDIX

TABLE 1 - WATER PRODUCTION LICENCE

State of Israel

Ministry of Agriculture - Water Commission

Name of Owner of Licence _____ Adress: _____ Licence No. _____

Names of Additional Owners of Licence: _____

The owner of the licence will produce and supply water as of _____ (date) until _____ (date) according to the following specifications (in thousands of c.m.):

A. SOURCE OF PRODUCTION

Total	Quantities of water permitted to be produced divided according to monthes and seasons (in thousands of c.m.)
April	
May	
June	
Total of Season A	
July	
August	
September	
October	
Total of Season B	
November	
december	
January	
February	
March	
Total of Season C	
Yearly Total	
Percentage of recharge	

List of sources of production of the owner of the licence

B. DIVISION ACCORDING TO PURPOSES OF CONSUMPTION (in thousands of c.m.)

Water Resources	Total yearly water allocation for all purposes of consumption	For Agriculture						
		Total for agriculture consumption	Season A	85% of the allocation in season A	Season B	85% of the allocation in season B	Season C	85% of the allocation in season C

For Industry				For Domestic Consumption			
Total for industrial Consumption	Season A	Season B	Season C	Total for Domestic consumption	Season A	Season B	Season C

Additional Terms

Date _____

(-----)
Water Commissioner

Appendix to the Production Licence

PURPOSE OF WATER PRODUCED AND SUPPLIED

The owner of the licence and his consumers	Season A			Season B				Season C				
	April	May	June	July	August	September	October	November	December	January	February	March

This appendix is an inseparable part of production and supply licence no. _____

Date _____

(-----)
Water Commissioner

TERMS OF LICENCE

Part A - General

1. According to the provisions of section 23 of the Water Law 1959, water is not to be produced, supplied or consumed otherwise than according to a licence from the Water Commissioner and in accordance with the terms of the licence.

2. The terms of the licence, detailed below, are an inseparable part of the licence itself.

3. Disobedience to the provisions of this licence or violation of its terms may cause the cancellation, suspension or alteration of the licence by the Water Commissioner.

4. Section 31 of the Water Law 1959 establishes:
   "a. Anyone considering himself aggrieved by the refusal of the Water Commissioner to grant a production licence, by the terms stipulated in the production licence or by its suspension, alteration or cancellation, may lodge an appeal thereof to the Court within 21 days from the date the announcement of the Water Commissioner was delivered to him.

   b. The lodging of an appeal shall stay the cancellation, suspension or variation of the licence."

Part B - Explanations to the provisions in the licence

1. a. This licence consists of several pages. On the first page the details relating to the owner of the licence, the source of production, the quantities of the water permitted to be produced and supplied, as well as its seasonal and monthly division, to the purposes of water consumption and to the quantities of water supplied to the owner of the licence by other suppliers, are given.

   b. The terms of the licence, which include explanations and the conditions accompanying production and supply, are given on the second page.

   c. The third page and the pages which follow (if necessary), are an appendix to the licence and give the full details of the purpose of the water produced and supplied according to this licence for the owner of the licence and for each of his consumers separately, including its seasonal and monthly division and in accordance with the purposes of the water consumption.

   d. Wherever these terms apply to the licence, the implication is to all the parts of the licence, including the appendix concerning the purpose of the water produced and supplied, as aforesaid.

2. a. When according to this licence, quantities of water are allocated for Agriculture, whether for production, supply or consumption, there is, on the first page, beside the allocated water quantities, a specification of 85% of every allocated water quantity, as aforesaid.

   b. Anyone who has not produced, supplied or consumed more than the said 85% of the allocated water quantity, will be exempted from the adjustment levy, everything as specified in the regulations concerning the adjustment levy.

   c. An exemption, as aforesaid, does not apply to quantities of water allocated for use in fish ponds and auxiliary farms and to water produced or supplied by gravity and according to the provisions of the Water Commissioner cannot possibly be used for commutative use.

   d. Anyone who has not produced, supplied or consumed the remaining 15% of the allocated water quantity or part of it, or anyone who has not used the full quantity allocated to him for agriculture, his right to receive in following years an allocated water quantity, calculated according to the maximum consumption quantities which are specified in the Water Use Regulation in rationing areas, will not be impaired.

3. The quantities of water permitted to be produced, supplied or consumed according to this licence have been divided according to seasons and months. The seasonal division is into three seasons: Season A - the months of April - June; Season B - the months of July - October; Season C - the months of November - March. Beside the said division, the overall water quantities permitted to be produced, supplied or consumed in each of the said seasons is specified, as well as the sum total of the quantities, as aforesaid, in seasons A&B. The addition of seasons A&B is given only in relation to the special payment, according to its meaning in the regulations concerning the special payment.

4. Whoever shall produce or supply water in a quantity which is in excess of the quantity permitted to be produced or supplied according to the specifications in this licence, whoever shall supply water to a consumer in a quantity which is in excess of the quantity permitted to be supplied to that consumer according to the specifications in this licence, or whoever shall supply water to a person whose name is not listed in the appendix to the licence as aforesaid, the Water Commissioner may impose on him a special payment in rates differing according to the purposes of the water stipulated in this licence, all as specified in the regulations concerning the special payment.

5. Where the quantities of water allocated according to this licence are duly recharged, specifications of the quantities permitted to be produced had the recharge not been carried out, of the quantities permitted to be produced on account of the recharge and the rate of quantities that can be produced on account of the recharge out of the overall permitted quantities according to this licence (percentage of recharge) are detailed on the first page of this licence.

6. Changes duly made by the Water Commissioner in the provisions of this licence during the period of the licence, and notice thereof having been submitted in writing to the owner of the licence, are an inseparable part of this licence, with all the implication evolving therefrom.

Part C - Terms of production and supply

1. The owner of the licence will produce and supply water only in accordance with the provisions of this licence.

2. a. The owner of the licence must supply water to those listed in the appendix to the licence, under the conditions stipulated for each one of them.

   b. Subject to the provisions of the terms of this licence, the supply as aforesaid will be conducted according to an agreement between the parties, and where there is no agreement, the terms of supply will be stipulated by the Water Commissioner or by one appointed by the Water Commissioner for this purpose, according to an appeal by the parties, or by one of them.

   c. Lack of an agreement as aforesaid will not be ground for not supplying or for discontinuing to supply water.

   d. A supplier is not obliged to supply water if the water charges, in the amount stipulated by the law or in the agreement between the parties, have not been paid.

3. Water shall not be produced, supplied or consumed in excess of the quantity stipulated for each of the seasons specified in this licence; water shall not be supplied in excess of the quantity allocated to each one of those listed in the appendix to the licence, and water shall not be supplied to anyone whose name is not listed in the appendix without prior, written confirmation from the Water Commissioner.

4. Without its importing the right to any additional yearly or seasonal water increment, and taking into consideration the possibilities of supply, the owner of the licence may deviate in the monthly production, supply or consumption from the seasonal and monthly division in this licence, as long as the overall quantity at the end of the seasons will not be in excess of the quantity stipulated in the above mentioned division for each one of those seasons.

5. No water shall be produced, supplied or consumed according to this licence except in accordance with the Water Metering Law 1955, including the regulation and orders issued in accordance with it.

6. Utilization of the allocated quantity of water or part of it for use which might cause growing consumption in the future, without prior written confirmation from the Water Commissioner, will not be ground for increasing the allocated water quantity.

7. a. The owner of the licence must submit, by the 7th of each month, a report on his water production in the previous month.

   b. An owner of a licence who supplies water to others must keep a monthly record of the distribution of the produced water, detailing his own consumption and the supply to each consumer listed in the appendix to this licence, according to the purpose of water. The owner of the licence must submit this report once in every two months, by the 7th of each second month. The report will specify the above mentioned details for each month separately.

   c. The above detailed reports will be submitted on special forms which will be sent to the owner of the licence and which can also be obtained at the Water Commission.

8. a. Whoever supplies water to consumers according to this licence and is liable to be charged with a special payment, in the rates specified in the regulations concerning the special payment, may collect from a consumer who has actually consumed the quantity of water on account of which the charge of the special payment is liable, along with the water charges, a charge which is intended to ensure the share of the consumer in the special payment as aforesaid, or receive from him an appropriate commitment to pay his share in the special payment as aforesaid.

   b. Had a payment been collected from a consumer or a commitment received from him as aforesaid, and a special payment was not imposed on the supplier on account of the quantity of water consumed by the consumer, or the special payment as aforesaid was revoked, the supplier will return, without delay, the payment or the commitment to the consumer, all according to the matter.

9. The owner of the licence must enable the Water Commissioner or anyone appointed by him for that purpose, to carry out surveys of the water-table in the wells, according to the Water Drilling Control Law, 1966 and its regulations.

10. The owner of the licence and his consumers must refrain from any action which pollutes water or might cause water pollution, in any water resource, directly or indirectly, immediately or after a time and it is immaterial whether the water resource was already polluted before this action, or was not.

11. The owner of the licence and his consumers must take all reasonable measures in order to prevent the installations used to produce water, supply, convey, store them, etc., from causing water pollution.

12. The owner of the licence and his consumers must inform the Water Commissioner, without delay, of any pollution detected in the water or of any action which might cause water pollution whether in the resource from which he produces, supplies or consumes water, or in any other resource.

13. Regulation, having been prescribed, concerning quality of water for the various uses, the production, supply and consumption of water according to this licence will be performed only in accordance with the prescribed regulations.

14. Production, supply or consumption of sewage water, having been permitted according to this licence, a permit from the Ministry of Health must be obtained in addition to this licence, according to the Business Licencing Law 1968.

15. Production, supply or consumption of drinking water according to this licence are permitted only in accordance with the sanitary quality of the drinking water as stipulated by the Minister of Health according to the Amendment to the People's Health Order Law (No. 4), 1970.

16. a. The owner of the licence must enable the Water Commissioner or anyone appointed by him for this purpose, to carry out tests of the water quality and to take samples of the water in the water resource which is the subject of this licence.

    b. An owner of a licence who has been so required by the Water Commissioner, will have to carry out tests of water quality and submit their results to the Water Commissioner, all as specified in the demand.

17. The owner of the licence must inform, in writing, all the consumers listed in the appendix to this licence about all the stipulations and terms of the licence which apply to them.

18. The owner of the licence must inform the Water Commissioner without delay of any change which may affect the details appearing on this licence.

19. As long as the owner of the licence has not been given notice about the cancellation of the licence, or as long as a new licence has not been issued after the expiration of this licence, the owner of the licence will produce and supply water according to this licence, including its terms of production and supply, unless anything to the contrary is explicitly said in this licence.

Table 2 - MAXIMUM CONSUMPTION QUANTITIES IN AGRICULTURE

In this table "ecological region" - a region as stipulated by the Centre of Agricultural and Settlement Planning and is included in a rationing area; the map of the ecological regions in rationing areas is deposited in the offices of the Water Commission in Tel Aviv-Jaffa, Haifa and Jerusalem.

Water Use (crop)	Maximum consumption Quantity in c.m. per Dunam										
	Ecological region 2 Acca Northern Upper Galilee	Ecological region 3 Western Galilee and Zvulun Valley	Ecological region 4 Central Galilee	Ecological region 9 Gilboa	Ecological region 10 Valley of Yzrael Ephraim Mountains	Ecological region 12 Coast Area	Ecological region 14 Jerusalem Corridor		Ecological region 15 South	Ecological region 16 North western Negev	Ecological region 17 North Eastern Negev
							Hills (200-400m) above sea level	Mountains [illegible]m + above sea level			
ORCHARDS											
Fruit bearing citrus	---	720	---	850	720	720	---	---	750	800	---
Young Citrus -											
1 year old	---	100	---	150	100	100	---	---	100	100	---
2 years old	---	170	---	200	170	170	---	---	200	200	---
3 years old	---	220	---	300	220	220	---	---	250	250	---
4 years old	---	400	---	500	400	400	---	---	400	450	---
5 years old	---	500	---	650	500	500	---	---	500	550	---
6 years old	---	600	---	750	600	600	---	---	650	750	---
POME FRUITS											
Apples	800	720	720	720	720	800	800	720	---	800	800
Pears	800	720	720	720	720	720	780	720	---	720	720
Quinces	600	600	600	600	600	600	600	600	---	600	600
STONE FRUITS	---	390	390	---	390	390	500	380	390	390	---
SOB TROPIC											
Avocado -											
1 year old	---	100	---	100	100	100	---	---	100	100	---
2 years old	---	200	---	200	200	200	---	---	200	200	---
3 years old	---	400	---	400	400	400	---	---	400	400	---
4 years old	---	600	---	600	600	600	---	---	600	600	---
5-6 years old	---	800	---	800	800	800	---	---	800	800	---
7 & more years old	---	900	---	900	900	900	---	---	900	900	---
Others	---	800	---	800	800	800	---	---	800	900	---
Bananas	---	1050	---	---	---	1050	---	---	---	---	---
Table Grapes	300	300	300	600	300	300	430	430	300	500	---
Wine Grapes	---	---	---	---	---	200	200	200	200	200	200
FIELD CROPS											
Annual crops	400	400	400	500	400	400	400	400	400	400	---
Perennial crops	1250	1000	---	1200	1000	1000	---	---	1100	1350	1500

Table 3

STATE OF ISRAEL
Ministry of Agriculture
Water Commission

THE WATER DRILLING CONTROL LAW - 1955

DRILLING LICENCE
No.....

By virtue of the authority conferred to me according to section 4 of the Water Drilling Control Law 1955 I grant this drilling licence.

A. Name of owner of the licence:.....
His address:.....

B. Specifications of the licence and its terms:
1. Place of drilling:..... District:.....
City, municipal authority:.....
Land mark:..... Block:..... Parcel:.....
2. Depth of drilling:..... Level of exploitation.....
.....

C. General terms:
1. The drilling shall be carried out according to the terms of this licence and the provisions of the Water Drilling Control regulations.
2. The owner of the licence will start the drilling operations within three months from the day the licence was issued and will conduct them uninterruptedly.
3. The owner of the licence must keep a record showing the progress of work and submit to the Water Commissioner, every week, a copy of it signed by him and by the contractor executing the work.
4. The owner of the licence will carry out, within a year from the date the licence was issued, a test pumping, save if he notifies the Commissioner within that period that he does not wish to use the licence. The test pumping will be carried out after a 7 days advance notice to the Commissioner and will extend to no longer than one month.
5. Upon completion of the test pumping, the owner of the licence will submit a report on the test pumping, to which a section and samples will be attached, as specified in the Water Drilling Control Regulation, 1955, as well as a localization sketch of the drill, as specified in the Measuring Regulations (localization of Drills) 1958.
6. This licence does not give its owner the right to produce water from the drill, except for the purpose of a pumping test, so long as he has not yet received a production licence according to section 23 of the Water Law 1959.
7. This licence does not import any rights to the land or the water resource.
8. This licence does not exempt from the obligation to obtain permits and licences in accordance with the Planning and Building Law 1965 and to comply with its provisions or the provisions of any other law.

Hakyria, Tel-Aviv.....

Seal

Water Commissioner

Table 4

STATE OF ISRAEL
Ministry of Agriculture
Water Commission

The Water Law 1959 (Amendment of 1965)

Recharge Licence No. _____

By virtue of the authority conferred to me according to section 44b of the said Law, I hereby grant this recharge licence:

General details:

1. Name of owner of the licence:
2. His address:
3. Purpose of recharge:
4. Area of recharge:

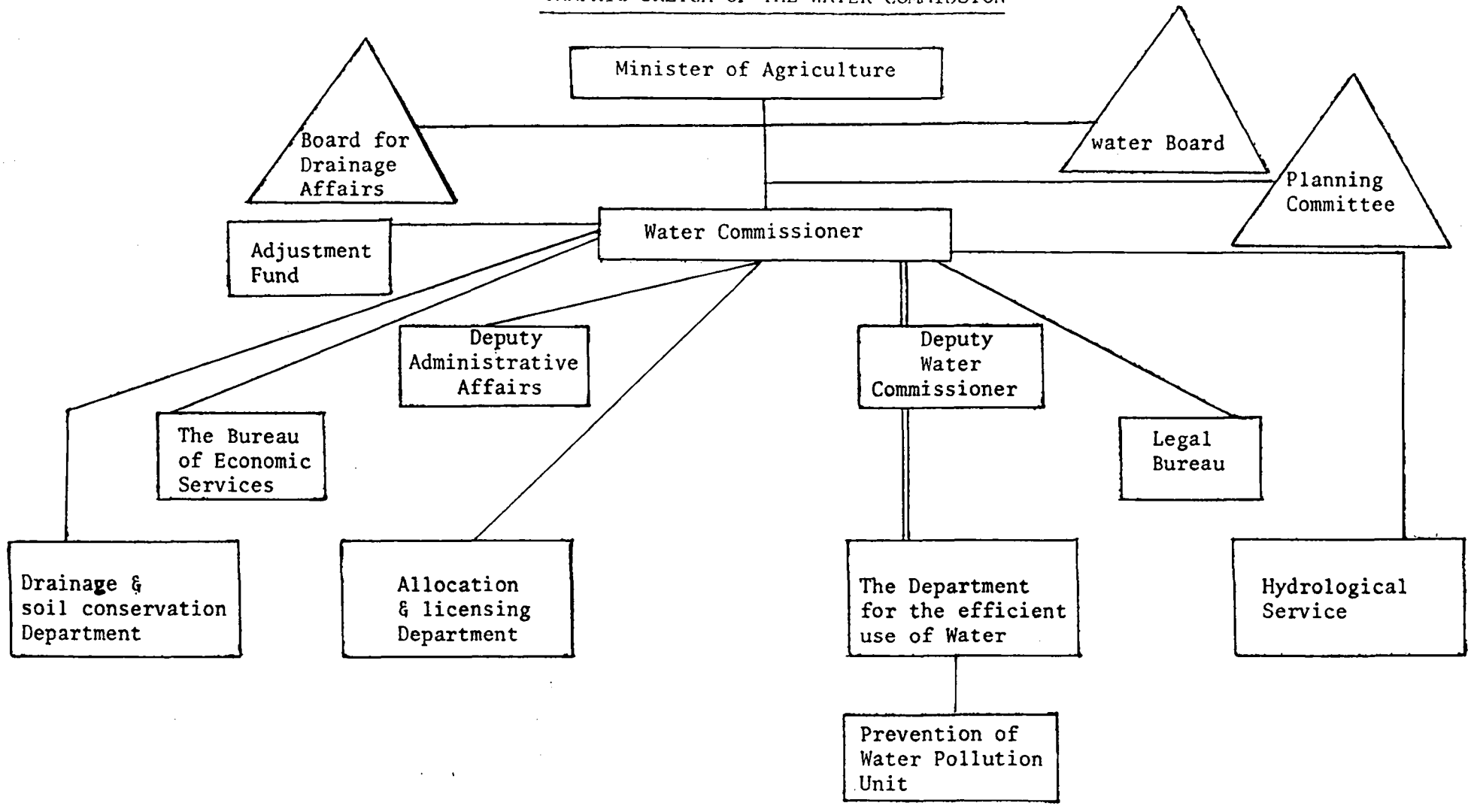
Specifications of the licence and its terms:

5. The owner of the licence will recharge water the source of which is ..... to drill..... the national number of which is.....
6. The quantity of water intended to be recharged according to section 5 above will be ..... c.m. per year.
7. Those who are to benefit from the recharge operations are:.....
8. The recharge is to be performed by metering, prior to the entry of water to the resource of recharging, according to the existing norm of water metering.
   The owner of the licence will record accurately the seasons of recharge, the quantities recharged and will send a monthly report thereof to the Water Commission.
9. The owner of the licence will carry out a test of the recharged water, in case such a demand is issued by the Water Commission, and in accordance with the demand.
10. The owner of the licence will inform the Sanitation District Engineer, within 24 hours at least before a test pumping is performed in the drill mentioned in section 5 above.
11. The owner of the licence will submit to the Water Commission, within 7 days from the end of each month, a report on the quantities of water recharged.
12. The validity of this recharge licence expires on.....

(----------)
Water Commissioner

Table 5

GRAPHIC SKETCH OF THE WATER COMMISSION



SOCIO-CULTURAL ASPECTS OF WATER MANAGEMENT

by Evan Vlachos*

Foreword

It would be indeed presumptuous to present in a short paper the summarization of the "social" aspects of every major water source development in our planet as well as every possible aspect of water management. Given the limited space as well as the imperative of the Congress to present issues relevant to legal implications of global water law management, it would be necessary to highlight only some key issues and central concerns.

The paper intends to be general in nature, trying to ferret out major issues when presenting the large topic of the social aspects of water. Given the all-encompassing character of the term social (almost an unlimited category for anything that pertains to the so-called "human factor), it is important for us to generalize on a number of key ideas that affect the evolution, nature, character, and practice of legal regimes vis-a-vis water resources. Thus, the paper tends to be comparative in nature by trying to present a variety of issues that transcend typical national experiences. However, we should qualify the remark by saying that most of the experience related below tends to come not only from the United States, but particularly from the western part of the nation, a salubrious region characterized by high aridity and the assorted problems identified with water-scarce areas. The emphasis on aridity provides also the permeating and pervasive character of the exposition that follows, namely a strong preoccupation with irrigated agriculture. While many other water uses are briefly discussed, irrigated agriculture becomes the focus of attention, as a result also of the pervasive need to increase agriculture and the food output of a starving world.

The paper is organized around some major categories of concern reflecting from the more general to the more specific the typical issues upon which social scientists, especially sociologists, are called upon to comment or work with when discussing the relationship of water and environment. The sequence of analysis includes:

1. A general introduction as to the problematic nature of water and the social characteristics of water resources.

2. A recapitulation of the traditional analysis of the relationship of water and society, the role of water programs and the principles guiding the sociological approaches to water uses.

3. A third section attempts to relate a cogent social sciences framework based on systems analysis to other critical variables in water management, especially to legal imperatives. The section attempts to provide a common language and vocabulary for relating social aspects

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to other "environments" and, thus, provide an interdisciplinary framework for analyzing systematically water resources management.

4. A number of persistent issues and concerns, especially the social forces of change, the role of natural resources in development and concern with environmental despoliation.

5. Finally, a last section attempts to relate some general sociological remarks as to the need for integrated water resources planning and the current concerns both with environmental impact assessment and problems of social forecasting. The last part attempts to relate how the past can act as a key to the future, not only in terms of the rise and fall of hydraulic civilizations, but also as to the current concerns in water resources planning and management. A few selected remarks are also made as to the role of social scientists in clarifying issues for meeting new circumstances and increased concerns in water resources management.

It is apparent that this is quite a grandiose purpose and one should not delude himself by thinking that all these topics can be met either adequately or through an in-depth exposition. Once again, the purpose of this paper as well as the variety of material presented in this Conference is aimed at presenting in simplified form major issues and concerns and out of the commonality of problems relate the types of factors that one should take into account when approaching the interdisciplinary, multi-objective, comparative analysis of water management.

I. GENERAL REMARKS

The total hydrosphere of the planet, resulting from the evaporation/precipitation/exchange cycle and linking terrestrial, atmospheric and marine environments in a massive interchange, constitutes 71.7 per cent of the biomass of our planet. Water is the vital link between physical and social environments. It is not only a commodity which is directly used for man's survival, but quite often the mainspring for extensive economic development and the backdrop for the many of man's activities.

Water, the key resource in daily life, agriculture and industry, forms many great systems through myriad paths, alternatives and cultural practices affecting the course of history and impacting in varying degrees on earth and society. But water is not only a great natural resource: it has also increasingly become a technological and social system. A large share of the national wealth is invested in structures to alter the hydrologic cycle. Vast technical structures dot the countryside, and complex socio-political systems have been devised to regulate, allocate, or help use water resources.

While concern with water resources, especially in moisture-short regions, has been a historical preoccupation, growth trends and changing circumstances have underlined the concern that water in many world regions is in critical balance. It has been estimated that approximately 95 per cent of the fresh waters are presently used at a greater rate than

their precipitation replacement in ground surface waters. Although much water use is of a multi-purpose "cycling" nature, continuous increases in each use have produced strains in the storage, replenishment, and in the natural recycling capacity of many areas.

There is no doubt that the tremendous increases in the number of uses of water by both agriculture and industry, as well as the pressures from geometrically expanding populations, all indicate a global possibility of critical shortages in the near future. Water is being withdrawn for use at a faster rate than its return to the streams, lakes, rivers and other sources of precipitation. An increased concern all over the world is how to return water to the source and at the same time guarantee that this return of water is not spoiled by waste, soil runoffs, and thermal discharges. In this context, it is important to notice that in many cases water has been generally treated as a "free good" to be drawn upon as required by expanding demands. But in the coming years there is a strong possibility that such a situation cannot continue. Numerous studies and national committee reports all over the world have repeatedly reflected on the very simple fact that increased demands cannot be met economically with existing supplies; even under the most optimum foreseeable developments in purification and engineering, there are going to be increased disparities between supply and demand.

Needless to say, it is not the purpose of the present document to describe again the ubiquity of water, its necessary nature for sustaining life, its basic properties, the interdependence of the hydrologic cycle in the biosphere, or the historical evolution and utilization of water for civilization. To sum the obvious, however: water is fundamental to all life forms, affecting all ecosystems, it is geographically and seasonably unevenly distributed, and the various uses to which water is put often compete, both quantitatively and qualitative, with one another. The paradox of water can, then, be stated simply: ample water exists in our world for all man's needs; but much of it is either in the wrong place or in the wrong form. Such a simplistic statement would also provide the basis for a simple technological problem to be solved. But accentuating this simple technological statement are two conditions which converge to increase the problematic situation of water. First, varying water supplies in both time and space. And, second, diversity in water uses and water requirements.

The emerging atmosphere of scarcity and concern with global water resources capabilities, especially in arid regions, has been documented abundantly in the literature. Historically, agricultural economies have always flourished in areas and regions with favorable ecological conditions for planned growth. Therefore, location and immediate ecology were key factors for agricultural production. The locational importance, however, has receded because control over the environment, technological innovations, transportation of water, etc., have provided greater flexibility for agricultural production in otherwise relatively hostile physical environments.

Yet, despite innovations and continuous promises of further physical breakthroughs (including futuristic alternatives of aquaculture, hydroponic potentialities, synthetic foods, and others) soil, water, and

climate as given in the ecological configuration of a given region are prime physical constraints in agricultural production. Thus, it has been observed that in more than one-third of the land area of the earth, water is the chief limiting factor on human activity. About 21 per cent of the land area has arid climate, another 15 per cent is simi-arid, and an additional sizeable area has an uncertain water supply. There are some 25 billion acres of land on the earth, of which something less than 3 billion or about 12 per cent are devoted to cultivated crops. Of this total, about 400 million acres are included under irrigation systems, and an additional 200 million acres are served by artificial drainage or protective works. The expansion of total food output in the form of cultivated crops can be brought about generally in two ways: by increasing the yield per acre of already cultivated lands, and by opening new lands to cultivation.

More important in discussing the general global look of water management are a number of substantive problems that emerge in the discussion of various water uses. First of all, it is generally recognized that there is an increasing problem of scarcity of water in many lands, particularly in an arid and semi-arid belt that seems to comprise a large segment of the inhabited earth. Second, while scarcity of water seems to be a major problem, equally important for a number of countries is also the problem of excess water and the assorted floods that seem to plague countries who cannot regulate their supply of water. Thirdly, transcending the conditions of either scarcity or excess are problems of water quality degradation due to either natural or human practices. The poor quality of water is many times associated with a fourth problem in water management, namely, misuse, and bad agricultural practices which accentuate complex problems of natural degradation. A fifth problem has to do with organizational ineffectiveness and the non-rational use of water supply. Even though water may be abundant, in many cases there do not exist the proper institutional mechanisms or the organizations that could effectively maximize allocation and use of existing natural resources. Finally, a persistent problem has to do in many cases with what one may describe as transnational interdependencies, and the fact that many water supply systems do not confine themselves within arbitrary national boundaries or artificial political divisions. Problems of jurisdiction can become major handicaps for total environmental planning.

The general problems described above are also accentuated by a variety of economic, social, and political situations in each country. Water resource problems, like most natural resources problems, are primarily of socio-economic nature. In other words, a technical solution can quite often be found. However, the costs both in economic and social terms are quite often prohibitive or the mechanisms for meeting them do not exist in a particular country. While certain nations have both the economic and managerial capability of meeting the variety of problematic situations and, thus, transport water even from hundreds of miles away, this may be quite a serious problem in a poor society.

One could easily go about constructing a whole variety of specific water problems which, for each country, would be result of unique combinations of social and technological circumstances. Nevertheless, and in the context of the present paper, we can summarize all such problems as part of common characteristics which provide the basis for an

integrated water resources approach. These common characteristics come about as a result of two major forces today. The first has to do with the exponential growth of water needs. There is no need to reiterate here the variety of sources that bring about the exponential growth and quantitative demands of water all the way from dramatic population growth to the particular ecological conditions that give rise to demands for increased agriculture. Some sixty countries, that is half the total number of countries in the world, are under arid conditions. Such cases of water shortages include Spain, Italy south of Lombardy, the Dalmatian coast, Greece, the Anatolian Plateau, all Arab states except Syria, most of Iran, Bangladesh, Western India, Taiwan, Japan, Korea, the western and southern belts of Australia and New Zealand, the northwest and southwest African Coast, the American Southwest, Panama, Northern Mexico, Central Chile, and the Peruvian litoral.

The repeated evidence of both national and international studies point out that the planetary shortage will be getting serious in about another thirty years, when the world's population will have doubled (from three and a half to seven billion) and demands for water nearly tripled. Demands of water in this case mean everything from swimming and fishing in it to making plastics and steel with it, cooling nuclear reactors, irrigating, flushing residues of pesticides, fertilizers and livestock, carrying off industrial and human waste, and of course drinking.

Parallel to the extreme quantitative demands, increased concern about water has also to do with the qualitative aspects of natural resources development. In the relationship between man, culture and the surrounding environment, qualitative problems arise from the exponential increase of pollution. Constantly increasing quantities of industrial, agricultural, biological and military wastes steadily poison fresh water resources. Fertilizers and pesticides that increase food production also contaminate groundwater, as does waste from big cattle populations.

In this respect and in the continuous argument about increased demands and despoliation of existing water supplies, many nations need to weigh new approaches and concepts, costs and priorities, technologies, education of large users in the avoidance of waste, and whether the ever-rising demand for fresh water can be reversed.

If one is to isolate some key items in policies and planning affecting water management, and in view of some of the impressionistic remarks made above concerning quantitative and qualitative aspects of water resource exploitation, the following concerns stand out:

a. the release of water for new demands;

b. the maintenance of agricultural productivity;

c. the minimization of water quality degradation;

d. an expanding economy highly dependent on water;

e. a developmental growth outlook;

f. lack of appropriate institutional and legal infrastructures to meet new and competing water demands.

Proper water management organization, technological innovations, and the efficient (and effective) allocation and use of existing resources are crucial factors for the success of any water project. However, national growth policies, environmental concern for despoliation, and emerging natural resources policies are pointing also towards more comprehensive, holistic or integrated planning. The positive and intangible benefits to community development, which have always been tacitly recognized and acknowledged, must be articulated in more specific terms. Water, as an organizing concept, can play an active role in guiding and stimulating growth, in providing new standards and evaluation criteria, and in strengthening its potential as an additional means for achieving larger social goals. At the same time, water becomes part of a broader natural policy which recognizes the social needs of the country in a balancing of three important dimensions:

a. efficiency, or the growth in material development so that a solid basis of economic sufficiency may be maintained;

b. equity, or fair access of resources and consumption to different segments of the population;

c. effectiveness, or the overall significance of any project or policy vis-a-vis the pursuing of certain larger social goals.

Environmental, holistic planning is not a luxury to be afforded by rich developed nations, but also a necessity for integrated developmental efforts. The tasks for developing countries in future agriculture development raise such important questions as to how can more food and materials be produced with dwindling land and water resources? How will agricultural water use compete with other demands? How can limited economic resources be used in an efficient and equitable manner for the achievement of important social objectives? Large as these questions may be, they are the necessary backdrop for understanding the more specific dimensions, problems, and opportunities in the more narrow question of an effective system of water management.

At this point one may ask the question as to what do we really know from the past that can act as a historical guidance for meeting problems of the present and of the future. All available records point out that the ancient water managers faced with parallel water problems have always tried relentlessly to match available water supplies to expanding needs of the economy, regardless of cost to the social, and sometimes to the physical, environment. Yet, while we may think that the environmental ethos that is currently prominent in water resources is something of a recent awakening, throughout history, despite the preoccupation with a developmental outlook, all hydraulic civilizations have showed an understanding of environmental perils resulting from intensive water development.

Following some of the insightful remarks of Teclaff on this point, we may expand some historical precepts that seem to have universal validity. Such precepts include the observations:

1. Wherever there has existed an ecologically sound water management system, evolved over a long period of time, it should neither be tampered with nor allowed to deteriorate through neglect or apathy.

2. Wherever resources should be administered in harmony with the total environment.

3. Potential harms from further water resources development should be weighed against the potential benefit of a project. This also points out that the acceptance of such principles involves also a more recent transformation from criteria of efficiency (i.e., benefit-cost criteria) to those of effectiveness which include also a variety of social costs not usually incorporated in economic analysis.

4. That the concept of public duty should extend to the entire population.

5. That planning, ideally, is a centralized affair requiring integration and coordination.

Again, Teclaff has observed that the most significant lesson of history is that without a technological breakthrough that would provide new sources of water or reduce consumption in many of the tasks which water now performs, sufficient water for the needs of a growing economy can be provided only at ever-increasing costs to the physical environment or to the social environment, or both (Teclaff, 1973). We have reached the point in water (and in the variety of all other natural resources) to recognize not only the limitations of "spaceship earth" but also the fact that there is a point in natural resource development when water can no longer be matched to the economy, but the economy must be matched to the water available.

The recent demands towards questioning the very idea of growth is in the heart of a debate concerning the balance between supply and demand. In this respect water resources developments and the degree of their impact and long-range consequences on surrounding communities must be seen as part of a broader picture of natural resources utilization involving a balance between supply and demand through a recognition of such constraints as:

Supply	Demand
• overall water limitations	• population growth
• technological limitations	• general economic growth and affluence
• economic and tax policies	• the extent to which lifestyles are or are becoming "water intensive"
• distribution policies	• amount of water wasted
• ecological limitations	

The elaboration of this juxtaposition could provide us with clues as to particular tactics to meet the variety of general problems described above, namely, how water consumption can be alligned with supply or one use may be sacrificed for another. In essence, the transformation of the ideology concerning the basic growth approach to water resources has to do with a compromise that recognizes both the augmenting of natural supplies and, at the same time, developing appropriate means for meeting alternative demands (including, of course, diminishing demand).

Strong debates are currently taking place concerning the extent to which we can continue living with all the traditional ideas about growth as compared with limits imposed upon by ecological conditions and social constraints. More than anything else, what is seriously challenged in many countries (and certainly in the U.S. is the notion of growth and development based on the deeply ingrained belief about an inexhaustible environment, a belief bolstered by a legally sanctioned lack of concern over environmental impact. Without entering into a further debate as to the "limits to growth" and the varieties of developmental strategies, it is important to close this introduction by pointing out that the environmental debate of the late 1960's and the current concern with the balance between supply and demand comes also as a result of repeated signals from history which point out that there are limits to which water development can be pushed without impairing both the very structure of society and the quality of life.

In the coming pages we need,then, to proceed not by expounding again general principles of environmental concern, but deduce some relevant socio-cultural remarks that will help us establish a cogent framework of water management.

2. WATER AND SOCIETY

A central assumption of the present paper is that natural resources need always to be understood within the context and in relation to a surrounding social-cultural milieu. Water has meaning and importance where socially used for the achievement of certain objectives. Its physical availability and natural characteristics are certainly constraining factors, but it is its eventual social use that makes it a valuable resource.

Thus, as part of an integrated social system the use of water must be socially controlled through sets of institutions. This means that the way in which water supply, patterns of water distribution, and water reclamation or reuse practices are regulated in a given society will depend on the nature, structure, and evolution of its particular water system as affected by the larger social-cultural environment and the specific ecological circumstances of a given region. Perhaps it is important also at this point to emphasize that when we use the term larger social-cultural evironment, we incorporate in that also the set of prescribed legal rules that govern what otherwise are accepted values or norms of a given society. The legal system is the writtern specification of the sets of rules that govern through custom and tradition or prescribe a set of behavior for the citizens of a particular society.

One of the critical problems for incorporating social factors in the water resources planning and management process is really an inadequate understanding of the nature and structure of what has been called the "social domain." There are, indeed, many questions to be answered here, such as for example, how many social factors should be considered? What is the nature of each factor? What is the relationship between one factor and another? Is this underlying structure relatively stable? Are such social factors specific only to certain circumstances and situations, or are they generally applicable? What are the values of the population that are incorporated in water resources planning values?

Generally, when one refers to the social system or social domain one refers to all non-physical and non-economic aspects of water resources that relate to two important items of collective life. One has to do with the structural blocks of the social system (i.e., the key variables or components as well as the set of relationships between key variables of the social system). The second refers to a set of outputs, or objectives (expressed or implicit) towards which a particular social activity in terms of water use is directed. Thus, the social domain in terms of the structure of its components and its relationship to desired outputs expresses in some grand fashion all the human concerns and aspirations of both the survival of a given community as well as fulfillment under the general term of "social well-being."

Before we begin, however, elaborating really what the social-cultural aspects in water resources management imply and how can one structure in a systematic way both component parts and interrelationships, it is important to provide a general backdrop in order to relate historically how social, legal, and economic aspects have been intertwined activities in the development of water resources.

As it was emphasized also in the introduction, aridity and irrigation were the central concern of early societies giving rise to the great variety of "hydraulic" or "fluvial" civilizations. One cannot really talk about water and society without once again emphasizing the extent to which water and community development have always existed in ecological zones where water seemed to be crucial to social organization. Indeed, a cursory perusal of history would point out that water has been one of the most defining influences on the size and distribution of human populations. Although tropical and arctic regions are also the other two geographic bands of low human density, it was only in arid zones that water managed to support highly dense populations and complex civilizations.

Aridity, therefore, is becoming a focal point of concern and a necessary catalyst for organizing our argument. Arid zones are useful locales for examining the ways in which environmental factors affect and are affecting the life and structure of human society. The arid regions combine sets of potentially rich resources with harsh environments that challenge the adaptive capacity of many societies.

Anthropologists tend to distinguish four general and often coexisting social forms that provide distinctive adaptive strategies in arid

environments. First of all there are the small hunter-gatherer bands such as the Kung Bushman of the Kalahari or the Shobone of the Great Basin; secondly, tribal organizations such as the Rwala Bedouin; thirdly, emergent sedentary villages around oases and water courses such as those of the Zuni or Hopi of the Colorado Plateau; and finally, the major complex organizations of hydraulic civilizations such as the Aztec or Sumerians.

All these civilizations and examples of an almost linear scale of social evolution provide us with characteristic social mechanisms for maintaining community solidarity. At the end of the spectrum, hydraulic civilizations represent the culmination of an interplay and reinforcement between religious values and bureaucratic organizations when, finally, villages and tribesmen become classes and ethnic components of a new order. It is interesting to notice that hydraulic civilizations seem to have emerged at significant ecological edges. Thus, many of the edges around the Indus River, the Gobi Desert, and the Huang River, the Iranian and Turkestan Deserts, and the Tigris and Euphrates Rivers, as well as similar boundaries of water rivers and deserts have been always the earlier sites of hydraulic civilizations. Spreading out from such important points of energy concentration are the agrarian villages, the nomadic tribes and the hunter-gatherer bands.

Irrigation enterprises are associated from early historical times with every civilized society. The first known irrigation took place in Mesopotamia and other areas of the Old World. The type of irrigation which took place in these early times was primarily one of river flooding which would cover the lowlands of the delta. The flood waters would prepare the soil for the forthcoming agricultural time, and would supply the early agriculture users with a new layer of fertile and productive silt. A good crop could be grown with a minimum of expertise on the part of the early agrarian people.

Irrigation developments were the product of complex civilizations which have progressed beyond the subsistence stage of agriculture. These civilizations required the construction of enormous public works in order to control water supply for irrigation with an inevitable development of complex bureaucracies and of elaborate systems of social organization. Throughout history the undermining of the delicate, complex irrigation systems either through war, conquest, or the silting up of reservoirs and canals have been associated not only with the collapse of the physical infrastructure but also with the decline of the particular civilization (Cantor, 1967).

Thus, irrigation has played throughout history a strategic role in the continuous course of agricultural development. Irrigated agriculture provided, and continues to provide, the agrarian basis of society. An important point always to be discussed with an historical overview of irrigated agriculture is that after the basic or central productive goal of an irrigation system is achieved, i.e., sufficient production for survival and economic growth, other social goals also appear which greatly complicate the institutional arrangements of an

irrigation system. Such developments and goals, however, carry with them both benefits and disadvantages. On the one hand, the control of water resources and the establishment of an irrigated system of agriculture in places where rainfall is inadequate or unreliable permit the establishment of highly productive agricultural practices, followed by an expansion of human population and economic growth. On the other hand, an irrigation system carries with it not only certain technological imperatives which cannot be ignored, but also important social constraints for the operation of what will eventually become a highly complex system. The imperative of efficient organizational structure and of strong supportive institutional mechanisms for the operation of an irrigation system have been strongly associated throughout history not only with the success of the irrigation system but with the whole rise and fall of many civilizations.

Throughout all the previous remarks it has been assumed that in any persistent human group activity society requires a set of adjustive mechanisms to environmental pressures. Indeed, any significant interference with the environment will require adjustments throughout the system and appropriate mechanisms which are maintained by human decisions via positive feedback. One of the most important hypotheses in the development of irrigation has been the role of population growth. It has been assumed that population growth increases resource scarcity and, therefore, increased scarcity brings about consequent socio-cultural structural changes and adjustments.

At this point one has to refer to a variety of historical works that have examined the rise and fall of hydraulic civilizations and the relationship between changes in the environment and socio-cultural changes. More than anything else, the seminal work of Wittfogel, elaborated in his Oriental Despotism (1967), has become in the literature a main organizing scheme for the understanding of the relationship of hydraulic society as a special type of agrarian society. The characteristics of this hydraulic society rest on five major conditions:

1. Cultural, i.e., the knowledge of agriculture.

2. Environmental, i.e., aridity or semi-aridity and accessible sources of water supply, which may be utilized to grow appropriate crops.

3. Organizational, i.e., large-scale cooperation among segments of population.

4. Political, or the organizational apparatus of complex order that is taken over by leaders of the commonwealth who direct vital external and internal activities to the defense and maintenance of peace and order.

5. Social, or a complex system of stratification separating the men of the hydraulic government from the mass of the "people" and, therefore, the rise of professional, full-time bureaucracy.

Essentially, what Wittfogel asserts is that in order for agrarian society to exploit a dry environment, there is a necessity for large-scale hydraulic works. The emergence of large-scale hydraulic works brings about a new scheme of social organization and the development of highly complex and interrelated forms of social relationships.

There is, however, a great current theoretical debate not only as to the position of Wittfogel, but also as to the relationship between large-scale irrigation and centralized political authority. Three key variables seem to be particularly relevant here:

1. the size and density of population;

2. the size of irrigation facilities;

3. the degree of centralization of the decision-making political authority.

Out of these three key factors (population, irrigation and political authority), a variety of orderings can be taking place and explanatory schemes with all the attendant theoretical issues as to what has come first. Such schemes involve the extent to which we had first population, then irrigation, and then the rise of political authority, or any other permutation of these three factors.

This particular debate as to the rise and fall of hydraulic civilizations is close to the current debate in the literature about the so-called "ecological school" that describes the major revolutions that brought about increased social organization. Essentially, this broader argument points out that as a result of environmental, technological and cultural factors a transformation in social activity has always taken place. The so-called ecological school assumes some complex interrelationship (without at the same time telling us the ordering of this relationship) between the size of total population (the minimum number required to sustain group life); the control of natural environment (minimal requirements for aggregate living); technological developments (inventions necessary for managing the environment); and developments in social organization (complex arrangements between the population and hinterland.

In any case, there is no need to discuss in detail the historical intricacies of the rise and fall of hydraulic civilization. The point that must be made here is that the type of social factors that one needs to consider in water management and the background that gave rise to the protection of certain legal rights have alternative explanatory conceptualizations. Indeed, in a recent work by Kappel it has been emphasized that major changes in irrigation system size occur only after changes towards centralization have already been made. While we may not know exactly the sequence of events that brought about the rise of hydraulic civilizations, one thing remains sure: water development has always been related to complex systems of social organization (Kappel, 1974).

Aridity and irrigation development are used here as an example of the kinds of complex socio-cultural factors that have developed into intricate systems of legal controls of water supplies. It is important, therefore, to describe briefly the complexity of the irrigation system. A concise definition of irrigation could be that of the artificial application of water to overcome the deficiency in rainfall for the growing of crops. Thus, an irrigation system can be understood as both physical facilities and the institutions by which the acquisition, distribution, use and reclamation of water contribute to increased agricultural production in a given enterprise setting. The practice of irrigated agriculture occurs today under three main conditions:

1. When water supply is inadequate. In the arid and semi-arid regions of the world the use of irrigation has been most extensive and practiced for thousands of years. Many areas could have never prospered unless cultivation took place under conditions of irrigated agriculture. In all such regions the water supply is derived partly from underground sources.

2. When water supply is unreliable. In those geographical areas which are characterized by a marked seasonal shortage of rain (e.g., circum-Mediterranean lands), irrigation is widely used when circumstances of rainless months and favorable temperatures make possible the promotion of plant growth.

3. When water supply may be used as a supplemental means of control and regulation. Generally, humid areas where the rainfall is normally sufficient to promote plant growth, irrigation may be used as a safeguard against drought and in order to promote higher yields.

As it has been repeatedly stated in many areas of the world, conditions of water surplus have never existed. The inhabitants of these areas have struggled throughout history to develop workable doctrines to accommodate the conflicting interests and to provide at the same time a sound legal base for continuous growth and survival. One may truly learn about from the experiences of the various legal institutions and develop valuable guides for other people faced with similar problems. In this respect the experience of the arid west in the United States is a particularly poignant example of intense social development and of the creation of particular doctrines for facing the question of survival in the arid environment.

The western United States is comprised of a number of regions formed by natural river drainage basins, not necessarily coinciding with administrative boundaries.To generalize, however, one may say that with the exception of the Columbia-North Pacific region and some portions of the California and Missouri regions, the area known as the Mountain and Western States simply lack an abundance of water. Water that is produced there is not available where needed or when needed. The northwest region may be the exception, but even the great Columbia River flows through large expanses of semi-arid land.

Historically, it took only a nominal amount of demand to exceed the low flows occurring from July or August through the winter months to early spring. Therefore, it was not long--well before the turn of the century, in fact--that the most easily developed storage sites were constructed, and the search for additional water was well underway.

This early development not only provided a stable domestic supply for the emerging population centers, but also permitted concurrently an irrigated agriculture. While mining was the main stimulus which precipitated the great westward migration after 1850, it was irrigated agriculture which gave it stability. While promulgated as a means for food self-sufficiency in support of a booming mining industry, irrigated agriculture soon became the focal point for settlement in various regions of the west, all the way from Colorado to California.

During the pioneer development period, settlements were formed on the streams where water supplies were available. Even the smallest creeks have a small community at their mouths and much of the water for irrigation in the west comes from small mountain streams.

The physical infrastructure for irrigation consisting of seasonal storage facilities, diversion works, and canals was well developed by the turn of the century. The institutional infrastructure was developed, too, with a multiplicity of mutual irrigation companies which provided a management capacity for groups of farmers to build, finance and maintain irrigation works. Furthermore, the companies could engage in litigation to both protect and procure water rights. And later, with the advent of reclamation, these companies also were in a position to provide an organizational vehicle to express interest in additional water supplies to the U.S. Bureau of Reclamation.

Coinciding with the physical development of water resources was the legal development of the right to use water. Initially, water was regarded as community property available for use by all. But as development in the semi-arid west took place, investments made upon a dependable water supply resulted in the early miners and settlers respecting a property interest to the water user. At this point, the benefits of a predictable water supply exceeded the costs of internalizing externalities prevalent in the community property status of this resource. The pioneer was willing to recognize an interest in others in order to gain the same treatment for his use of the water. Through custom, miners had previously developed a moral code prohibiting claim jumping, and this same respect was accorded the use of water. As a consequence, a firm "property right" developed, subject to certain restraints (i.e., beneficial use and nonwaste), and accorded the same protection under the law as real property. Legally described as a usufructary right, the possessor could use the water once it was captured and it then became his personal property, but this right did not attach to any specific waters because of the resource's fugitive nature.

Since the inception of the property right concept in water, there have emerged several basic doctrines. The humid east has adopted the English "riparian water law" giving owners of land adjacent to a water

body a proportionate right to use the water. In the 18 western states, the doctrine of prior appropriation was adopted. The gold rush days of 1849 in California provided its foundation. Colorado was the first to include the doctrine in its constitution in 1876; since that date it had been adopted by constitution or statute in the other 17 western states.

More than anything else, the prior appropriation doctrine provided the needed security of a water supply for mining, agricultural, municipal, and industrial interests, so that they eventually proceeded to mold institutional sophistication to meet their needs and economic motivation for investment and subsequent growth.

Parallel also to physical (and legal) developments, water use in the west was also determined by changes in the surrounding social environment. Essentially, the pattern of settlement in the west, as well as in other parts of the country, followed a series of interrelated stages of development. Initially, individual farmers would settle in small parcels of land close to the water sources, followed by small services for farmers, such as blacksmiths, wagon and wheel makers, etc. Agri-business was the next order of development, serving the farmers through such services as mills, farm implements, etc. The small settlements of the early pioneers were then augmented by the influx of other people. By the turn of the century, a major part of the initial settlement phase had been largely completed. The west was changed within the span of fifty years from a virgin territory to a set of communities and economic activities, towns, cities, industries, irrigated farms, and ranches, all layed out on a vast pristine national hinterland. The transformation from primary to secondary industry began towards the end of the last century. As in the rest of the nation, but to a lesser degree in western states, creeping urbanization and the meshing of the urban fringe with the rural hinterland characterize the more recent history of community development.

There are two additional considerations in the analysis and understanding of the social environment in the west in relation to water resources. First, part of the cultural background and customary use is shaped by the presence of an indigenous population with senior rights under the "reservation doctrine." Secondly, the Spanish legacy has left a distinct cultural tradition and customary practices and attitudes toward water use. Thus, to speak of the social environment of the west, one should consider quite a variagated combination of normative resources, community environments, cultural traditions, water management systems, sources of social conflict, and images toward water resources.

No attempt has been made, of course, in the few preceding pages to present a comprehensive history of water resources development in the western United States. The cursory examination of some of the conditions of development in the region was needed in order to reemphasize the point that water in the arid west remains a central point of concern and a sensitive issue, reinforcing a widely shared conviction about the need for control and coordination and repeating the truism that "water and land in the west are inseparable."

At the same time, it is worth noting the overall special attitude toward water in the western United States as well as in many arid

regions of the world. Water is regarded as a scarce resource and is treated as such. Innumerable litigations have resulted in a highly complex system of water rights based upon case law, interstate compacts, and legislation. Central to this is the tradition of the states to develop and control their own water and hence shape their destiny as may be limited by the availability of water.

Because water is not an abundant resource in the western United States, its allocation and development is guided by public policy. Such policy, while not in the form of a specific single declaration, is nevertheless deeply embossed in two disparate but sometimes complimentary themes: (1) states' water rights; and (2) federal legislation. The first is an extension of the laissez-faire traditions of a "frontier" economy. The second is an expression of a national purpose as seen by various regional factions having influence in the United States Congress.

Recognizing the necessity of water as a means of survival and further growth, one can also understand how the western water rights system provides the specific mechanism for allocating water as a scarce resource. Such a system provides also mechanisms for adjudicating conflicts among users and for administering the system. The essential concepts of this legal system are discussed in a variety of other papers by authors in the Conference, but it is important to summarize here the social background of a frontier society as exemplified in the concept underlying this system, namely the doctrine of prior appropriation.

The well-known phrase, "first in time, first in right" captures the essence of this doctrine. The concept of beneficial use further elucidates whether a right can be perfected to the extent desired. With such a perfected right, water has the legal status, conferred by the State, of real property (but the State holds title). Beneficial use has not been defined in the statutes but adjudication of water rights by the courts and state engineers is based upon the concept. Thus, an irrigator may be restricted from applying wasteful amounts of water to his land if the State engineer or the courts decide otherwise. One of the main themes permeating western tradition and extending the beneficial use concept is that water should not flow unused to the sea. Every drop should be put to beneficial use. Generally municipal use, agricultural use, industrial use, and power generation are unquestioned. In-stream uses such as maintaining a fishery or enhancing aesthetic attributes have not been considered beneficial uses. The law also embodies a "higher use" concept which permits municipal uses to usurp other uses in time of need.

There is no doubt, whatsoever, that western water law is indelibly woven into the fabric of western culture. It has provided the guidelines for orderly development and use of a scarce resource. The nature of the law was molded by these circumstances of scarcity and the ethic of laissez-faire development. The law has set western development upon a course of full productive use of its water resources. This has had a certain ecological characteristic in that the nature and characteristics of the law have preordained the reinforced a certain rural orientation to western culture and heavy emphasis on agricultural production.

In the past when water shortage problems appeared, all efforts were geared toward exploring and creating additional water supplies, rather than developing programs to deal more effectively with existing supplies. The development of supplemental water has frequently involved the importation of water into the drainage area (or river basin), additional reservoir storage to catch winter and spring runoff, or additional pumping from the groundwater reservoir, or any combination of the above. This assumed, of course, inexhaustible exogenous supplies, a fact that was soon negated by the fuller development of other river basins. By continuously emphasizing increased supply, rather than appropriate demand level, a paradox emerged: to continually import additional water supplies from adjacent river basins usually forestalled development of efficient water management, resulting in consumptive, inefficient, or "non-beneficial" practices. But the traditional solution of additional supplies may become increasingly difficult as competing demands and economic realities impose complex requirements of integrated planning.

The western United States is increasingly presented with a rather stark situation. On the one hand, there exists an established cultural, legal, and institutional system of water resources with many of its beneficiaries satisfied and unwilling to change. On the other hand, scarcity, increasing new demands, and a more complex political and social structure clamor for attention and press for drastic changes. The early cozier relationship between water and agriculture nas been changing through the forceful presence and expanding power of municipal and industrial interests either upstream or downstream of a given valley. The hue and cry of abetting pollution, the stringent voices of conservation and return to nature are forcing significant changes in the earlier isolated water resource development.

At the same time, a new activist political and natural resources movement, dedicated to maintaining a "quality of life" and preserving environmental values, has taken shape all over the United States since about 1962, becoming a strong force and strident voice in the 1970's. The key emphasis of this movement has been in three areas: a) in preserving existing natural environments from ecological perturbations and visual intrusions of new physical facilities for water; b) in maintaining minimum stream flows in the streams from which water is diverted; and c) in using water, as a rate limiting "factor of production," in order to arrest rapid population growth.

The emerging social conflicts can be understood in the context of a point made earlier about survival and the attendant traditions and ethics, ultimately codified in the form of protective laws and regulations. Once established, formulating a structural basis for community (e.g., agriculture-urban), traditional ethic is not easily changed, for change will indeed cause new equilibriums to take place. For example, transfers of water use from agriculture to urban or from agriculture to mineral extraction and energy production (e.g., oil shale development, coal gasification, etc.) will certainly cause changes in regional character from "western-rural" to "western-industrial." So, change is resisted by established factions who see their economic welfare affected for better or worse.

The relatively detailed exposition of developments in the western United States point out also, on a larger scale, that cultural institutions usually evolve slowly and are shaped by religion, history, language and the surrounding natural environment. The shared values about the relationships among individuals and between the individual and the group, assumptions about motivation and initiative, concepts about justice, attitudes toward the environment, policies regarding water, and many other cultural precepts will determine whether any given institutional arrangement vis-a-vis irrigated agriculture will succeed or fail. By understanding these cultural institutions as well as in studying the general community system we are also able to provide clues as to institutional support for water development. Perhaps what needs to be emphasized once again is that a blind transferrence of institutional arrangements from one culture to another may lead to a variety of problems, since many institutions tend to be "culture specific."

If we were to generalize at this point the relationship between social and political factors and emergent legal institutions, some broader patterns may be discernible. Originally water rights were established as implicit privileges and as a response to the need for survival and growth. In the evolution of a legal system and in the context of a larger social transformation one may observe an important shift of values and priorities associated with the changes from a scarcity environment to affluence and through conflict to some idealized ecological and societal equilibrium. This notion may be perhaps better delineated in Figure 1, which attempts to summarize the perceptible shift in water resources development from one of guaranteeing survival and growth to one of a balanced, "steady state" economy. This figure points out that while originally water resources have been used for expansion and maximum development, recently depletions and pollution are increasing conflict and environmental confrontation. Ideally, such a conflict would be solved, both socially and legally, with the help of appropriate technological innovations in a future society which will be very close to balanced growth and steady state. Water legislation parallels this idealized scheme of value transformation. During an initial stage, where water availability exceeded its demands, the legal system was intended to promote the wider use of water by offering a variety of motivating schemes for guaranteeing growth. During this second stage of confrontation and conflict the law (because water demand exceeds availability and because of despoliation of existing water supplies) is becoming predominantly regulatory and restrictive in nature by adopting precepts which constrict rights, allocate among competing demands, or resolve problems of water degradation. Finally, in this idealized transformation, the legal system of the future will be involved more or less in efforts of determining the parameters of "cybernation," i.e., the protection of water rights through some beneficial use. The last may represent such concepts of an hypothesized equilibrium as ecological economy, steady state economy, or spaceship earth; in other words, all the concepts that reflect an integrated approach to water resource development within the context of ecological limitations.

In order to expand the argument, we may, then, ask two broader questions: what do water programs do? And, how can we classify systematically water uses?

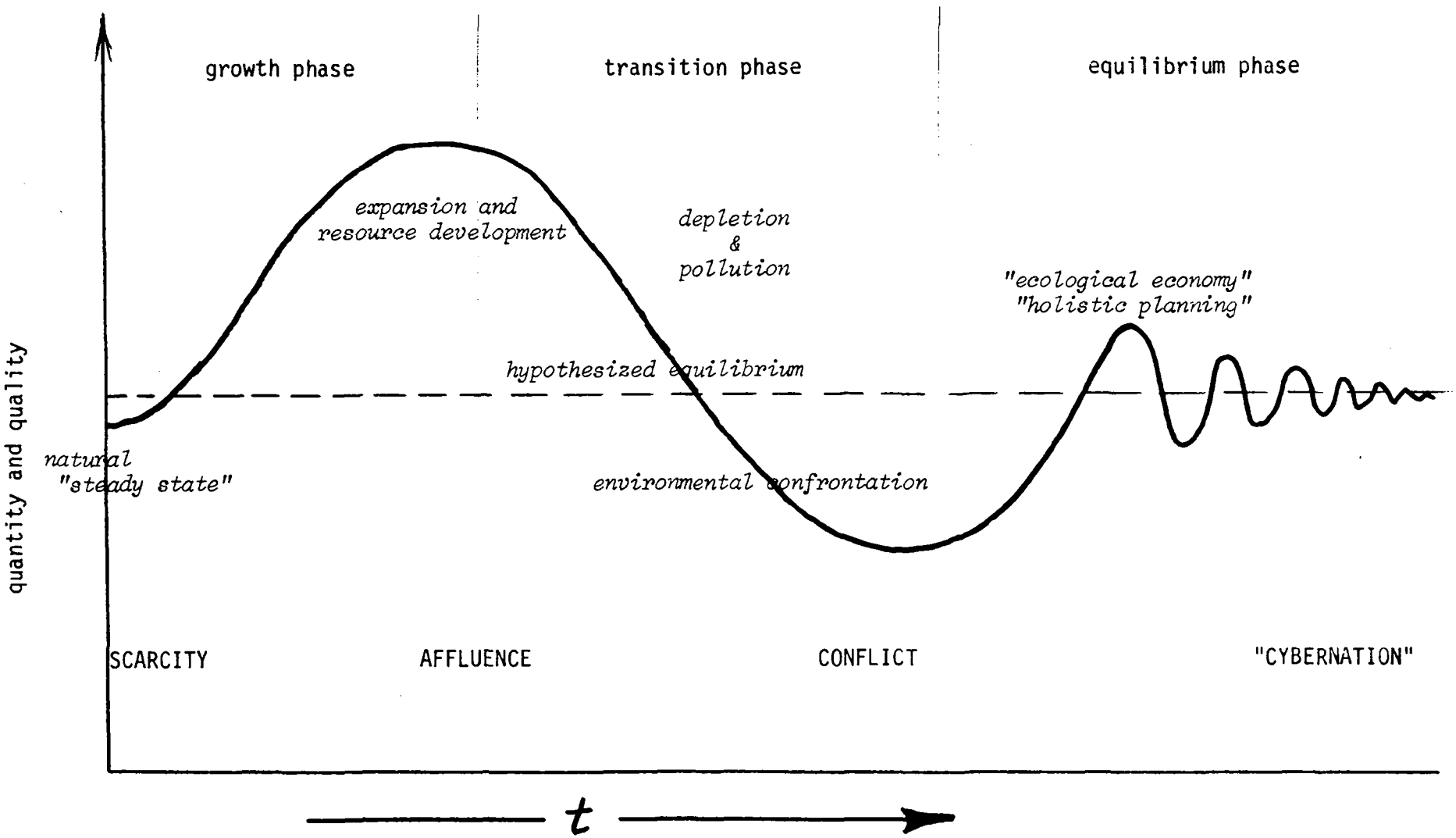

Figure 1. The transformation of resource values over time.

That water is essential for the support of life needs no further debate. Especially in areas of scarce water resources, the entire life support system, the very existence of communities depends on the capricious presence of water. Furthermore, water is a major "factor of production" in the overall metabolism involving economic sectors of society. The output of water as a resource commodity permits a higher level of economic and community metabolism. Thus, two major corrolates can be identified with water resources; first, the capacity for sustaining life for existing population and social activities; and, second, the potential for further expansion and growth.

There are many ways that one could proceed recounting the variety of societal activities supported by water, all the way from food production and agriculture, to the services and necessities of urban life, to the basis for industrialization, to the exploitation of other natural resources, and to the secondary services provided for recreational or leisure activities. On top of these, if not before all of these, water is also part of the ecological cycle by providing the necessary basis for the survival of wildlife and the vast array of species that sustain the balance of the biosphere. The wide variety of social activities related to water development and the essence of water in civilization can be seen in a recent figure of the United States Bureau of Reclamation that presents a diversified array of water activities vital to every aspect of daily life (Figure 2).

In its varied expressions and presence water can meet four major goals:

a. Meeting of earlier inadequate provisions for the survival of given populations and the carrying out of activities supported by supplemental water.

b. Assist overall growth by providing an expanded capacity, wealth, and local and regional stability.

c. Through ancillary features, adjunct to a specific project, facilitate a multi-purpose policy for integrated efforts of development, (e.g., irrigation development may be coupled with hydroelectric power, flood control, fish and wildlife conservation, recreation, etc., that together provide the framework for the development of a given society).

d. Upgrade "quality of life" through improved services and contribute to the overall "social well-being."

It should not be forgotten, however, that when developing the physical infrastructure to meet societal demands or new social goals, numerous transfers of water that must be regulated in time and space are also involved. This removal of water from the natural environment imposes new equilibriums for the surrounding ecological and human environments and new considerations as to emerging problems or desired ends.

It might be recalled at this point that while the availability of water supply may or may not cause growth and development of a region, its presence certainly does permit or facilitate this particular option. The

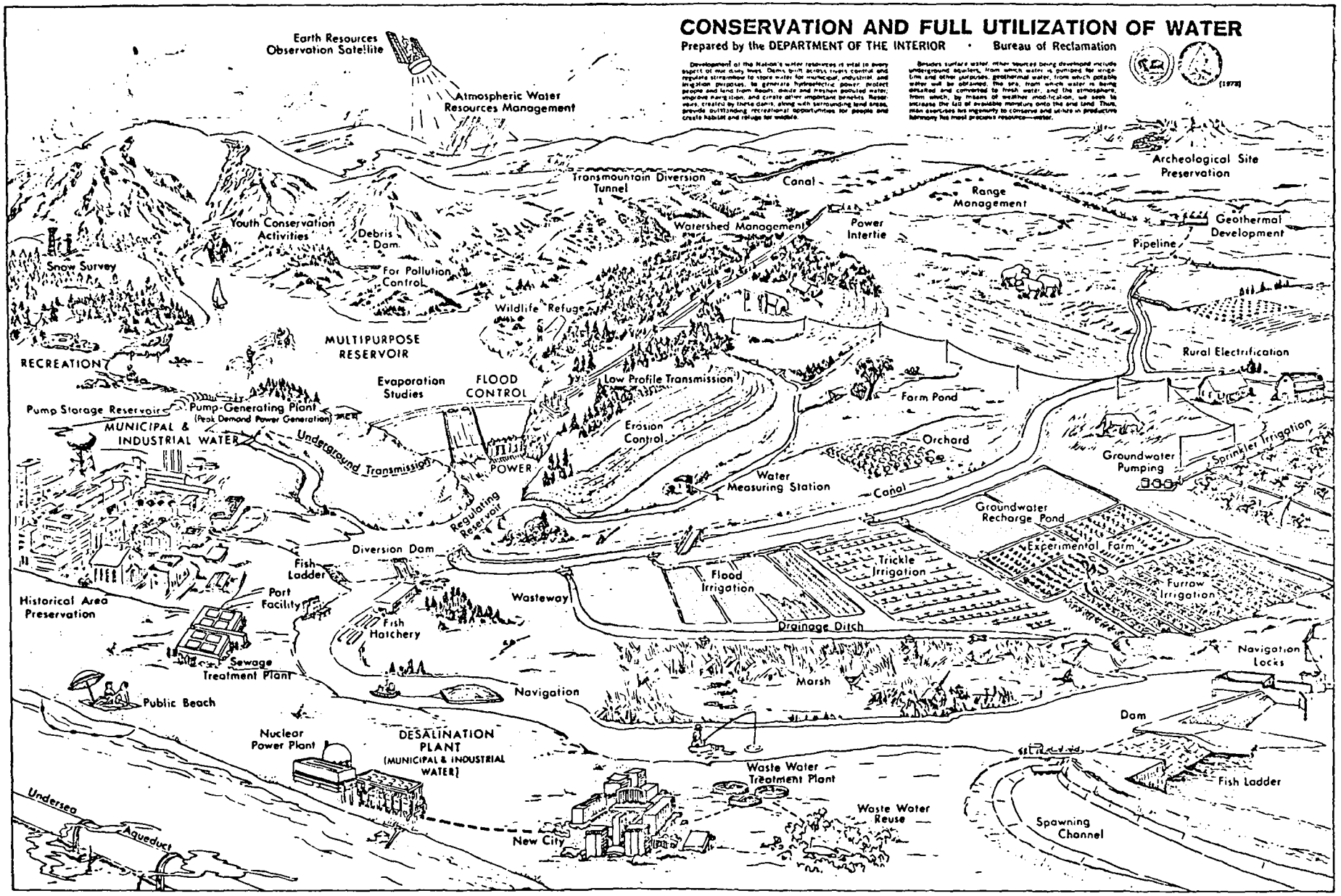

FIGURE 2. Water Uses

main point that should be made is that as a water resource system becomes more developed, the more sensitive are all related subsystems. Further, options for future use of water and associated resources' uses become either closed or extremely limited. Changes, then, become possible not by further water development, but through reallocation by market or political mechnisms. A current debate in the literature can be summarized around the questions as to: whether water should be a tool for further growth or for expansion options; and, whether society or larger political regional bodies should assume the role of using water as an organizing concept and as an instrument for enforcing desired changes.

Turning then back to the question as to what do water programs so, it seems that their primary role is to meet existing needs and desired objectives by providing better or improved standards of services. This implies that the planning of water resources is teleological in nature, namely in meeting expressed needs and desires, rather than ontological which implies that it has a momentum of its own in generating and sustaining growth by its own dynamic forces. Such an argument coincides also with a perennial debate as to the role of technology, namely if it is autonomous or if it is only a response to expressed needs and desires.

All in all, water resource projects are opportunities and nodal points for a reconsideration of many community aspirations and priorities. For example, the construction of a dam is not only directed toward the creation of more water output or regulation of flow. Achieved objectives provide the impetus for new capital investments, increased poulation, and new values vis-a-vis the changing environment (such as, e.g., renewed confidence or the ability of a community for survival, or increased "cosmopolitanism" from the influx of new residents and large tourism in the region). Increased water supply is only but the tip of the iceberg in a complex situation where one is called upon to examine commitments for concerted planning, monitoring and readjustment, and visions of desired goals for communities or the region as a whole.

To generalize, then, the argument as to what water programs do is that the optimum development of water is directed towards:

→ the greatest common good

→ of the largest number of people

→ for the longest time.

These three major principles and commitments concerning optimum development of water are also exemplified in the variety of social policies and legal responses that many nations have developed concerning water development. For example, the idea of "the greatest common good" has been exemplified in the Principles and Standards of the National Water Commission in the United States, through the development of the "four accounts," namely National Economic Development (NED), Regional Development (RD), Environmental Quality (EQ), and Social Well-Being (SWB). The idea of "the largest number of people" reflects the degree to which a nation is commiting itself

to questions of equity, multi-purpose, and multi-objective planning as a need to respond to a variety of publics. Finally, the concern with "the longest time" implies the increased preoccupation with long-term enhancement as compared to short-term benefits resulting from any kind of public project activity. These general assumptions as to optimum development of water are also the guiding thoughts behind all current concern with environmental impact assessment and social forecasting and exemplify the preoccupation with developing goals and objectives that are in agreement with both the question of survival and that of fulfillment.

Before closing this brief section concerning some general remarks on water and society, we need to indicate also approaches that social scientists utilize concerning water uses. There are many ways of classifying water uses which, then, could be treated separately as types requiring closer scrutiny of associated cultural values and social mechanisms. We may propose three ways through which water uses can be approached from the social sciences point of view:

1. The first has to do with water per se, i.e., *actual* versus *symbolic* uses. In terms of actual uses we may see water as either a means of subsistence, as a method of communication, or as a production technique. In terms of symbolic uses, we may perceive the water bodies as part of religious, mythical, or socio-political expressions all the way from the Mother Nile to the Sacred Ganges.

2. A second form of approaching water uses is by types of functional uses. Here, we may classify water uses and appropriate management techniques either as part of nature, culinary, agriculture, industry, power, navigation, transportation, flood control, municipal, recreation, mining, agriculture, land building, aesthetics, etc.

3. A third type of classifying water uses is in the relation of water to social values. In such an approach, rather than reflecting on the water per se or the types of water functions, one may emphasize the types of values or goals that we try to achieve through water use, such as the protection or enhancement of environmental qualities; aesthetic and amenity values; community identity and cohesion; health, safety and security; recreation and leisure; cultural and spiritual; social justice; income distribution; transportation, economic development, etc.

Independent of whatever definition, uses or goals you want to use in order to describe the relationship of water to society, one thing is sure: water has produced an intense network of social activities. For every type of use, goal, or functional relationship appropriate institutions and cultural practices have been developed and can help us also understand the background of the legal principles and doctrines upon which people have organized and crystallized in an overt form societal relationships. It is important, then, at this point to specify what "social" implies, what problems can be brought forward, and how does one go systematically about relating social to legal, economic, technical and environmental conditions so that a holistic, interdisciplinary, and integrated model can eventually emerge.

3. TOWARD A SYSTEMATIC APPROACH

In past years the challenge of water resources development was met primarily as a basic physical problem. Elements of this traditional space included:

a) hydrologic delineation of the water resources;

b) development of a plan--economically viable, financially feasible and technically sound;

c) appropriate design of the physical facilities;

d) pertinent institutional arrangements.

In recent years, however, because ecological and social externalities of water resource development are becoming incrementally more significant, the planning space has begun to broaden. Indeed, diversified questions of social policy and equity in water management have underlined an increased preoccupation with expanded time horizon, the search for a higher resolution in any project effects, and multi-disciplinary integration.

All these are part of the increased awareness and commitment to holistic planning (or as some like to refer to as "total environmental planning"). There is no need at this point to spend an inordinate amount of time trying to develop from the beginning a generally agreed argument as to the ecological imperative and the requirements for understanding the environment. What is most important here is to emphasize the idea of a harmonious relationships between three parts that compose what one may describe as the "total environment, namely *individual*, *culture* and *physical environment*. In doing so, we want to examine how individuals in creating culture affect both their individual lives and the surrounding natural environment. In turn, the natural environment provides certain constraints as to what men can do and how a given culture is shaped. In essence, then, the term environment may be defined as the system of spatial, temporal, and social regularities which influence the biological and behavioral processes of a given population.

At the same time, such a broad concept does not differ significantly from other physical and biological sciences' definitions, namely a configuration of parts that are in a relationship of interdependency. Both the physical and social environments at large are only descriptive categories of a complex set of interdependent relationships subsumed under the broad term of total environment, i.e., all conceivable systems affecting man as an individual and his community as a whole. The key argument of the above remarks is that what is usually called natural environment has meaning and utility only in the context of a social setting in which individuals (and their culture) interact with nature. The individual-centered system is the heart of a total environmental approach and of the society-technology-nature symbiosis.

As it has been repeatedly stated so far, water has meaning and importance where socially used for the achievement of social objectives. It is exactly because of the above observation that a consensus seems to emerge concerning

the assessment of water resources development and management, namely, the estimation of physical potential, the determination of technical and economic feasibility, and the evaluation of social desirability.

The use of the above terms may help us begin to delineate a variety of key factors and variables involved in the systematic analysis of water management. On the one hand, the physical or natural environment includes the water supply, airshed, minerals and land and it is often referred to as the geosphere. As important as the physical environment, however, is also the social environment or what we may call here the sociosphere. This last environment contains the common patterns of interaction between people in the physical environment, historical and community values, and all aspects of human resources as well as knowledge and skills. These two major environments (physical and non-physical) or major resource systems are only descriptive categories of a complex set of interdependent relationships subsummed under the broader rubric of total environment, i.e., all conceivable systems affecting man as an individual and his community as a whole.

There is little agreement, at least in the social sciences, as to how best to describe the human community as a sociological entity and as a focus of analysis for natural resources. Although multiple usages of the term may be unavoidable and part of the elusive character of social phenomena, nevertheless they make things difficult for those who seek to study communities and understand their importance as crucial mechanisms of social organization in any water management scheme. Independent of the defininitional characteristics, however, communities represent an organizational pattern through which persons meet their daily needs in a local area. At the same time, although there is disagreement concerning the best way of describing community as a focus and unit of social organization, there seems to be an underlying agreement that one of the best ways of presenting such an entity is in terms of a social system, or as a network of social interaction.

In order to provide, then, a systematic framework that would permit an analysis of the socio-cultural aspects of water management, we may want to use as a key organizing concept the notion of "human community" as part and as key expression of the idea of the social system. The term human community is often used in the broad sense that groupings of individuals with some degree of interrelatedness and interdependence can be defined along a multidimensional continuum from the small, homogeneous and cohesive grouping living and working together in the same territory to the metropolitan, state, regional or even world human community.

Thus, generally such terms as "community," "social structure," "social system," "society," and "social organization" are part of diversified definitions as to how men organize their activities in some systematic fashion. Perhaps it would be appropriate to adopt another term, "social environment," as a more relevant definition in environmental studies whereby we recognize three key variables: the *territorial* variable (physical environment), the *sociological* variable (social interaction and organizational and institutional networks), and the *cultural* variable (common ties and the normative system). In any case, some agreed-upon elements of community include:

People: a demographic base;

Place: a given geographic area;

Identity: feeling of belongingness;

Common culture: sharing of knowledge, beliefs, customs, laws, etc.

As a result of these four major elements emerge recurrent patterns of behavior which provide the basis for the delineation of a social system. A major definition in the field is that of a community as a "combination of social units and systems which perform the major social functions having locality relevance," with the emphasis placed on a firm territorial base. Above all, communities represent an organizational pattern through which persons meet their daily needs in a local area.

By using the social system concept as a backdrop, we can organize our data and model the social system within some cogent parameters by trying to answer the following questions:

a. What are the major variables involved?

b. Can these variables be classified in any meaningful clusters?

c. What are the major types of relationships that ought to be investigated?

In the context of a larger policy approach we can understand the modeling attempts of a social system through an incorporation of the following problem-oriented questions:

1. What *goal* or *values* are to be sought?

2. What are the *trends* in the realization of water resources values?

3. What broad physical and non-physical factors *condition* such trends?

4. What *projections* characterize probable and possible course of future developments?

5. What *policy alternatives* may bring the greatest net realization of water resources values.

Thus, a proposed water resource project provides for or facilitates the types of activities, densities, and intensities which have impact not only on the physical arena within which social life takes place, but also on people and organizational structures (social, political, cultural, etc.) of the community. Such activities are related to, coincide, or may even conflict with values, goals, and objectives of the local as well as the larger society. In practical terms, these goals and objectives may be translated to norms and standards of a more technical level. Norms, standards, or criteria may, then, be incorporated in specific plans or programs, providing the basis for the execution, alteration or even abandonment of a proposed water project.

The key question in all studies that attempt to develop a systematic framework for incorporating social factors is not only the definition of all those ambient conditions that one identifies with the so-called human environment or human community, but also the inclusion of all important variables which are potentially or likely to be affected by any scheme of water management. No doubt, it is almost utopian to believe that any particular approach can include all the important variables, since a selectivity always operates as to which ones are considered as important in any given water resource project, at any given time, in any particular locality, or at any particular culture. Since apparently it is very difficult to examine all appropriate social variables, history, cultural systems, etc., that may be affected by any water management scheme, there is the need for developing a preliminary conceptual map as to those dimensions in water resources that one may consider as important, however, to recognize that the selection of such dimensions is nothing more but part of the vision that one has about society, the assumptions that we may make about individuals and nature, and, hence, a model of reality that we are constructing as constrained by conceptual and ideological conceptions of the problem.

A variety of authors and documents, as well as legal guidelines in the U.S. on the fast developing field of environmental impact assessment have tried to develop important variables of what one may describe as the social environment affected by water management. For the purposes of the present paper two key dimensions are particularly important: structural and cultural.

By structural parameters in human community, one may include the basic variables within a spatial/temporal location that describe the essential arena within which social interaction takes place. Such important structural variables in water management include first, human ecology (population variables, and spatial arrangements); second, characteristic institutions (such as family, education, religion, political, economic, health, leisure and recreation); and finally, social collectivities (both in terms of formal organizations and informal associations).

Cultural features of a human community, on the other hand, refer to philosophies and patterns of life shared by a number of interacting individuals. Culture is the system of knowledge, beliefs, practices and artifacts shared by a people and passed on from generation to generation. The culture of a people includes such particular traits as lifestyles, historical or legacy features, world views, beliefs, perceptions and definitions of reality, as well as intercultural relations.

Both structural and cultural features of any human community provide us with clues as to who people are organizing their lives and how a system of values, result also of historical circumstances as well as of ecological configurations, have also resulted in certain practices and legal regimes affecting water resources activities.

Implicit in the above brief presentation is the adoption of the idea of systems analysis in the social sciences. Thus, a social system may be defined as a collection of people, devices and procedures

intended to perform some function. A social systems model is a working model of a social organization which is capable of achieving its goals and involves a systematic exploration, analysis, and evaluation of all possible consequences of proposed alternatives to an on-going set of interdependent role components surrounded by a boundary of social norms. This rather long, if not obscure, definition does not intend to confuse the argument at hand, but it can serve as a description of the complexity of the conditions and the variety of basic variables that must be taken into account when one wants to discuss the social aspects of water resource management.

There is a great variety of water resources systems resulting from different geographical conditions and cultural circumstances. Yet, despite great variations in scope, extent and organizational form all systems encompass common elements and mechanisms which result from the following crucial questions:

a. How will the water resources be used in the productive process?

b. Who will plan and how will the production facilities be installed and organized?

c. Which individuals or groups will exercise control over the acquisition, distribution, use, and reclamation of water resources?

d. What will be the distribution and marketing of goods and services produced, including also the installation and operation of distribution facilities?

Any coordinated plan for the exploitation of water resources recognizes at least three major parts in water-related activities: supply, use, and reclamation. More specifically, the overall structures of a water resources system may be seen as involving five major functions and dynamic processes, exemplified in Figure 3.

1. Water supply and water source considerations, including new or potential sources of supply.

2. Water control aspects and characteristics of diversion, such as storage, reservoirs, and wells, and the assorted institutional forms of regulation.

3. Water distribution systems, or the means of transmission and patterns of water flow.

4. Water utilization systems, including cultural practices and the spectrum of diversified uses.

5. Water reclamation, including return flows, waste treatment, and recycling.

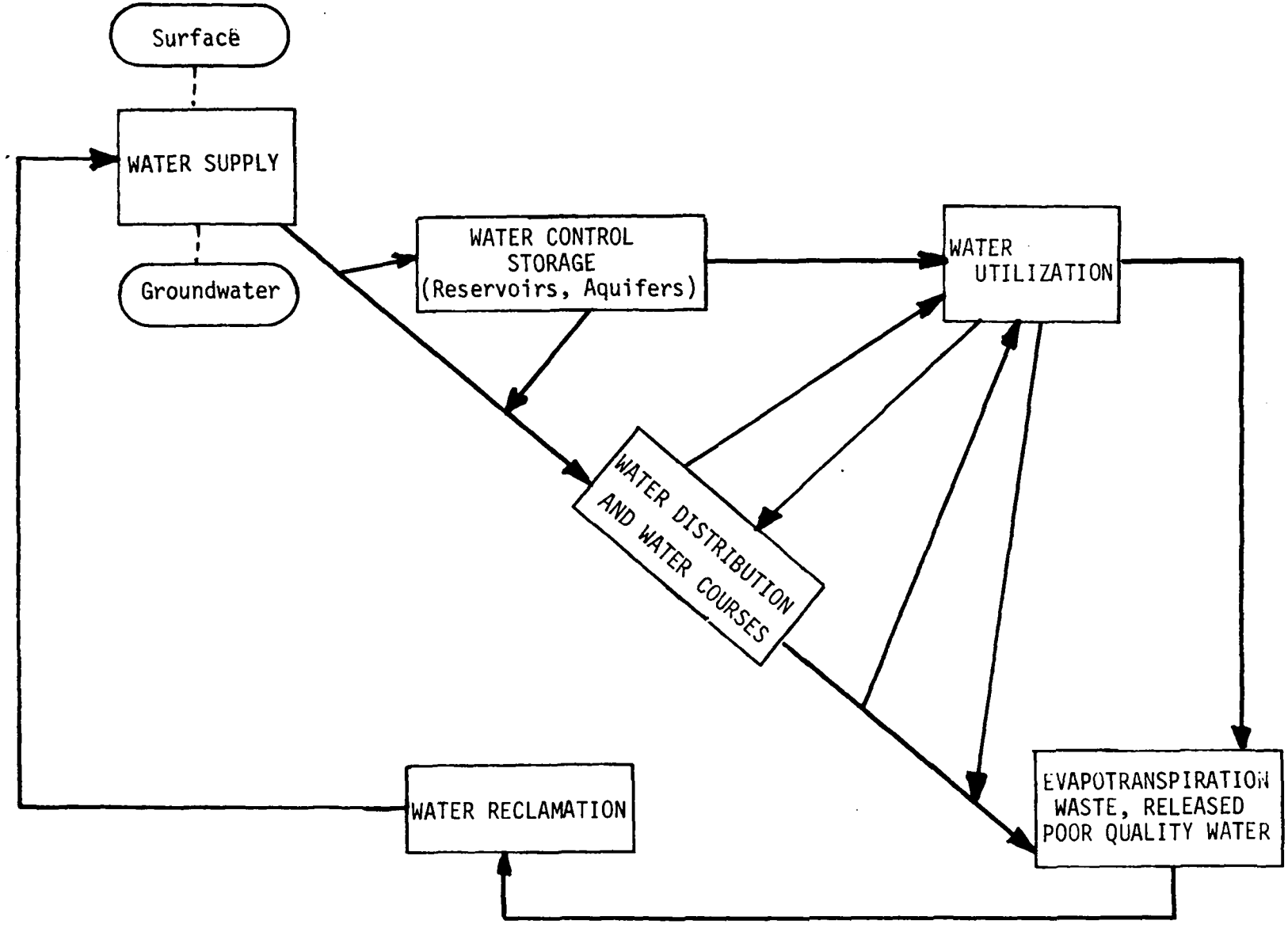

Figure 3. Dynamic Water Functions

Starting from such basic notions, one may then proceed to classify key variables, functions, or dimensions characterizing water balance for a region.

There are many ways of proceeding after all these observations to answer the question of how to organize the socio-cultural dimensions of a water management system per any particular water use. Briefly, water management is perceived as a system operating within a given environment where inputs (physical and social) processed through a particular "system" (thruput) result in goals established for the functioning of the system (output). Input considerations include such variables as the physical environment, population characteristics, normative resources, economic viability, political networks, and technological developments. System or thruput considerations are various structures and processes identified with organizational arrangements, such as personnel, facilities, and procedures (or "rules of the game"). Finally, output considerations are variables referring to the established goals or objectives of a water management system, revolving around such goods or services as the total volume of water supply, water quality, flow and distribution, enhancement of life, and long-range water resource development.

By using the basic notions of systems analysis introduced above we may, then, proceed to apply the systems approach in the organization of the socio-cultural aspects of water management. To start with we may recapitulate the kinds of problems concerning water resources management by using a simplified version of analysis summarized in Figure 4. By using this general descriptive framework of analysis as a springboard we can delineate in greater detail the variety of socio-cultural dimensions of various management schemes in the spectrum of diversified water uses. For example, Figure 5 represents a simplified version of a local irrigation system designed to achieve maximum agricultural productivity through the application of water by human agencies in order to assist the growth of crops and grass.

Figure 5 indicates that four major environments provide the necessary inputs for the operating of a system or organization, namely, socio-demographic, economic, physical, and normative. In a typical systems analysis approach the variety of inputs from these environments are processed through structures and procedures which attempt to maximize desired goals. These organizational structures or thruputs, varying in size, scope, integration, and complexity from country to country, from basin to basin, and from region to region, including physical facilities developed for meeting the need for increased productivity; and, various dimensions of infrastructure, such as rules of operation, patterns of leadership and command, efforts of control, integration, information, communication, and ways of interacting with other organizational environments.

The various linkages and component parts incorporated in Figure 5 can become much more complicated if we try to develop a more comprehensive analysis of a large array of irrigation systems (rather than the local irrigation system depicted in this descriptive figure) and their intra- and inter-system dependencies.

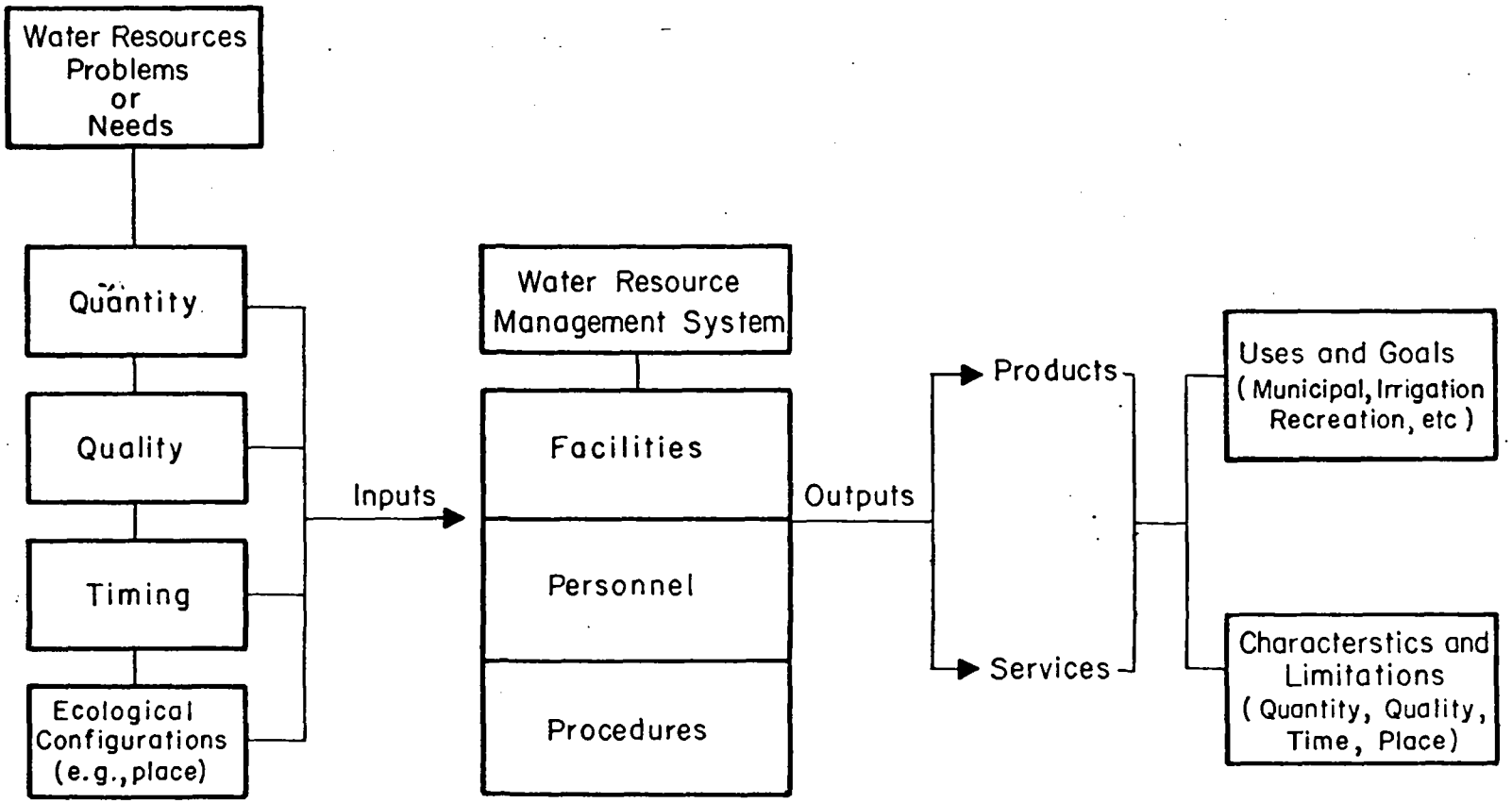

Figure 4: A Simplified Version of Water Resource Problems and of Water Management.

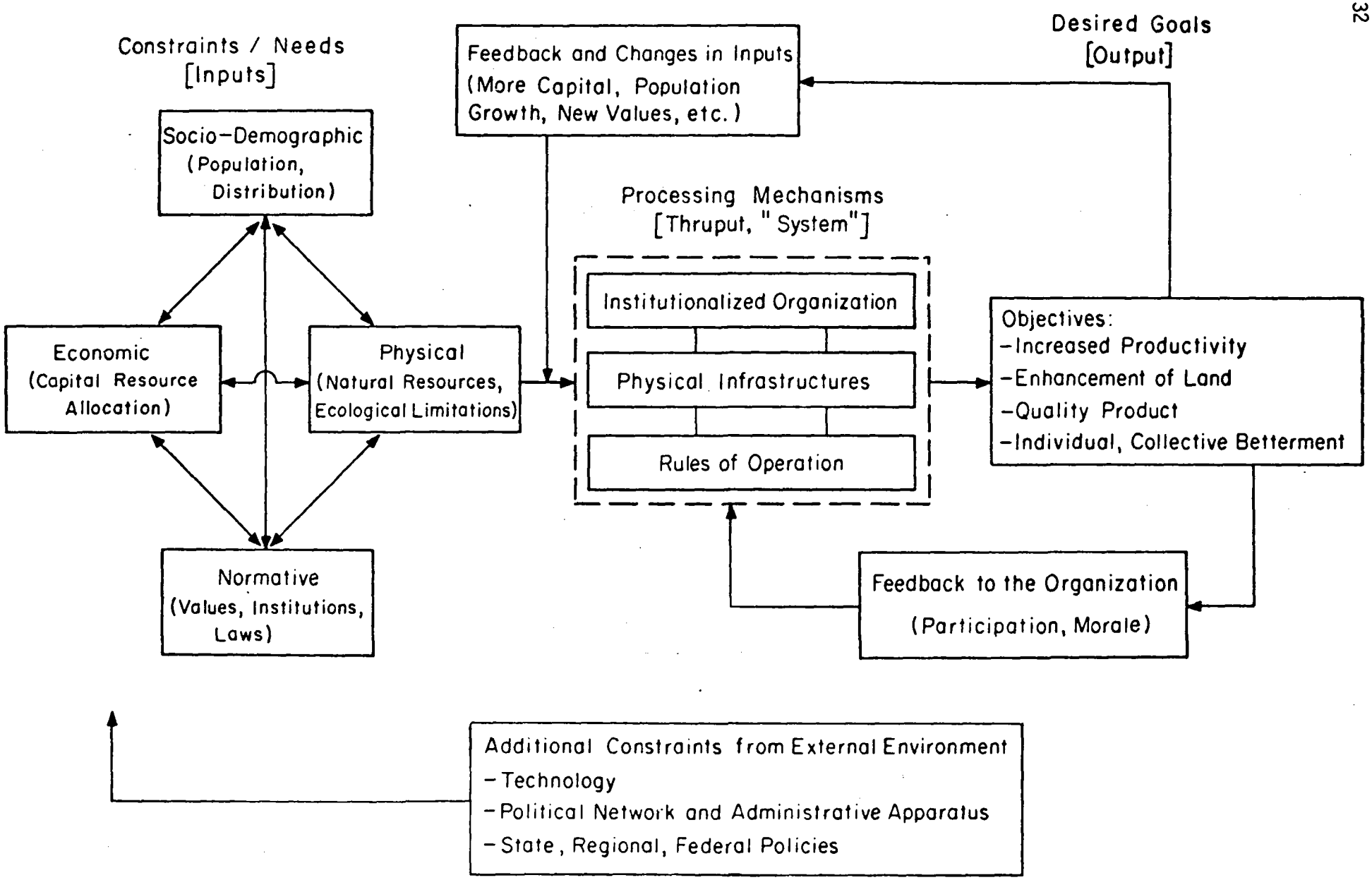

Figure 5: Simplified Version of a [redacted]l Irrigation System

What the previous two figures try to emphasize is the multiplicity of the levels of analysis as well as the multiplicity of functions in any water management system. Most important, at each level and for each subsystem, component part and function, problems of institutional order arise, difficulties of organizational arrangements, and need for specific understanding of the normative rules involved at each stage or phase of a dynamically operating water management system. The major sociological remark to be made at this point is that each system function is associated with important organizational and institutional considerations and aspects of decision-making. Independent of their essential connection with the physical or engineering aspects, each dynamic water function presented in the previous figures requires considerations eminating from the larger socio-cultural context.

One could go on to present an almost infinite variety of classifying water-related activities and water resources management situations, especially around particular uses such as urban water systems, run-off situations, urban metropolitan organizations, integrated besin development, etc. The characteristics of the particular system and the combination of elements within each may be different, but the five water system functions and dynamic processes described in Figure 3 (supply, control, distribution, utilization, reclamation) must always be taken into account in the context of ecological limitations, technological factors, and socio-political realities. At the end, efficient water management, technological innovations, and effective allocation of existing resources become the crucial factors for the successful operation of any water system.

While the above gave us a way of approaching in a systematic fashion aspects of water management, we need to again emphasize that the advantages of systems analysis as a tool for identifying and understanding the complex interactions of a total water management scheme include:

a. a balancing of social science with physical solutions to water problems;

b. integration of technological ("hardware") and non-technological ("software") solutions;

c. modeling of complex problems;

d. improvement of design of the total environment;

e. definition of standards and cost factors for action alternatives and desired ends.

However, one should not forget that systems analysis and the adoption of a natural science model for complex socio-cultural situations, have inherent dangers (including also major epistemological differences as to the use of linear logic or causal models in social sciences). Among key problems in the use of systems analysis and such models are such difficulties as:

a. the problem of reiffication or treating theoretical constructs as real;

b. the restricted determinancy of social systems models, in that they do not completely account for social behavior;

c. the emphasis on stability, since prevailing social system models have built-in tendencies towards equilibrium and status quo rather than emphasizing or defining change and conflict.

In the context of the present Conference and in the effort for developing a larger model of analysis, we may now bring together the previous remarks with the general concerns about water and society. The proposed scheme of comparative analysis of Figure 6 may help us relate the basic parameters of the problem through critical variables; their interrelationship (model); the generation of appropriate legal and organizational alternatives; and the concern with output or desired goals and objectives. Figure 6 reflects not only a structuring of the argument of how we may go about relating a variety of problematic conditions, but also an underlying sequence of concern that has to do with critical questions of water resources management; the purpose to which these questions are directed; the decisive role of the constraints/facilitators of ambient conditions; the range of alternatives in practice; and, finally, the larger principles that may be developed from a juxtaposition between existing conditions and desired goals in water management.

4. PERSISTENT ISSUES AND CONCERNS

So far we have been discussing in a general fashion some historical principles delineating water as a problem and opportunity, a broader approach to water uses, and, finally, proposing a systematic approach for relating water management functions and various environments through a systems analysis approach.

At this point, it is also important to expand the argument on water management by underlining some key concerns in any discussion of socio-cultural dimensions. For example, the relationship between natural resources and development has been identified as a key element in all attempts for modernization and economic growth. In many respects, the economic life of a nation revolves around the availability, use and exploitation of natural resources, especially as expressed in the pursuit of concerted natural resources policies, Yet, while one recognizes the importance of irrigated agriculture in the context of problems of development and environmental concern, one should also realize the importance of dwindling uncommitted lands, negative environmental effects from large-scale water resource projects, competing and conflicting water demands, and incompatibilities that may result from the creation of a "growth environment."

Although it is impossible to discuss in detail such large issues, the analysis of various dimensions and items introduced above, emphasizes a central thrust, namely that efficient and effective employment of water resources require an integration of three major criteria in planning and development: physical, economic and social. Irrigated agriculture, then, must be seen as an integral part of larger socio-economic trends and of

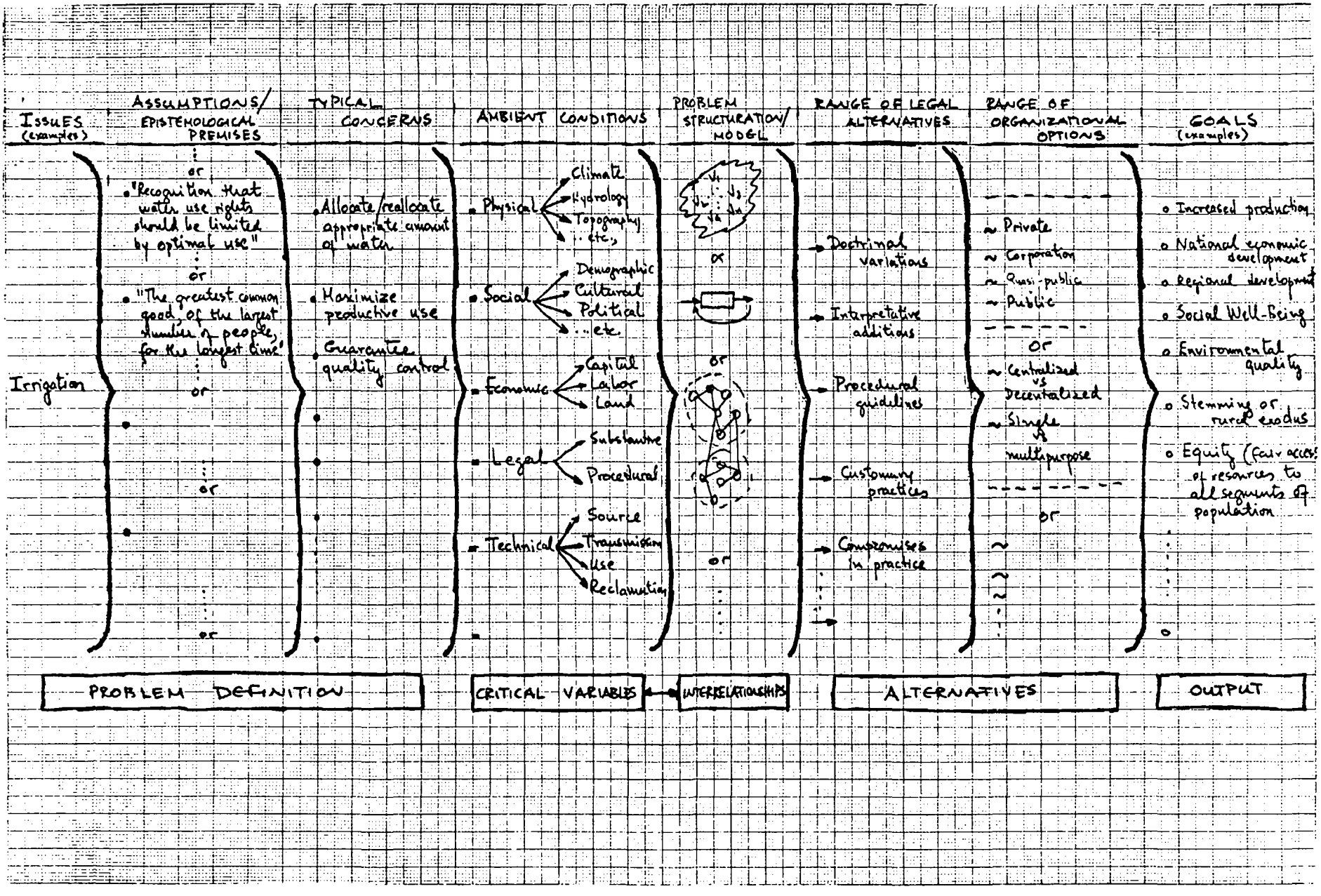

Figure 6. A paradigmatic scheme relating socio-cultural factors to other "subsystems" in water management.

increasing awareness of new equations between technological interventions and ecological balance.

One of the items that must be continuously underscored is that human and natural resource conditions in many developing countries are generally far different from those in industrialized countries and that technological solutions may not (indeed, should not) be the same. Differential characteristics of many of the developing countries include limited financial resources, limited manufacturing capacity, lack of skilled labor, scarce engineering manpower and planning staffs, and a variety of a combination of historical and cultural traditions that affect the nature and management of water resources.

It should be recalled that the 1960's have been really declared as the developmental decade. Yet, towards the end of the 1960's a number of books and works have brought forward a recurring discussion concerning the disappointing results of development efforts. Many writers have emphasized the structural inadequacies, the faulty planning methods, and a host of irrelevant evaluation procedures which did not permit many developing countries to achieve or even take advantage of a parallel growth environment characterizing developed nations. In agricultural development, in particular, there seems to be agreement that the apparent inadequacies center around the following points:

1. Incompatibility between development planning and the political decision process, especially because of the limited time span of planning and unstable organizational environments.

2. Lack of goal orientation and weak normative or "teleological" thinking. What we find here is a preoccupation with short-term production objectives as contrasted with long-term capacity orientation important for a growth envirionment in many developing countries.

3. Ignorance, and many times failure, to realize the differential process of development in various countries of the Third World, including a failure of incorporating principles of complex interdisciplinary approaches in the transformation process.

4. Narrow development alternatives, preoccupation with megastructures and, often, blind transferrence of knowledge from developed to developing countries with little understanding of the socio-cultural context within which change takes place and of the need for a flexible framework of technological conditions suited to each specific country.

5. Preoccupation with sectoral planning and reductionistic analysis rather than systemic thinking orientation and multi-objective, multi-disciplinary considerations.

What needs to be emphasized from the above brief remarks is that, technologically speaking, the development of water resources of a given country can be achieved with the existing level of scientific and technical knowledge. However, development is not a matter of technology alone. We cannot simply transplant the technological apparatus of a given country into another social structure expecting the same benefits. Technology,

in the absence of relevant data, organization, planning, institutions, human skills, available capital, and more than anything else, a clear understanding of the motivation of the people who are to employ it can become a futile task of mimicry with no organic connection to the life of a given region.

It should be noted here that the accomplishment of development, economic growth and material progress can be achieved not only by an effective use of given resources but also by a general economic tendency, orientation, and capacity of responding to what Wiener has labelled "a growth environment" (Wiener, 1971). This growth environment incorporates the capacity of a socioeconomic system to modify its structure and to respond with greater variety and great coordination and control to improve conditions. Thus, in the case of irrigated agriculture, increased production becomes part of a well-coordinated effort of improving incentives, allocating goods, and channelizing growth to desirable directions, including cumulative growth and equitable distribution throughout society. To meet such harmonization of economic and social goals, strong political mechanisms must exist that can translate directives into action and bridge discrepancies between social intentions and actual performance.

Thus, the history of development in many developing countries reveals that the classical models as they have been applied do not seem to be responsive to the unusual or specific situations of many developing nations. Extreme rigidity and narrow alternatives in planned change schemes, transplantation of inflexible models and of engineering routines from the developed nations, as well as limited feedback information have impeded the creation of a growth environment. Some authors have been increasingly calling for new methodologies and new models that would be a synthesis between the technologically sophisticated information of developed nations and the culturally rich situations of many developing countries. Sucn a synthesis includes a planning methodology, characterized by a variety of responses, insuring compatible mixes and uses of relatively meager resources. At the same time, proposed agricultural programs should combine sensitivity to the socio-economic structure of the developing country and recognition of the importance that planning will depend on major transformations through public intervention.

In addition, in many regions of the world, particularly in arid or semi-arid areas, the very existence of irrigated agriculture has been called into question. Recent writings both in the United States and in other nations have been raising questions about the constant hunt for water, especially for all those big projects designed to bring more of it to arid lands. As a matter of fact, the point has been raised that perhaps we should redistribute popopulation toward more productive lands, and in order to save water practice agriculture only in regions that seem to be much more amenable to agricultural production. A larger question looms in the background, however, a question equally important for water, energy, and all other aspects of natural resources utilization: a balance must be restored between supply and demand. Rather than continuously responding with structures and programs to an assumed increasing supply, we may concentrate on a diminishing demand especially through curbing of population growth and lifestyles which are "water

intensive." Yet, despite all such hopes and desired conservation policies, it seems that barring a global catastrophe it is virtually certain (given current problems of food scarcity) that irrigation will increase in the years ahead.

As related before a variety of circumstances today coalesce to create water-related problems all over the universe. Increasing demands and the despoliation of the natural environment are major expressions of these concerns. Indeed, two central problems have come to summarize today the so-called environmental plight: quantity and quality considerations in the interrelationship between man, technology, and environment. Quantity reflects the concern with the exponential growth of population in many developing countries and the Malthusian specter of wide-spread famines resulting from the disparities in growth rates between population and food. Quality, on the other hand, reflects the concern with excessive consumptive patterns in developed countries and the predatory exploitation of natural resources through lifestyles that encourage environmental despoliation. Indeed, the 1970's have brought dramatically forward the combined and accumulative effects of both quantitative and qualitative changes in the human environment with dire predictions as to a viable future of many regions of the planet.

The voluminous material on population, the ecosphere, and the depletion of natural resources all attest to the centrality of a plight of modern society for accommodating expanding numbers, the limitations of space, and the decay of the living environment. Critical issues in natural resources today remain the population explosion, resource shortages and depletions, environmental despoliation, and limits to human adaptive capability in a technological society.

Such concerns, combining quantity and quality, tend to reinforce a prevailing fear that something fundamental is changing in the relationship between man and nature. As a matter of fact, some scientists believe that the world strains today are signals of fundamental and perhaps unsolvable crises: namely, the approach of physical limits to human and material growth.

It is in the context of this concern that one has also to understand the larger perspective of socio-cultural aspects of present and future water management schemes. Socio-cultural aspects in water resources should relate to the basic socio-economic activities of any country or region through the following water concerns: a) food production; b) urban water demands; c) industrial water demands; d) municipal waste disposal; e) power generation; f) recreation and wildlife demands; g) environmental enhancement. Thus, both technological and social responses to such concerns as well as legal mechanisms for carrying out management schemes would tend to fall under four major categories:

1. Strong incentives for efficient or new uses, including economic benefits, redefinition of the doctrine of beneficial use, etc.

2. Structural changes, such as new organizational arrangements, creation of new water agencies, etc.

3. "Regulatory counter-incentives," such as stricter enforcement and pricing policies.

4. Changes in "water intensive" lifestyles and cultural practices.

The above tend to emphasize what one may call non-structural developments and policies. Another major part of the story would be of course the technological solutions that would alleviate problems of supply. All the above, however, point out that essentially humanity as a whole and particularly regions of increasing demands and of arid conditions need to put into a proper perspective a pervasive attitude of people vis-a-vis water. Many people in arid environments express the belief that water should be made freely available to everyone who "needs it." This attitude originates in many respects (such as in the case of the western United States) from either the past place of origin of many people who move from humid regions where the water was regarded as plentiful, or from the strong emphasis of the inhabitants of arid regions to see water as a means of survival in a rather "hostile" environment.

All in all, schemes of water management should combine both "structural" and "non-structural" mechanisms as parts of a comprehensive policy connecting water to growth. Either through increased supply or diminished demand we should be affecting the extent and rate of change in the surrounding environment.

5. INTEGRATED WATER RESOURCES PLANNING

To be done properly, planning for water development obviously cannot be isolated from the planning of other resources, both natural and human. The use of the term "comprehensive planning" as applied to water resources is not a recent invention but goes back to the turn of the century when in many countries including the United States the term "multi-functional" planning was first introduced.

The comprehensiveness of water resource planning has been the subject of controversy and debate in the literature. It has been recognized, however, that in order to be able to maximize the benefits from any water resource project a much larger systemic analysis of the surrounding environment is needed, a broadening of the horizons of traditionally narrow planning efforts, and increased sensitivity to decision-making problems associated with multi-objective and multi-dimensional interventions.

The objectives of planning become the crucial elements in understanding the need for integrating water projects in a broader social policy. Objectives are statements of purpose, and their determination is in many ways the most important single phase of the planning process. Objectives may be divided into classes by degree of abstraction. One category of objectives may consist of those which are general, ultimate, or theoretical and refer to all encompassing questions of human welfare. Other classes of objectives are much more specific and geared to the particular circumstances surrounding a given community, territory, area, region, or particular grouping.

The basic goal in the formulation of water resources projects is to provide the best use, or combination of uses, of water and related resources to meet foreseeable or conceivable needs. From this general quest, the major objectives for planning water resources are:

1. National economic development and development of particular regions or communities within the country, through increased employment and improvements of the economic base.

2. The preservation of the nation's resources, including protection and rehabilitation insuring availability for the future.

3. Enhancement of the quality of the environment by improvement of certain natural and cultural resources and ecological systems.

4. Promotion of the well-being of people and concern with the social welfare of all, by contributing to the recurity of life and health; by providing educational and cultural opportunities; and, guaranteeing balanced growth among various affected persons or groups.

The beginning and end of comprehensive planning is goal setting. The definition of long-term goals produces medium-term objectives from which quantifiable short-term or immediate targets may be derived. At every level, however, goal setting, the determination of trade-offs, and the establishment of priorities depend primarily on political value judgments.

What we are trying to say above is that in considering, planning and managing a water project we are guided at the same time by an awareness of what indeed such a proposed technical project can do for the larger society. Especially in countries and situations where little knowledge exists, we need to be careful not to superimpose a technology, or transplant experiences based on blind faith on the technological experience of other nations. In any detailed study of irrigated agriculture, we must continuously review the following considerations:

a. Strive to adapt to natural conditions by using existing ecological elements to the advantages offered by the local landscape;

b. Utilize resources to their best advantage by designing facilities requiring materials locally available, or by raising crops best suited to the temperature and moisture conditions prevailing in the particular situation;

c. Respect local culture and religious traditions. This is done by introducing improvements gradually, by avoiding disruptive established patterns, and in general, by respecting the local traditions and the prevailing norms of long experience of local residents.

To summarize, any successful technical and institutional arrangement for managing water resources projects needs to meet certain important criteria which center around our concern of how to respond to local demands. In addition, competency in planning, coordination in research, control over both water quality and quantity, and the ability to provide flexible financial support are among the guarantees for designing a good water system with minimal disruption to the surrounding physical and human environment.

In the United States, natural resources research and policy in the 1970's has been significantly shaped by legal and theoretical development in the general area of environmental impact analysis. Impact analysis and assessment have become essential parts of the process of evaluating the effects of large-scale public projects and requirements for total environmental planning.

There is no doubt that the National Environmental Policy Act of 1969 constitutes a landmark, not only as a legal precedent but also as a potential basis for far-reaching policy of social planning. Paragraph 102 2 (c), in particular, made it possible to move beyond the noble spirit of NEPA to more operational means for achieving higher resolution in planning. This paragraph introduced the concept and requirement of an Environmental Impact Statement which created and is creating quite a legal, theoretical and methodological turmoil. The major point to be made about this particular Act, as well as a host of other environmental laws, resource policies, agency guidelines, court interpretations, and the avalanche of professional literature that followed, is that the 1970's have ushered a new era in the planning of water resources. In trying to mold a new planning and decision-making ethos, there is a fruitful combination of traditional project considerations with such items as social cost estimation, long-range consequences, unintended effects and higher order consequences from any intervention in the surrounding environment.

The natural culmination of such legal trends is an expanding process of assessing long-range effects, a procedure which requires not only simple prediction of current trends and developments, but also the analysis of future environments within which projects will be operating and against which potential effects of water resources project can be more meaningfully evaluated. Thus, increasingly water resources research and management is acquiring a future-oriented emphasis.

Most critical in the analysis of all these recent developments on impact assessment has been the incessant search for criteria to justify water resources projects. Benefit-cost has been the time-honored criterion for many projects. But this appealing concept, of sensibly incorporating the idea of the market and resulting in a cardinal measure of a project's worth, has never been without controversy. While sound in its premises the above principle has often resulted in a false sense that because one had a measure--such as dollar value, or benefit-cost --the manifestation being measures was a valid surrogate measure of the plan being considered.

The search for appropriate criteria has finally evolved into the Water Resources Council "four accounts systems." Together with a variety of other documents and related literature, the *Principles and Standards* is one of the most widely used means for developing coherent goals and objectives in water planning, and permits planners, affected publics, Congressional members, and others the opportunity to evaluate effects of a given water project in terms of environmental quality (EQ), regional development (RD), and social well-being or quality of life considerations (SWB).

These principles and standards, and all the recent efforts of various agencies to interpret, expand and clarify their broad characteristics, are particularly significant for water management, assessment, evaluation, and decision-making. They are becoming the basis and vehicle for emerging systematic water planning and concrete mechanisms for evaluating both short-range and long-range consequences. In addition, the principles and standards have strong policy overtones in that they: a) help assist in the allocation of scarce resources; b) delineate a system and criteria for displaying trade-offs in the form of alternative plans; c) recognize both quantifiable and non-quantifiable benefits and costs; d) demand public participation; e) require interdisciplinary input; and f) afford greater detail in the evaluation process and rational decision-making.

Perhaps the most succinct observation that one can make at this point is that water resources in the past have been used to accommodate rather than shape the future. The legal and philosophical developments briefly touched upon above point out at an important transformation: the future is not coming upon us an amorphous and irresistible historical evolution; we are creating the future, we can change the course of events, we can select alternatives that are more appropriate to the pursuit of desired social policies.

Given these trends and developments about water management, an integrated system of water resources involves the following major points of concern to the social scientist:

a. Successful development and management of water resources requires much larger institutional and organizational arrangements, quite succinct from the presently prevailing highly segmentalized and individualized approaches in various parts of the world.

b. Norms and cultural values concerning water use must be coordinated within a larger social planning domain, especially with regard to water rights.

c. Each proposed water resource system, independent of its level of analysis, must develop unique patterns much more responsive to the specific people and cultural conditions found in a given region, rather than a simple transferrence of generalized information from other nations.

d. The larger the scope of the water system and the greater the scale of analysis, the more complicated the organizational arrangements and, therefore, the more the need for coordinating powers and comprehensive planning.

Perhaps the final conclusion of the cursory analysis of socio-cultural aspects of water management must be the reiteration of a commitment and epistemological approach that reinforces holistic planning through:

1. systematic integration and recognition of the genesis of the system;

2. normative preoccupation and acceptance of succinct goals and objectives;

3. hierarchical considerations, including social priorities and ranking of alternatives;

4. anticipatory change and the Promethean pledge to help bring about desired futures.

Planning with a sensitivity to all affected environments, assessing impacts, considering alternatives, forecasting future water resources environments, all are, then, part of a continuous quest for understanding the present and by utilizing the historical experience of the past be able to provide principles of water management responsive to new and expanding demands and to the perennial quest for increased happiness for all segments of the human population.

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TABLE OF CONTENTS

THE IMPORTANCE OF WATER LAW IN THE DESIGN AND OPERATION OF IRRIGATION SYSTEMS FOR IMPROVED ON-FARM WATER MANAGEMENT

by

Gaylord V. Skogerboe*

1. INTRODUCTION

Whether the goal is minimizing diversions to new croplands because of limited water supplies, reducing future diversions to irrigated agriculture to provide water supplies for new demands, minimizing water quality degradation in receiving streams resulting from irrigated agriculture, or maximizing agricultural production on existing croplands; the solutions are identical--improved water management practices.

Irrigation is one of the most important agricultural practices developed by man, with irrigation being practiced in some form since the earliest recorded history of agriculture. The economic base for many ancient civilizations was provided by irrigation. Irrigation farming not only increases productivity, but it also provides flexibility which allows shifting from the relatively few dryland crops to many other crops which may be in greater demand. Irrigation contributes to strengthening other facets of a region's economy in that it usually creates more employment opportunities than rainfed agriculture through intensive and diversified cultivation, the stimulation of important agri-businesses and public institutions, the provision of products for export, and the creation of a healthy domestic market (Skogerboe, 1974).

History is replete with declining civilizations due to declining agricultural productivity, which has usually been the result of improper soil and water management practices. This potential danger is present today at many places throughout the world. This comes at a time of dangerous food shortages in a hungry world, when the goal is to increase per acre crop yields.

To maintain agricultural productivity in irrigated agriculture--and we must do more than that today--salts applied onto the croplands, which are dissolved in the irrigation water supplies, must be moved below the root zone in order not to retard plant growth. Therefore, it is mandatory that water supplied to a crop must exceed the actual water requirement of the plants to include evapotranspiration needs, leaching requirements, seepage losses and in most cases other transit or ditch losses which in most countries are substantial.

As is known, usually the quantity of irrigation water diverted from a river far exceeds the cropland water requirement. Data from many

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irrigation regions indicate that seepage losses from canals and laterals throughout the irrigation distribution systems are extremely high. Added to this problem is the excessive application of water on farm fields, which results in surface runoff from the lower end of the field (tail-water runoff) and/or large quantities of water moving below the root zone (deep percolation). The combination of seepage and deep percolation losses cause groundwater levels to rise (waterlogging). In many irrigated regions, the groundwater levels have reached the vicinity of the root zone which frequently results in the upward movement of groundwater due to capillary action. When upward moving water reaches the soil surface and evaporates, the salts contained in the moisture are left behind on the ground surface. This process of salinization has not only resulted in declining agricultural production, but has caused many lands to become essentially barren.

The quality of water draining from irrigated areas is materially degraded from that of the irrigation water applied as we have discovered along the Colorado and other rivers.

Agriculturists have viewed this phenomenon as a natural consequence of the several complex processes and strangely enough even today little attention has been given to the possibility that progress could be made toward controlling or alleviating this degradation of water quality.

Historically, some degree of salt concentration due to irrigation has been usually accepted as the price for irrigation development. In some areas, however, there has been so much laxity that quality degradation has become a serious matter. As pressures on water resources become greater, due to increasing populations and the necessity to produce food in increased quantity and improved quality, there is a mounting concern for proper control of serious water quality deterioration and soil salinization. The need then for more precise information as a basis for wise policy action is a matter of critical importance.

The major problems resulting from irrigation are due to the basic fact that plants are large consumers of water resources. Growing plants extract water from the supply and leave salts behind, resulting in a concentration of the dissolved mineral salts which are present in all natural water resources. In addition to having a greater concentration of salts in the return flow resulting from evapotranspiration, irrigation also adds to the salt load by leaching natural salts arising from weathered minerals occurring in the soil profile, or deposited below. Irrigation return flows provide the vehicle for conveying the concentrated salts and other pollutants to a receiving stream or groundwater reservoir. It is necessary then to examine the waterlogging and salinity problems resulting from this process and to develop and implement measures to control or alleviate the detrimental effects.

Impaired crop production resulting from salinity is not limited to the western United States, but is a major problem in many areas of the world. In fact the more one observes problems in other countries the more one is convinced that this is indeed an international problem. Unfortunately, the portions of the world now facing the greatest

population pressures are the same areas which have the least amount of additional land available for agriculture and in some cases where waterlogging and salinization are rampant. In such areas, increased food production must come from more intensive farming with consequent increased yields and, as the economist reminds us, the modernization of agriculture requires that output continue to rise with decreasing per unit input costs. On the one hand, there is a great need to increase the productivity of such lands, but on the other agricultural production is continually being damaged due to rising groundwater tables (waterlogging) and increased salinity in the soils and groundwater supplies. Though there are estimates of the extent of these salt problems in the world suffice it to say that it is a creeping plague of death in many places.

Whenever water is diverted from a river for irrigation use, the quality of the return flow becomes degraded. The degraded return flow then mixes with the natural flows in the river systems. This mixture is then available to downstream users to be diverted to satisfy their water demands. This process of diversion and return flow may be repeated many times along the course of a river. In the case of the original diversion, if the increase in pollutants contained in the return flow is small in comparison to the total flow in the river, the water quality would probably not be degraded to such an extent that it would be unfit for use by the next downstream user.

If the quantity of pollutants (e.g., salinity) in the return flow is large in relation to the river flow, then it is very likely that the water is not suitable for the next user unless the water is treated to remove objectionable constituents. Since water is diverted many times from the major rivers, the river flows show a continual degradation of quality in the downstream direction. As the water resources become more fully developed and utilized, without controls, the quality in the lower reaches of the river will likely be degraded to such a point that the remaining flows will be unsuitable for many uses, or previous uses of the waters arriving at the lower river basin no longer will be possible.

2. MAJOR WATER PROBLEMS

2.1. Water Quantity

The purpose of irrigation is to increase crop production, but the real difficulty lies in sustaining increased crop production over a long time period. History is replete with hydraulic societies which flourished and then floundered, or became extinct. Why?

Maintaining or increasing agricultural productivity in an irrigated area requires, first of all, that a salt balance be achieved in the root zone; and secondly, that not too much water is applied such that the groundwater levels rise until the water table is near the ground surface, thereby resulting in waterlogging and increased salinity levels in the root zone. Thus, a balance must be reached in order that sufficient

water is applied to the croplands to leach salts from the root zone, but not so much water that groundwater levels nearly reach the ground surface. The history of hydraulic societies has been primarily one of applying too much water. And over-irrigation continues today in most portions of the world.

In order that water does not limit crop yields, the proper amount of water must be applied to the cropland at the proper times. The timing and quantity of required irrigation water is a function of primarily climate, soils, and the stage of crop growth.

In many regions and countries, increasing urbanization and industrialization requires the reallocation of agricultural water uses in order to meet these new water demands. In order to accomplish this water reallocation, improved water management practices must be instituted in the agricultural sector, thereby reducing agricultural water diversion requirements.

The real detriment in over-irrigation is that groundwater levels rise, thereby resulting in waterlogging of the soils and a continual decline in agricultural productivity until the land may finally become barren. In addition, over-irrigation results in water quality degradation of irrigation return flows and consequent degriments to downstream water users.

2.2 Water Quality

Usually, the quality of water coming from the watersheds is excellent. At the base of the hills or mountain ranges, large quantities of water are diverted to valley croplands. Much of the diverted water is lost to the atmosphere by evapotranspiration (perhaps one-half to two-thirds of the diverted water), with the remaining water supply being irrigation return flow. This return flow will either be surface runoff, shallow horizontal subsurface flow, or will move vertically through the soil profile until it reaches a perched water table or the groundwater reservoir, where it will remain to be pumped or be transported through the groundwater reservoir until it reaches a river channel.

That portion of the water supply which has been diverted for irrigation but lost by evapotranspiration (consumed) is essentially salt-free. Therefore, the irrigation return flow will contain most of the salts originally in the water supply. The surface irrigation return flow will usually contain only slightly higher salt concentrations than the original water supply, but in some cases the salinity may be increased significantly. Thus, the water percolating through the soil profile contains the majority of salt left behind by the water returned to the atmosphere as vapor through the phenomena of evaporation and transpiration. Consequently, the percolating soil water contains a higher concentration of salts. This is referred to as the "concentrating" effect.

As the water moves through the soil profile, it may pick up additional salts by dissolution. In addition, some salts may be precipitated in the soil, while there will be an exchange between some salt ions in the water and in the soil. The salts picked up by the water in addition to the salts which were in the water applied to the land are termed salt "pickup." The total salt load is the sum of the original mass of salt in the applied water as the result of the concentrating effect plus the salt pickup.

Whether irrigation return flows come from surface runoff or have returned to the system via the soil profile, the water can be expected to undergo a variety of quality changes due to varying exposure conditions. Drainage from surface sources consists mainly (there will be some precipitation runoff) of surface runoff from irrigated land. Because of its limited contact and exposure to the soil surface, the following changes in quality might be expected between application and runoff: (a) dissolved solids concentration only slightly increased; (b) addition of variable and fluctuating amounts of pesticides; (c) addition of variable amounts of fertilizer elements; (d) an increase in sediments and other colloidal material; (e) crop residues and other debris floated from the soil surface; and (f) increased bacterial content (Skogerboe and Law, 1971).

Drainage water that has moved through the soil profile will experience different changes in quality from surface runoff. Because of its more intimate contact with the soil and the dynamic soil-plant-water regime, the following changes in quality are predictable: (a) considerable increase in dissolved solids concentration; (b) the distribution of various cations and anions may be quite different; (c) variation in the total salt load depending on whether there has been deposition or leaching; (d) little or no sediment or colloidal material; (e) generally, increased nitrate content unless the applied water is unusually high in nitrates; (f) little or no phosphorus content; (g) general reduction of oxidizable organic substances; and (h) reduction of pathogenic organisms and coliform bacteria. Thus, either type of return flow will affect the receiving water in proportion to respective discharges and the relative quality of the receiving water.

The quality of irrigation water and return flow is determined largely by the amount and nature of the dissolved and suspended materials they contain. In natural waters, the materials are largely dissolved inorganic salts leached from rocks and minerals of the soil contacted by the water. Irrigation, municipal and industrial use and reuse of water concentrates these salts and adds additional kinds and amounts of pollutants. Many insecticides, fungicides, bactericides, herbicides, nematocides, as well as plant hormones, detergents, salts of heavy metals, and many organic compounds, render water less fit for irrigation and other beneficial uses.

3. DEFINITION OF AN IRRIGATION SYSTEM

An irrigation system can be subdivided into three major subsystems: (a) the water delivery subsystem; (b) the farm subsystem; and (c) the water removal subsystem. The water delivery subsystem can be further subdivided into two components; namely, (a) the transport of water and pollutants from the headwaters of the watershed to the cross-section along the river where water is diverted to irrigate croplands, and (b) the transport of water and pollutants from the river diversion works to the individual farm. The farm subsystem begins at the point where water is delivered to the farm and continues to the point where surface water is removed from the farm. Also, the farm subsystem is defined vertically as beginning at the ground surface and terminating at the bottom of the root zone. The water removal subsystem consists of (a) the surface run-off from the tail end of the farm, and (b) water moving below the root zone.

4. PLANNING FOR EFFECTIVE IRRIGATION WATER MANAGEMENT

The resource base for irrigated agriculture has not substantially changed since its inception thousands of years ago. Over the last century there has been little incentive for any major innovation to improve efficiency in the use of water which now fortunately is considered a scarce resource. The provision of irrigation water since ancient times has been considered a governmental or collective responsibility, and the direct charges made for water have usually not been high enough to encourage proper budgeting of water or other necessary innovations. This custom of undercharging for water has continued to this very day; a few regions charge the farmer for the real cost of water. However, there are a few examples of extremely water-scarce areas in the world where considerable ingenuity has been applied in effectively utilizing water supplies.

Aggravating this situation of so-called "cheap water" is the fact that the development of irrigated agriculture in most places, even in the last few decades, has focused almost entirely upon the construction of water delivery subsystems. This preoccupation with the installation of "hardware" results from a naive single-discipline approach to water management (Wiener, 1972) and let us be reminded that one discipline cannot begin to solve the complex physical, economic, political, and sociological problems involved. Probably the greatest deterrent to improved water management in most irrigation systems today is the inordinate focus on the water delivery subsystem and the almost complete neglect of other problems. How long can we afford to neglect other problems of the system such as the need for improved soil-plant-water management techniques, improvements in cultural practices, farm machinery, agrarian structural reforms, roads, marketing systems, advisory services and input supply systems, administration of institutions, water laws, cooperatives and water users associations, and many other factors all of which must fit together in all their interdependencies and complementarities to form a most complex system. In reality, though, especially in irrigation agriculture, we come face-to-face with a wide gap which

frequently exists between "hardware development" and the development of all the other requisites for increased agricultural production.

The approach which has been applied to irrigated agricultural development in the past is characterized by separating the development of water resources from the management aspects of water resource utilization. Therefore, the record shows development being emphasized greatly while management is most often neglected. This orthodox approach has been used almost exclusively in the western United States with reasonable success. However, as the water resources become more fully utilized, the necessity for meeting new water demands (along with physical, socio-economic, and political problems of water quality degradation) require that we reject much of the conventional wisdom of the past. It should also be obvious that the less developed countries (LDC's) today neither have the time nor resources many western irrigated regions had to utilize in their development. Pressures created by rapidly rising population rates alone will force them at some point to reevaluate their approaches.

In contrast to the mere development of water resources approach, the "management" approach attempts to achieve water development objectives by applying a variety of measures after studying the entire system, thereby attempting to modify the total system to meet new and changing demands as well as estimated future demands. Therefore, instead of constructing new engineering works to meet new demands, the focus should be upon water resource management, with construction works being considered only as a tool when necessary to meet water management objectives (Wiener, 1972). Unfortunately, in most cases, water management and the many disciplines required to produce efficient management are relegated to the post analysis of engineering works (e.g., much of the future emphasis will be geared towards improving existing irrigation systems), which aggravates not only the implementation of technology, but really constrains or makes extremely difficult the implementation of a host of services requiring strong institutional measures.

5. DESIGN OF IRRIGATION SYSTEM

The "heart" of an irrigation system is the farm subsystem. The purpose of an irrigation system is to grow food and this "action" takes place in the root zone. The purpose of the water delivery subsystem and water removal subsystem is to support this "action". Therefore, the proper design of an irrigation system requires, first of all, that the farm subsystem be adequately designed so that the water delivery subsystem can be designed to provide the quantities of water at the times required by the plants. The most important constraint in the design procedure is the necessity for assuring adequate drainage through the root zone in order to maintain a root zone salt balance to insure continued long-term agricultural productivity.

5.1 Farm Subsystem

The first important variables in designing the farm subsystem are climate, soils, and crops. The interrelationships between these

variables dictate the capability of the land resource for producing food and fibre. We need to understand the interactions and relationships between water and management factors such as optimum rates of fertilizer, proper pest control measures, seeding and tillage practices, and other improved cultural practices. Much of this research is adaptive and protective, which due to its rather low level of sophistication, is sometimes neglected.

The next important variable will be water and its physical availabiltiy. Frequently, in arid areas of the world, water is the most limiting factor. However, the capability of the available water supplies (precipitation, surface runoff, and groundwater) for plant production is highly dependent upon the efficiency with which the water is used, which in turn is a function of both economic and institutional factors. Besides physical limitations, the questions of economics in supplying water must be answered to insure that costs are commensurate with planning goals.

Once the general scope of an irrigation project has been determined, then the more detailed design procedures can follow. The critical factor at this point becomes the infiltration characteristics of the soil. Unfortunately, infiltration is a complex phenomenon and the intake function of a particular field will vary during the irrigation season, as well as varying from season-to-season. There are a number of laboratory and field methods available for determining the intake characteristics of a soil.

Using climatic data, the potential evapotranspiration of the various crops can be calculated. These computations will provide the information regarding water consumption with time, provided sufficient moisture is made available in the root zone.

The next important step is designing the farm irrigation layout so that sufficient moisture will be available in the root zone when required by the plants. The root zone is capable of storing moisture for future plant use. Again, soil characteristics determine the amount of storage, as well as the capability of the plant to extract the moisture from this "reservoir". At the same time, the leaching requirement for maintaining a salt balance in the root zone must be kept in mind. Consequently, the farm irrigation layout must be capable of supplying not only the plant water requirement, but also the leaching requirement.

The proper design of the farm irrigation layout is crucial for: (1) uniformly distributing the necessary moisture throughout the field; and (2) minimizing deep percolation losses so as not to aggravate problems in the water removal subsystem (e.g., waterlogging and salinity).

Generally, the development of irrigation projects has not entailed the design of farm irrigation layouts suited to the individual characteristics of each field. Instead, only the general method of irrigation may be adopted (e.g., basin or furrow irrigation). The farmer is usually left to his own means in irrigating his fields, without having the benefit of technical (or economic) assistance. The situation is further

aggravated because, along with adopting a general method of irrigation, an average irrigation efficiency for this method is "pulled out of the air." If this so-called average water use efficiency was even close to being correct it would be most fortunate--let alone taking into account the variability of this "magic" number on any specific field throughout the irrigation season, as well as the variability from field-to-field. Usually, the application of this average efficiency results in large quantities of deep percolation during the early part of the irrigation season, which in turn contributes to waterlogging of the soils and consequent poor crop yields (or eventual failure of the irrigation enterprise).

5.2 Water Delivery Subsystem

The design of the individual farm irrigation layouts should dictate the design of the water delivery subsystem. The irrigation layout design, if properly accomplished, will show the necessary quantities and timing of water deliveries at the farm inlets. The water delivery network must be designed to meet the farm water requirements. Except for alluvial channels conveying large sediment loads, the design of the conveyance works is rather "mechanical".

One of the essential facilities for successfully operating an irrigation conveyance network is adequate and numerous flow measurement devices. To begin with, since each farm has a particular water requirement, then the only means by which the proper amount of water can be delivered is by measuring the water at the farm inlet. After all, the farmer cannot be expected to use good water management practices if he doesn't even know the quantity of water being managed. Besides each farm inlet, a flow measurement structure should be provided at all division points in the water delivery subsystem.

The real problem in the water delivery subsystem is the institutional framework controlling the operation of this portion of the irrigation system. Generally, the operation of the conveyance facilities has not been related to the requirements for sustaining a long-term productive agriculture. In particular, institutional factors have acted as constraints to improved water management or increased agricultural production.

The primary requirement for sustaining an irrigation system is an institutional framework that is compatible with the design requirements for the water delivery subsystem, which in turn has been dictated by the proper design of the farm irrigation layouts, as well as any constraints imposed by the water removal subsystem. Thus, even if all three components of the irrigation system have been properly designed, the lack of an adequate institutional framework for operating the system in accordance with the design criteria will likely lead to either failure of the system, or at least having agricultural production levels below (or far below) expectations. Many LDC institutions for irrigation systems were developed by outsiders for other than the modernization of agriculture. In some LDC's, the objective was a simple system which would almost operate itself. Some of these institutions were regulatory rather than service oriented and little attention was ever given beyond the canal outlet.

5.3 Water Removal Subsystem

The principal function of the water removal subsystem is to allow proper drainage below the root zone so that adequate leaching of salts from the root zone will occur. The most satisfactory mechanism for insuring adequate drainage is proper operation of the water delivery subsystem. By so doing, a drainage problem will probably not occur. This is much better than allowing the problem to occur, then constructing drainage facilities to correct the damage. Unfortunately, the usual solution consists of constructing additional facilities. Frequently, project reports will state---"drainage facilities will be designed after the project has been in operation for a number of years in order to more precisely ascertain drainage requirements." This is the same naive single-discipline thinking referred to in the previous section, which is the rule rather than the exception. Perhaps the statement is correct that the history of irrigation systems teaches one that man often does not learn from history.

Another important consideration in the water removal subsystem is water quality. If canal seepage and cropland deep percolation losses result in water quality degradation of the underlying groundwater supplies, then the use of these supplies may become impaired. Also, the return flows to the river may limit the usefulness of the river water to downstream users. Numerous examples of this situation can be cited throughout the world. Again, this is the rule rather than the exception.

5.4 Administration of Irrigation System

The proper functioning of an irrigation system is highly dependent upon an institutional framework which is compatible with the design criteria used in developing the system, as well as providing flexibility in achieving improved water management as the need arises. Satisfying on-farm water management objectives cannot be achieved without controlling water deliveries. Therefore, the administration of the irrigation system requries that satisfactory legal mechanisms exist that control water deliveries.

The failure of new irrigation developments to meet estimated production goals has largely resulted from the lack of follow-up in providing essential agricultural inputs and services to farmers. Again, the lack of training in farm water management and other farm practices by those responsible for the planning, design and construction of the irrigation development leads to the shortcomings in output. Also, the lack of cooperation between disciplines is certainly a detriment in any country, but is particularly noticeable in the developing countries. Interdisciplinary team research is a noble concept but it is seldom internalized by researchers and implemented effectively. Perhaps the most expedient solution is to expand the training of those personnel involved in the planning, design and construction of irrigation enterprises. Such training would then hopefully provide feedback into the planning and design of future irrigation developments.

The provision of adequately trained personnel for the operation and maintenance of irrigation systems may be understood, but is sometimes difficult to accomplish. Much focus must be given to training not only the engineers and technicians, but those who work directly and indirectly with the farmer. Although agricultural experiment stations may exist, there is usually a severe limitation in accomplishing on-farm improvements because of insufficient adequately trained farm-level advisors capable of transferring applied research results directly to the farmers. In many countries, the components of research and advisory services have never been brought together in a carefully planned marriage relationship.

We are all aware of the need for improved delivery systems for technology once it has been made available by research. How best can this transfer of technology in water management be made to the end user, the farmer? Here we need the help of the applied social sciences such as economics, sociology, anthropology, political science and even the social psychologist. Some extension system is required which will take the proven findings of research, along with utilizing the knowledge of the social sciences "package", in such a way as to convince the end user to move from the trial to the final adoption stage.

6. IMPROVING EXISTING IRRIGATED LANDS

Much of the emphasis in the future will have to be--"improving what we have." In other words, water management will have to be improved, waterlogging and salinity problems alleviated, and crop production increased on existing irrigated lands. Technology alone will not usually bring about the necessary improvements. Instead, a combination of technological changes and instututional modifications will usually be required to effectively manage existing irrigated lands.

An approach for defining technological solutions to the above-mentioned problems will be briefly described below (for a more complete description, see Skogerboe and Walker, 1975). This description applies to a combination of water quantity and salinity analysis; however, the salinity component can be deleted, or models for other pollutants can be substituted for the salinity models.

6.1 Inflow-Outflow Analysis

An inflow-outflow analysis is usually the first step in analyzing water management and salinity problems. An inflow-outflow analysis is commonly represented by the difference in two stream gaging stations located upstream and downstream from an irrigated tract of land, or valley. Initially, the analysis is undertaken using annual data over the time length of available data for the two stream gaging stations. (A word of caution--unmeasured subsurface flows underneath the two stream gaging stations could have a significant effect on the analysis.)

An inflow-outflow analysis is primarily useful for identifying which areas are contributing salts to a river or whether or not an area is maintaining a salt balance. This analysis will not provide the solutions

to indicated problems, but will disclose which areas in a river basin require additional study in order to arrive at necessary technological solutions.

6.2 Hydro-Salinity Model

Salinity problems from irrigated agriculture are the result of subsurface return flows. Therefore, it becomes highly important to model subsurface, or groundwater, flows. The capability of a hydro-salinity model to provide the necessary information for arriving at technological solutions is highly dependent upon the accuracy of the groundwater field data and analysis.

A difficulty often encountered while preparing water and salt budgets is the variability in the accuracy and reliability with which the hydrologic and salinity parameters are measured. Usually, the measurement precision varies with the scope of the investigation and the area of the study.

Since the hydrologic system is difficult to monitor and predict, it is impractical to expect models to operate without applying some adjustments in order that all components will be in balance. In short, the budgeting procedure is usually the adjustment of the segments in the water and salt flows according to a weighting of the most reliable data until all parameters represent the closest approximation of the area that can be achieved with the input data being used. The vast and lengthy computation procedure of calculating budgets is facilitated by a mathematical model programmed for a digital computer. The details of the computer program are listed by Walker (1970).

The mathematical model attempts to simulate the hydrologic conditions of an agricultural system. The concepts are general and can be extended to many areas with some modifications likely required for each area. The program is written in individual but interconnected subroutines that provide a measure of flexibility during operations by separating the calculation phase from either input or output phases. Thus, several of the subroutines become optional if their functions can be replaced by input data, or if certain outputs are not desired.

In controlling the computational order of the program, the main program separates the calculation of the water and salt budgets. Consequently, the modeling procedure involves only the water phase of the flow system (which allows models for other water quality parameters to be substituted, or added, to the salinity portion of the modeling process). This is possible when sufficient field data have been collected. Once the water flow system has been simulated, the individual flows are multiplied by measured salinity concentrations and converted to appropriate units. At this point in the formation of the budgets, careful attention must be given to the salt flow system since irregularities may be present, thereby necessitating further model adjustments. Thus, when the final budgets have been generated, the salt system, groundwater system, and surface flow system must be reasonably coordinated and additional reliability is assured.

6.3 Predicting Chemical Quality

The hydro-salinity model describes the present situation in an agricultural area regarding water and salt flows. However, the only method for predicting the reduction in salts returning to the groundwater and river through implementation of any salinity control measure(s) is by assuming a one-to-one relationship between water (reduction in subsurface return flows) and salt pickup. That is, if the subsurface return flow is reduced by 50%, the salt pickup is also reduced by 50%.

The primary objective is to model the transport of salts through the soils. The first portion of the flow of water and consequent transport of salts is through the root zone, which is usually a zone of partial saturation. A numerical model of the moisture flow and chemical and biological reactions occurring in the root zone has been developed by Dutt, et. al. (1972). (This reference contains a complete listing of the computer program.)

The model consists of three separate programs. The first program describes the soil moisture movement and distribution with time. The second program interfaces the soil moisture movements with the chemical-biological model. This is needed because the horizons used in the calculations of soil moisture and chemistry differ. The third program computes the chemical and biological activity occurring in the soil profile.

The model computes the moisture flow and couples the flow with the chemical changes computed in the biological-chemical program to give the salt transport. The chemical exchange model computes the equilibrium chemistry concentrations for calcium, magnesium, gypsum, sodium, bicarbonates, carbonates, chlorides, and sulfates. The nitrogen chemistry including ammonium, nitrates, and urea-nitrogen uses a kinetic instead of an equilibrium approach. The kinetic approach is needed since microbial activity involved in nitrogen transformation occurs over a period of weeks and days instead of minutes and seconds. The equilibrium chemistry for inorganic salts is a good approximation since the reactions describing their chemistry occur in a matter of minutes or seconds in a flow regime which is changing very slowly.

Once the necessary field data has been collected, equations can be developed to predict the variation in chemical quality (including ionic constituents) of the moisture movement through the soil profile, as well as the salt pickup (or salt precipitation) resulting from movement of subsurface irrigation return flows. These results, when combined with the hydro-salinity model, will allow an evaluation of various control measures upon salinity reaching the groundwater and returning to the river.

6.4 Cost-Effectiveness of Technological Solutions

The results from the hydro-salinity model will provide considerable insight as to which technologies might be most appropriate in order to

reduce subsurface return flows (since salintiy is a problem associated with subsurface return flows). The goal in reducing subsurface return flows might be: (a) to lower groundwater levels in order to alleviate waterlogging, thereby allowing the leaching of salts in the root zone, which in turn facilitates increased crop production; (b) reducing downstream water quality degradation resulting from salt pickup; (c) improved on-farm water management to increase crop production; or (d) any combination of the above three goals.

Field studies must be undertaken to evaluate the effectiveness of any particular technology, or combination of technologies, in achieving the desired goal(s). Cost-effectiveness functions should be developed for each appropriate technology that can be identified. Then, cost-effectiveness functions should be developed for each combination of appropriate technologies. These cost-effectiveness functions, which relate subsurface return flow reductions to the desired goal(s) resulting from a specified investment, would then be assessed in an optimizational format to arrive at the least cost combination for achieving a desired level of the stated goal(s). Thus, this analysis details the optimal strategy for implementing various levels of individual technological improvements into a comprehensive technology package.

7. WATER LAW AND IRRIGATION TECHNOLOGY

The implementation of technological solutions for improved water management will require, in most cases, the employment of water use restrictions. The most effective means for restricting over-irrigation is to apply controls in the water delivery subsystem. This can be accomplished by evaluating the water requirement for each farm, then sum the water requirements moving from the last farm on each watercourse to the head of the canal system, and then provide flow measurement devices at each farm inlet, all water division points, watercourse inlets, etc. The combination of water use regulations and flow measurement devices are the necessary prerequisites to accomplish the desired water management goals.

The necessity for change should dictate the setting of water management goals. The degree of required change will likely increase with time; therefore, water management goals should reflect the time component. Thus, water use regulations should not reflect dramatic changes in a short time period, but rather, the allowable water use should decrease with time, thereby requiring the farmer to become more efficient with time.

Just as technological change cannot usually be successfully achieved without institutional modifications, water use restrictions alone cannot be expected to bring about the desired changes. The necessary inputs for technological change must be provided hand-in-hand with the setting of water use regulations.

8. CONCLUSIONS

Much emphasis will be given in the future towards improved irrigation water management to reduce downstream water quality degradation and minimize diversions in order to provide water supplies for new demands; but more importantly, to alleviate waterlogging and salinity problems in order to increase crop production on existing irrigated lands. In many cases, the key will be improved on-farm water management. However, technology alone will not usually bring about the necessary improvements. A combination of technological changes and institutional modifications will usually be required to effectively alleviate water management problems resulting from irrigated agriculture. The combination of water use regulations and flow measurement devices are the necessary prerequisites to accomplish desired water management goals.

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DESIGN AND OPERATION OF URBAN AND RURAL HYDRAULIC WATER SYSTEMS

by Stavros Triandafyllides*

1. WATER FOR MAN

Water is an indispensable element for human life, whether free when used as solvent of various substances, or when combined in foods. Water provides all living matter with fluidity and movement and becomes part of chemical reactions necessary for life. Many everyday functions of the human body are based on water, such as the circulation and quality of blood, other liquids and substances of the body, temperature variations, the digestion and distribution of foods, etc. The average amount of water rejected from the human body dails is 2.5 kgs. New water quickly replaces the water previously rejected because otherwise the human body would be subject to fatal dehydration.

The contribution of water to the existence of continuous life of mankind has been the object of study and observation from the ancient times, both on the individual and the collective level. The Greek Anaxagoras, Pericles' friend and teacher, was the first to state that matter derives from the basic elements, water, air and fire, which in turn are capable of making-up other substances, since a certain substance cannot render a different substance. " Πῶς γαρ Οὖν ἐκ μιᾶς τριχός γένοιτο θρῦξ καὶ σὰρξ ἐκ μὴ σαρκός." (How then out of hair comes a hair and flesh not from flesh.) Similarly, the Greek philosopher Embedocles, who discussed aspects of matter, stated that matter originally existed inactive in its own substance, consisting of the basic elements. He called them roots, i.e., air, water and earth. Embedocles together with Anaxagoras and Heraclitus, introduced the notion of evolution (an advance statement of Darwin's theory), thus asserting the gradual perfection of originally imperfect organs of every being. Finally, Aristotle, the father of sciences, in all his writings and particularly in his "Meteorological," especially in such sections as "concerning the sky," "concerning youth and old-age," "concerning plants, etc." states the importance of water for the existence and life of human race, and of the animal and plant kingdoms.

Water existing on our planet follows a closed cycle, beginning from water vapouring, cloud formation, precipitates in the form of rain or snow, it circulates on the earth as surface water and beneath the earth's surface as underground water, thus forming creeks, torrents, rivers, springs, to end, finally, in lakes or seas. From there, it evaporates and returns to the atmosphere completing the hydrological balance and the cycle begins all over again. In such a manner, the hydrologic cycle constitutes a fundamental factor for life and for the continuous change of our planet's surface.

The sea occupies an area of 361.3 million sq. klm and its mass has been estimated to 1.43 times 13 million tons, corresponding to 97.2% of

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the total amount of water on earth. The remaining 2.8% of the earth's water can be divided as follows: 2.15% polar ice caps and glaciers. 0.62% underground water, 0.01% lake water, 0.001% in the atmosphere, and only 0.0001% river water.

From the above, one can conclude that the percentage of circulating water found in the atmosphere, lakes and in the variety of flowing water, represents an extremely small amount of the total. Taking into consideration that this amount serves a large number of human needs, the problem of finding such water becomes immediately acute. This problem is intensified by pollution which is brought about by man. Therefore, a vast field of action comes forth, not only for the technical experts, but both for lawyers and social scientists in determining efficient water use and protecting the environment from further despoiliation of the surrounding environment.

The total amount of annual rain in round figures is estimated from 300 to 400 times seven million tons, from which only 1/4, i.e., 100 times 7 million tons (similar to the proportion between land and sea), fall on land. More than 60% of that water escapes through evaporation, plant transpiration and infiltration. Thus, hardly 40 times 7 million tons remain annually for eventual use by man. In highly industrialized and agriculturally intensively used areas, man's daily needs in water amount to 6,000 litres, about 2,000 tons annually. Therefore, the total needs of humanity, based on population of 4 billion, would reach 8 times 7 million tons of water annually, i.e., 1/5 of the annual rainfall. Due to the fact,however, that rainfall is not equally distributed over the globe, and that many times rivers are far away from production areas (such as the Amazon, Siberian rivers, Asiatic and African rivers), it is obvious that in those areas which are highly developed in industry and irrigation, there are significant shortages of water, which often force us to recycle water for repeated use.

From the above, it is rather obvious that vexing problems of water inadequacy in certain densely inhabited areas are rising, expected to be much more intense in the near future. Water reuse, multiple use and elimination of water pollution from industrial and city wastes become not a luxury, but a necessity for survival. In this respect, facing questions of pollution is fast becoming a new and very active field of research and application not only for technical world but also for lawyers and sociologists. If nothing else, this area requires immediate attention and study and the enforcement of protective laws, because otherwise mankind will reach the point of no-return.

2. URBAN AND RURAL WATER SYSTEMS

2.1. Urban Water Systems

2.1.1. Water Distribution Systems

A complete study of a water system refers to the finding, removal, conveyance, treatment, storage, and distribution of water to a given

settlement. The design and implementation of an urban water system serves the main purpose of supplying water to an urban area irrespective of its extent. It is necessary to supply with abundant, clean and fresh water all people living either in big cities, small villages, or even in isolated settlements. In this sense, water is a "good" necessary for life and for the very existence of man on this planet. In past societies, this need of water was limited to drinking, washing, cleaning and other personal needs of man. In the present stage of civilization man's need for water has greatly increased. In a modern city it involves a wide spectrum of general purposes, such as sanitation, production, protection and comfort. Thus, apart from direct personal needs, we need water for cleaning streets, sewers, public lavatories, baths, hospitals, military facilities, schools, clubs, boarding schools, public and municipal buildings, industrial and professional centers, fire protection, gardens, parks, plants decorating city streets, swimming pools, fountains, etc.

The various needs mentioned above, as well as other needs of local or limited importance, oblige us to give high priority to questions of water use. Indeed, we can say that at the present, including also developing countries, it is impossible to live without prompt and adequate confrontation of the various manifestations of what broadly can be labelled "the water problem."

2.1.2. Sewage Systems

Of course, the purpose of sewage facilities is not to supply a good such as the water supply of a city, but they are a necessary element for a modern, civilized society. They concern, generally, the collection, disposal, treatment of unclean waters of a city. There is no other way of discharging waters in a modern city but through the design and construction of a sewage system that permits the discharge of house effluents and of industrial wastes.

In the past, urban residents solved this problem by constructing cesspools. Today, this is neither acceptable nor practically possible, mainly from the sanitary point of view, and because of the continuously increasing quantities of wastes. In order to protect the environment and to be able to recycle unclean water, it is necessary to treat the polluted water, both mechanically and biologically. This treatment may theoretically reach a percentage of 95 to 99%.

In addition, a flood control system runs parallel or is combined with the sewage system of a city or a district. Its main purpose is to dispose of surplus water coming from snow or rain from rural areas. These systems may transport large quantities of rainfall in short periods of time. However, this water does not need special treatment, and, therefore, it can be conveyed to the physical reservoirs of the district such as rivers, lakes or the sea being near the city.

The systematic drainage of unclean waters and rainfall is a new and continuously expanding scientific enterprise which is being improved, especially with the advances in water recycling and with the general concern and efforts for protecting the environment from pollution.

2.2. Rural Systems

The design and construction of rural water systems, while having enormous importance for the prosperity and development of contemporary society, does not at the same time have the absolutely necessary character of survival required for the basic drinking water supply system. The use of water in the countryside is divided mainly into the following works:

a) Flood control works aiming at the protection of settlements, communication works, industrial areas, agricultural lands, etc., from floods, torrents and rivers. Such floods are, of course, quite rare but they cannot be exactly forecasted. Large quantities of water, in a relatively short period, are discharged and may overflow vast urban, industrial and agricultural lands causing uncountable damage to urban and rural properties or the death of humans and animals.

b) Irrigation systems, or water works designed for the increase of agricultural income and in part for livestock expansion. In regions where rainfall is not equally distributed throughout the year, particularly when this is combined with a serious increase of temperature in the summer time (such as in the Mediterranean region), in order to increase agricultural production, it is necessary to resort to supplemental water supplies. This is accomplished by removing water from existing physical sources (rivers, lakes, wells, springs) or artificially created sources (artificial lakes, dams), and distributing it to the fields through a system of channels, so that plants are given the necessary humidity.

c) Drainage works have an opposite purpose from the above. Sometimes in certain rural regions either periodically or permanently water stagnates, making it impossible to develop intense cultivation. At the same time, these regions are the source of contamination and of various diseases, extremely dangerous for both man and domesticated animals. Such regions, known as marshes, swamps or water saturated grounds, are usually the source of serious agricultural and demographic problems, since entire populations may be destroyed by the cursed malaria.

d) Finally, flood control works should be also included as part of an irrigation system (see b, above). The purpose of such works is to discharge surplus irrigation waters in order to protect plants from extreme humidity. At the same time in winter, such works will remove excess rain-waters from cultivated areas.

2.3. Use of Water in Power Production

The purpose of such works is to use the waterfall, through physical or artificial level differences, in order to produce power serving urban, industrial, communication, agricultural and other needs of modern civilization. Such works are slightly out of the scope of this speech but they can be technically combined after their original use in order to serve the two former purposes in an integrated multi-purpose, multi-objective scheme of water resources development.

2.4. River Navigation

A typical or extended net of sailing canals in relation with rivers and lakes may constitute an important factor for the improvement of economic possibilities and for the prosperity of a large area. It should be apparent that such a project would considerably decrease the cost of mass transportation of goods, provided that there are favourable topographical factors (small level differences), so that the construction expense of such projects does not rise, or exceed permissible limits. Needless to say, by means of combined construction of projects, this water body may again serve a variety of other water systems as those mentioned above.

2.5. Relations Between Urban and Rural Systems

As indicated previously, the purposes of the two systems are fixed and different. In the urban system, water is a necessary resources, providing for both survival and continuous life. In the second one, it is either a resource of prosperity and development in certain districts, or an "enemy" that must be confronted in order to guarantee further security and public health.

Despite the fact that the use and purposes of these two systems are different, there are some similarities between them. First of all is the origin. In both systems, water is taken from nature either directly or indirectly, coming from rain or snow. This water falling on the earth's surface, flows on or under it, forming streams, rivers, lakes, or underground waters. Water from the above sources can be generally utilized for urban or rural water systems. The only difference is that when this water is to be used in a water supply system, it should often undergo certain physical, chemical and biological treatments in order to meet sanitary and health requirements and be finally used by man.

Another common point may be that of water withdrawal. A project of drawing water can serve both systems and purposes, as long as geographical and topographical features contribute to this. In cases of projects concerning high cost construction, such as dams, economic reasons make necessary the multi-objective use of a project, such as water supply, irrigation, flood control, power production, etc. If, however, it is necessary to consider purposes by order of priority, the use of water for supply would be given preference since it is indispensable for the very human existence, while all other purposes of water usage concern prosperity, economic development and man's safety.

This distinction is particularly relevant for legal and sociological analysis. Water transfers and competing and conflicting demands present us often with serious socio-demographic problems and complicated disputes. Solutions to such problems require a skillful balancing of technical recommendations, economic viability, and the answering of larger questions of social policy. In addition, this problem becomes even more complicated given the tremendous increases in water requirements for the entire mankind. Where physical resources are beyond the national boundaries of various

nations, perplexing questions and knotty problems of international law accentuate the requirements of charting an almost virgin scientific territory.

2.6. Problems of Water Sources Planning

The basic prerequisite for considering the planning and design of water systems is the presence of adequate water resources. Many times in certain developing nations water resources are not immediately visible either because of climatic conditions, because of the fact that the country is small in size, because of ground conditions (very permeable grounds), or finally because of other local reasons. One of the first concerns, therefore, is the research on water sources and the possibility of determining their profitable quantity, so that the hydrotechnical data of the problem can be given. The location, distance, profitable quantity, and purpose of use, would be the base of a feasibility study which would also relate social and demographic problems that may arise after the construction of projects. For example, if a water source is found at a considerable distance, while probably the conveyance of water for supply or for power production may be economically advantageous or even necessary, it may be doubtful whether it would also bring an economic profit when used for irrigation, if the land to be irrigated is far away or when the water level must be elevated by mechanical means.

After the search and determination of water sources, further planning should be based on an hierarchy of priorities according to the purpose of water uses and the economic profit that will arise after the construction of projects in relation to expenses and probable future exploitation. This basic policy is sometimes altered in certain countries, due to demographic or political influences. In such cases, a more expensive solution may be chosen in order to support production and raise the standard of living of a region even though cost/benefit considerations may point out to alternative plans. This conventionally unsound system is sometimes followed by developing countries, for example, when emigration problems need to be faced, either in the form of out-migration from poor rural regions or as emigration abroad to wealthier countries. Efficiency criteria for project design should not fail to consider that emigration attracts young and strong hands, leaving behind old men, women and children, thus upsetting population composition with long-range consequences for the demographic future of a country.

In the past, Greece had to confront such problems when faced with a vast emigration current, and rural exodus from poor agricultural regions towards more rich and developed countries, such as the United States, Canada, Australia, Germany, Belgium, etc. In order to stem the strong currents of emigration, which in the course of ten years reached 1/10 of the total Greek population, the Government began the construction of extended irrigation projects aimed at retaining rural populations in the dispersed localities of the country. The result of this measure was an improvement of the quality and quantity of cultivation, resulting to a return of many emigrants who, on the one hand were happy to return to the sunny countryside of their birth (with an improved standard of living obtained abroad). On the other hand, such a policy made possible the retention in the countryside of many other potential migrants.

In this respect, then, the contribution of economists and social scientists to integrated resource planning and development is essential to planning technologists. One should not forget that despite heavy commitments to industrialization by developing countries, one must not fail to take into account that the economic development of a nation should correct regional imbalances and be in harmony with the customs and traditions of the people. It is not possible to change immediately people having long-established agricultural values and traditions, to a heavy industrial community, since this may eventually lead to the failure of the development program or to serious lack of skilled personnel. In this case it would be necessary to import foreign hands, a solution which is extremely expensive and which contributes to a reversal of the economic base of developing countries.

Many countries with directed economies have attempted to impose such rapid growth programs, but results so far have been more or less unsatisfactory due to a pervasive lack of skilled personnel and to the reaction of people. Even within the presumably Greek agricultural sector, a number of major difficultues were met due to local customs, special traditions and values, when we changed the poor and traditional dry farming to an intensive irrigated one with a variety of fruits and plants. Indeed, an area producing wheat for years is difficult to be changed into an irrigated cotton or fruit producing one because of the farmers' attitudes and value system.

For this reason the development of an agricultural country should be based not only on the increase of production through irrigation, but also on the parallel growth of industries related to local production, such as fruit juices, tomato or fruit cannery or other similar supporting agricultural industries. Of course, there are particular cases due to local circumstances or to the existence of certain raw materials in the country that are favorable for the installation of other industries. This is the case in Greece, where development policies tend to favor shipyards and light indus ries in the urban centers and, thus, redirect resource commitments.

3. MANAGEMENT AND ADMINISTRATION OF WATER RESOURCES IN GREECE

3.1. History

As a developing nation, Greece has begun about 20 years ago to apply a fast growth program which has resulted to a raise of the annual per capita national income from $450 to $2,000. This transformation must be seen in the light of an historical experience where the country, after a series of wars, had been brought to ruins, lost 1/10 of its population, and the virtual destruction of most of its economy.

This program of economic growth was based on general support and development projects. One of the most important parts of this program has been the construction of reclamation or beneficial works. These works were aimed towards an improvement of the agricultural income and

the raising of the standard of living of the agricultural population who have been harassed, abandoned, or ignored for many years. The basis of these works has been the planning, design, and construction of a series of irrigation works that covered a total area of 562,000 hectares.

Perhaps this number may not be impressive for some of you who live in much larger countries, but you must compare this figure against the ratio between irrigated and not irrigated land. Our country, covering an area of 134,000 sq. km., is in its greatest part mountains, producing heroes and enlightened people, but being at the same time, until a few years ago, poor in resources and income. For this reason, within the Greek capabilities and natural constraints, we tried to take advantage of whatever available water resources through planning and construction of productive works of irrigation and power in order to improve the national income, the prosperity and welfare of our people.

3.2. Water Potential

Greece, being a country of the Mediterranean type and being also a peninsula, lacks large and continuously flowing rivers. Although the rain level is quite high, Greece has a limited water potential. In northern Greece, rivers come from neighbouring coutries where most of their watersheds exist (Axios, Nestor, Strymon, Ardas and Evros rivers). Therefore, the potential of these rivers depends on the technological policies and water developments in these countries. The rainfall, being the consequences of the mediterranean climate, is seasonal, lacking almost completely during the summer, a period covering about 100-120 days. This intense summer dryness, in conjunction with the intense sunshine and radiation, creates for Greece an exceptionally ideal climate for tourism and recreation for the rest of Europe. On the other hand, it constitutes an unfavorable factor for the development of agriculture and animal husbandry. This problem becomes more difficult due to the particular geographical and topographical conditions. Half of the country (western and northern) has double the rain level than the other half (eastern and southern). For this reason the construction of irrigation works is limited to the relatively flat plains of the country.

Both for general water supplies and for irrigation, the winter water potential may be used in our country in a beneficial way, through construction of dams on the principal rivers. These projects collect winter water for profitable utilization for supply and irrigation purposes in coordination with power production. For the latter purpose, due to the limited quantities of water, hydroelectric works are used only to face power consumption in times of peak-demand, while the main energy use is based on steam generated power plants. Owing to the fact that mountain basins are located in neighbouring countries, it is impossible for us, from the geographical point of view, to construct dams on the rivers of northern Greece; therefore, we rely on the actual small quantity of water rendered by the rivers in summer. International agreements and contracts between countries in the Balkans, to be discussed below, aim at increasing the capacity of the rivers in the summer, so as to promote the agricultural production of our northern provinces. Likewise, in a smaller scale, we

contemplate the use of underground waters, the volume of which is relatively small due to limited snowfall. This type of water supplies smaller towns and villages and permits irrigation of certain areas lying nearer to the underground sources.

3.3. Development Problems of Water Resources in Greece

Fast technological progress during the last years provides renewed possibilities for carrying out hydraulic works of enormous extent and of considerable capacity when compared to the land surface of Greece. The problem of planning profitable usage of water resources, however, is interwoven with a great deal of problems related not only to water matters, but also to questions of developing other natural resources too, such as soil, agriculture, etc.

In order to achieve the maximum contribution of hydraulic works in the development of water potential, it is necessary to face them on the basis of certain fundamental concepts, criteria and objectives. If this is done successfully, it has good effects on the administration, management and national utilization of water within the scope of general development on a regional or national scale.

The evolution of basic concepts in hydraulic works which starts with projects of simple or multiple water use and ends with the meeting of other works as basic units for the foundation of complex plans or programs for regional development, directly affects the shape and lay-out of separate works as well as the order of priority for their construction. The basic prerequisites for the planning and construction of water works are the following:

1) Storage of surplus water during winter.

2) Mass conveyance of water from areas with available surplus water to those lacking it.

The contribution and active role of the central government are necessary both from the geographical point of view and scope, when aiming at a broader solution of water resources problems. A broad governmental water policy may solve the problems of the country's water resources, since they are also interrelated to a more general economic and demographic State policy. The Greek State studies, plans, enforces and develops the projects through its appropriate Ministries:

-- of Public Works, for the planning, design and construction of the works.

-- of Agriculture, for their agricultural development, administration, and exploitation, and

-- of Industry, for power production by means of waterfalls.

Most of the expenses for public works included in the National Budget concern the above purposes, basically transportation (roads-harbors) and development of water resources (water supply and mainly irrigation). Under present circumstances this figure represents 1/6 of the country's budget. Thus, we hope and, in part we have achieved the necessary increase of our National Revenue, so that eventually we can approach the income of most advanced European countries. Such figures may also permit larger investments in resource exploitation.

3.4. Characteristics of Urban Water Systems: The Case of Greater Athens

The city of Athens has been lacking adequate water from ancient times. The healthy but dry climate of Attica does not permit the formation of abundant natural water resources. The history of its water supply goes as far back as the mythological era, beginning with the legend of the conflict between Minerva (Athena) and Nepture (Poseidon) in giving a name to the city.

I do not wish to delve into the long historical background, although this would be a pleasurable excursion thanks to the poetic and fanciful imagination of our ancestors. Reality, however, has been hard for the city of Athens as regards its water supply. Only in the year 140 B.C. did the Roman Emperor, Hadrian, furnish the city with abundant water by constructing the famous Hadrian Aqueduct. In my opinion, this aqueduct can be characterized as the technological wonder of the centuries, since it is an underground suction system conveying water through a 25 kilometer underground tunnel. I will not deal with historical and technical details, but this aqueduct, although repeatedly destroyed and then rebuilt, has served the city of Athens until 1930.

The city of Athens became, in 1833, the capital of the small regenerated Greek State. It had a population of 12,706 which in a period of 140 years grew to more than 2,500,000 inhabitants in an area of 240 sq. km., consisting of the Metropolitan area of Athens, Piraeus and the surrounding suburbs. In 1922, when refugees from Asia Minor came in great numbers to Athens, the capital expanded quite rapidly. A serious demand for water arose, since the inhabitants' needs could not be served with the existing supplies. In 1926, the State entered into an agreement with the American Company "Ulen and Co." and built a dam in the northern part of Athens, the Marathon Dam, which is unique for its marble facing. This dam is 54 meters high and the capacity of the lake is 42,000,000 cu. meters. Through a 23,400 m. tunnel and through a series of mains, the Greek government managed to meet the water supply problem. In 1953, the constant increase of consumption (which in 1932 was 11,400,000 cu. m. and in 1955 reached 37,000,000 cu. m.) forced the government to augment the Athens' supply with water from Iliki Lake, lying near the ancient Lake of Copais, and thus solve the water supply problem of the capital, hopefully, for another long period of time.

In 1962, however, new water resources were needed in order to face the demands of continuous increase of population, the rapid development of industry, and the expansion of tourism. In 1974, the annual consumption in Greater Athens reached 174,000,000 cu. m. Today it is estimated to about 190,000,000 cu. m. Subsequent to many researches and comparative solutions,

a study was drawn for the conveyance of the Mornos river waters, through 23 m.m./sec open aquiducts from water-rich Western Greece. These works include the construction of an earthen dam on Mornos river, one of the biggest, in terms of volume, in Europe. It will be 126 m. high, with a volume of 15,000,000 cu. m. and a reservoir total capacity of 640,000,000 cu. m. with an annual output that may reach up to 600,000,000 cu.m. From there, through an aqueduct covering 192 km. and consisting of a tunnel 52 km. long, siphons and water-bridges of 15 km. and an open channel 126 km. long made of reinforced concrete. Athens will be supplied at an elevation of 1,328 m. This entire aqueduct system, including collection, conveyance and treatment of water, is estimated to cost $300,000,000 in current prices.

The construction of this project began through stages in 1968 and will be completed by 1978. By that time, abundant supply will be available not only to the metropolitan area but it will be possible to extend the water supply network to the entire area of Attica, which covers 856.4 sq. km. This area includes a number of smaller towns, villages, highland and seashore tourist installations, industries of every type, and a great number of country homes.

3.5. Water Distribution in Urban Networks

Water was conveyed to the city by means of aqueducts and mains; however, the distribution of water required the construction of a dense pipe network of various diameters from 80 to 1,300 m.m. throughout all the city streets, in order to supply all buildings.

From a general point of view the water distribution problem appears difficult and complicated, since it is influenced by many factors, not only technical and economic ones, but by such broader considerations as demographic, industrial, tourist policy, sprawl of the city and increases in height, legal and social status in conjunction with the rise of the residents' living level, price of land, political structure, city expansion (commercial and administration centers, big hotels and densely populated urban districts), as well as such meteorological factors as droughts, during which considerable part of the water supply is used for watering gardens and public parks.

The water distribution system in a city is based on the demand principle. Water should be available at any time to meet the requirements of the consumer, whether this refers to a family, a hotel unit, a public building, a factory, or a public park. The different consumption coefficients in relation to desired outputs and pressure of water in the pipe system, constitute an extremely difficult parameters, determined on the basis of certain accepted principles according to which the most unfavorable cases are taken into consideration or better serving the consumers' requirements.

Given the fact that water pressure depends on level differences at various sites of the city and that it cannot exceed the definite resistance limits of the piping of the interior hydraulic installations of

buildings, water distribution in a city of irregular topography and relief is achieved by creating appropriate zones at different elevation points. This matter complicates further the problem because certain districts may be well supplied, while others in higher points or upper floor of tall buildings are deprived of water. This happens in our country primarily during summer months, at peak demand hours, i.e., 17.00 to 21.00 p.m. and especially on Saturdays. All these particular conditions become even harder in cities with warm and dry climates and should be taken into consideration when designing water networks, because otherwise we would face the justifiable complaints of consumers who do not have only obligations but rights for good service as well.

In the case of Athens-Piraeus and environs, the water supply distribution system covers an area of 240 sq. kms. and consists of 27 pumping stations, 64 reservoirs of 435,000 cu. m. total capacity, which are used to impound and store water to equalize rate of flow and pressure on the distribution system. The distribution system includes 4,600 kilometers of piping, 41,000 valves, 850 hydrants, and 848,000 water meters. Because of the differences in surface elevations of more than 410 meters, the distribution is divided in 58 zones of 30 meters elevation difference each. The pressure is maintained between two to six atmospheres.

3.6. Irrigation Systems' Development

The problems in irrigation systems manifest themselves in a different fashion, because water requirements are usually seasonal. Particularly in the Mediterranean area water demand takes place during summer between May and September, of which July and August are of peak demand.

The role of the agricultural economy in Greece is of primary importance both for the direct servicing and life improvement of agricultural population and for its influence on other basic branches of general economy. Agricultural production occupies 45% of the active population of the country and contributes approximately 20% to the national income. At the same time, exportation of agricultural products represents approximately 54% of the total foreign currency flowing in and, therefore, it is of particular importance for the balance of payments. For this reason and because the balance of payments constitutes one of the main restrictive factors for the economic development of the country, particular attention has been paid to the economic growth of agriculture by drawing-up 5-year development programs.

Out of a total area of 134,000 sq. km., 38,000 sq. km. or 3,800,000 hectares are actually cultivated. An eventual dramatic extension of this is quite limited, since the present exploitable territory includes all flat and semi-mountainous areas that can be possibly cultivated. However, the percentage of cultivated land tends to be somehow less in recent years, because inhabitants of poor mountainous and semi-mountainous areas desert the areas as they search for our other occupations, especially in the urban centers of the country. Therefore, in order to face the problem of extending irrigation, emphasis should be placed on actively promoting cultivation in the flat areas, where potentially arable areas can be easier watered.

These lands cover 800,000 hectares, approximately 21% of the arable land. The increase can reach up to 1,600,000 hectares, or 42% of the total area which can be irrigated on the basis of the country's water potential. Large-scale, systematic, and efficient irrigation will permit, among other things, the application of a correct policy of crop-planning and a turn of agriculture to more choice crops which may yield a higher income and an easier absorption of products in the local and foreign markets. Actually, our country's problem consists mainly of livestock development, a considerable percentage of which is being imported from abroad. Thus, valuable foreign currency, representing 14% of our imports, is spent for this reason. Meat, dairy and other livestock products could be easily procured in adequate quantities, once irrigation is secured.

For the above reasons and for additional financial, social and demographic reasons, the promotion of irrigation works in order to secure a systematic and scientific watering system of larger areas constitutes a national necessity. As a consequence Greece has begun, as of 1952, the application of a development program for irrigation networks on a large scale, through amendments in the appropriate legislation and through the design and construction of major projects.

Before 1950, irrigated areas amounted to 140,000 hectares, representing old and primitive irrigation systems, based mainly on local or private initiative. As of 1952 systematic development began so that by 1975 the original area has been increased by 600,000 hectares with its total now reaching 800,000 hectares. Of course, these irrigation systems were designed and constructed on the basis of evolving scientific methods. Thus, today there is an increased proportion of sprinkler irrigation, affording a more complete and economic use of water and efficient utilization of the farmer's time. Through this method, which is the later achievement of irrigation science, 140,000 hectares are irrigated or will be served by irrigation networks currently under construction. It is expected that sprinkler irrigation will also prevail on the rest of the 800,000 hectares, since its construction is not expensive and it offers the advantages of considerable economy in the consumption of valuable water, easy design of irrigation networks in areas which are not completely flat or easily permeable, and significant time saving for the farmer. Moreover, it permits the development of a large variety of crops.

3.7. International Dependencies

As already mentioned, the country's northern provinces are crossed by rivers with the watersheds, however, situated in neighboring territories. More specifically, the Axios river comes from Southern Yugoslavia where 92% of its watershed is situated, while only 8% lies in Greece. The important point is that the 92% is in mountainous or semi-mountainous areas and flat only to a limited extent while the 8% of the Greek territory, forming the river's outfall, criss-crosses mainly fertile and flat land permitting the development of extensive irrigation.

Considering that our relations with the friendly neighbor country are excellent and long common struggles for freedom form the basis of friendship

and prosperity between the two nations, the problem of irrigation water has not constituted a cause for strained relations; on the contrary, it has contributed to their tightening. To this end a joint committee of equally privileged members has been established through an International Convention, alternatively meeting in the capitals of the two countries. This Committee studies and proposes to the Governments correct solutions to all emerging problems.

Three years ago it was decided to establish a common equally-privileged board for the study and implementation of a joint "bonifica intergrale" plan for the entire watershed. This was a successful solution which has had also the moral and financial support of the United Nations. We think that the realization of such a project will be the most economic solution of the irrigation problem, as well as a poignant example of an international legal, economic, national and technical cooperation of two neighboring countries and a manifestation of the mutual benefits to be derived from such a joint enterprise. To this day history has to present many examples of a country's success to the detriment and misfortune of the neighboring country. Unfortunately, there are very few cases of simultaneous success of two neighboring people through mutual help and solidarity. In this respect, we hope and wish that our Yugoslavian neighbors and our country will be an example for imitation.

The rivers Strymon, Nestos, Ardas and Evros come from the Bulgarian territory. Subsequent to a series of discussions and contacts a committee was formed of legal and primarily technical experts from the two countries with opinions, proposals and studies exchanged for facing common problems. With regard to the rivers Strymon and Nestos, matters are at the stage of exchanging views and data. An international agreement has been completed for the supply of irrigation water. Thus, both countries can be served by the Ardas river, whose entire mountainous basin lies in Bulgaria (which uses the water for power production) while the flat country basin in situated in Greece (where water is utilized for irrigation). This agreement, signed in 1965 continues to be in force with no particular obstacles. On the other hand, for the Evros river, which comes from Bulgaria and constitutes the boundary between Greece and Bulgaria on a 17 km. stretch, an agreement was signed in 1968 for the design and construction of common flood controls on the entire length of the border. This agreement was fully complied with and the works, carried out in common, are an example of good and successful cooperation between two countries.

Thus, we have proved in practice that collaboration in peace and good faith can achieve much more than enmity and disputes. I consider myself happy because as Chief of the Greek Committee, I have contributed not only to the construction of a serviceable project but I have proved also that good faith and successful cooperation can reach results which diplomats may not think of. I should recognize, from this seat, that I encountered good faith, sincerity, mutual esteem and trust on the part of out Bulgarian colleagues. Moreover, this was the basis for our eventual success.

At the same time, Evros river forms, for many kilometers, the boundary between Greece and Turkey. Flood control measures along the river have been decided by an international agreement. Subsequent to the international

agreement of 1954, the design of the specific works was assigned to the American Company HARZA. The completion of this project took place between the years 1958 to 1964, on both the sides of the river. The common success of this project did give one more example of good understanding between two nations. This work will be completed in future, when irrigation works on both sides will also be constructed. At this point, I must also praise the part played by our friends the lawyers who helped us on the basis of the rules of international law, in formulating the relative decrees which were passed by the parliaments of the two countries and formed the basis for the series of agreements regarding design and construction of the projects.

4. OPERATION AND MAINTENANCE OF WATER SUPPLY NETWORKS

4.1. The Business of Supplying Water

The water supply of a city constitutes a common utility enterprise, which either as a public utility, as an autonomous organization, or as a corporation forms a financially independent enterprise, usually protected by special legislation and enjoying particular privileges granted by the State. The design, construction and maintenance of the water supply works as well as their operation are justified both from a technical and from an economic point of view. The consumers themselves are the shareholders of this company and its success depends on the very consumption of water and the successful operation and maintenance of the network. With established water rates, deficits and expansion expenses are covered by them through consumption. In the case of corporations, it is possible, and it is usually so done, that a profit be distributed to the shareholders.

The enterprise's success is based on the improvement of the general standard of living as well as the raising of the public's awareness of water resources matters. Therefore, the provision of abundant, healthy and cheap water is necessary as well as appropriate public relations, the issuing of illustrated informative leaflets, the drawing-up of a rational and uniform accounting system, and the aesthetic appearance of buildings, gardens, fountains, etc., of the entire water supply enterprise. The proper persons for the design, construction and administration of this enterprise are specially qualified professional engineers, assisted by a staff of sub-engineers, economic and management employees, and legal advisers. In my opinion, a qualified engineer is the most competent person to cope with the stages and facets of a water enterprise. The engineer guarantees the faultless construction and operation of the water supply works, throughout all stages of research, designs and construction combining technical and financial points of view. The same approach applies also for the maintenance, exploitation and extension of the water network.

Apart from purely technical duties and functions, other activities must also be performed for the operation of the enterprise, including relations with consumers; policies to meet unexpected events such as fires, floods, hurricanes, earthquakes, social disorders, strikes, sabotage, frost and prolonged drought; broader economic policies of the enterprise;

special protective legislation; implementation of state regulations; measurement of consumed water; and, finally, the provision of security measures for the water works.

The water supply enterprises, whether public, municipal, or private always come under the laws and regulations concerning public security due to their nature and scope. State control is exercised on the basis of certain contractual regulations concerning protection and common security matters, water and supply sources in general, matters pertaining to public health, as well as with regard to standards and criteria of water quantity and quality. Other similar concerns affecting water supply administration include city protection from fires, irrigation efforts, public and private industrial areas, etc.

4.2. Legal Rights and Obligations

Water for supply is legally recognized as a public necessity and, as such, it is secured through expropriation of private property in favor of public benefit. The sale of water, however, does not constitute a state privilege. Anyone can supply water to a settlement, subject to a relative agreement and privided that state regulations are complied with from a technical, economic and sanitary point of view. For this reason, any negligence or carelessness of the enterprise as to matters of satisfactory water supply or inadequate serving of fire-fighting brigades is not permissable.

The enterprise has the right to establish rules and regulations through appropriate legal channels. These rules are approved by the State, which then provides the company with special privileges. Such privileges include, among others, the right to interrupt water to non-cooperating customers, to those making bad use of water, or those whose actions may entail the potential danger of water pollution; the right to collect, in advance, expenses for the installation of water mains in properties applying for water; the right of classifying customers by categories corresponding to the quantity of water consumed by them; special provisions regarding procedures for the sale of water by extending the water network to adjacent areas; the collection of additional charges in certain cases (such as e.g., frontage fees); and collection of an advance guarantee for securing eventual payment of water consumed.

On the basis of these regulations, special police privileges are granted to the enterprise's personnel for the supervision of the network and the fulfillment of contractual provisions, such as entering homes for inspection, meter reading during proper hours, filing charges against those stealing appurtenances or polluting water, etc.

4.3. Expropriation Legislation

The current Greek legislation concerning the use of water is principally based on the existing principles of the Constitution and, more specifically, on the article "concerning property and public utility works," which reads as follows:

> "No one is deprived of his property, except for duly proved public benefit, in those instances and according to procedures that the Law prescribes, with full indemnity being always previously paid."

Indemnity is always fixed by regular courts. In case of emergency, it can be also provisionally determined through courts, following hearing or invitation of the person concerned, who, according to the judge's opinion, may be obligated to furnish a guarantee as stipulated by the law. Before payment of the final or provisional indemnity, all property rights are strictly maintained, with occupation not being permitted. Specific laws govern matters concerning property and disposal of mines, archaeological treasures, minerals, surface and underground waters. Likewise, laws govern matters concerning property and vivarium exploitation and administration of lagoons and large lakes. Special provisions rule requisitions for the needs of armed forces in case of war or mobilization or in order to meet an immediate social need which may possibly endanger public order or health.

With regard to water legislation, the provisions of the Roman Law, supplemented by the Civil Code, are in force in Greece. Roman law accepts three kinds of waters: Common, public, and private. All three are included in the Pandects, the instructions of Markianos, Justinian, and the Code.

Continually flowing water (aqua profluens) in the form of air, sea and the seashore is an element which, according to natural law, comes under nobody's possession and hence it cannot become private property. In this state, water is classified among the so-called "universal things," belonging to the human race at large. But, wherever water flows under land occupied, then it ceases to be a simple element and forms, together with its bed, an inseparable entity, and the same laws govern it. This entire complex can become either public or private property. If water flows in a natural waterway, which is under nobody's authority it is common resource according to natural law. But, if it is conveyed through a technical project for a certain use (irrigation, supply, power production) it belongs to the party that carried out the project or which profits from the water supply. Stagnating waters can come under man's authority and can constitute part of his property, if they are part of wells or in reservoirs. Wherever stagnant water occupies an extended area, such as the sea and the lakes, and since it cannot be separated to smaller parts owing to its nature, it is not eligible to absolute authority and it comes under everybody's use.

According to Roman Law, the most important constant water flows, necessary for serving the people, are public, while all others are necessary for such use can be private or free. In order to provide, however, more respect to the public water use, especially in the case of supplying a city with drinking water, certain water flows were protected by the divine law as sacred things, under the protection of the Gods and any offense against them was considered a sacrilege. Again, it is clearly stated that waters of public use are beyond any transaction, consequently beyond private property or usufruct or any other substantial right.

More specifically the Greek Civil Code mentions springs and public fountains and specifies that if they deviate from their original destination and come illegally into private use, they should be returned to State or City possession. Aqueducts supplying water for the inhabitants' needs, as well as the sources that feed the aqueducts, are also included among state lands. For this reason these lands are exempt from expropriation, and, therefore, are imprescriptible, i.e., a private person cannot obtain a particular right for possession or use, even if a regular or irregular usufruct has taken place, and if they are not used by the public, they are still not lost. Similarly, water flowing from a municipal fountain is exempt from expropriation and imprescriptible and, therefore, no possession or easement on it can be obtained. If, however, this water is not sufficient to cover the needs of the members of the community, this reason does not afford any right to those who first made use of it as of years ago.

The right for public use granted by the law is public and belongs to all citizens. All people may use water freely, according to the way prescribed with citizens having a personal and temporary right and not a separate, individual or private one. However, exercising this right should not impede others to make the same use in the same manner.

4.4. Financing -- Servicing of Capital

Water supply is a financially independent enterprise which, however, requires considerable funds for carrying out necessary works. The expense required, arises from the addition of expenses of any nature for the design, carrying out, and operation of the enterprise. They are broken down into expenses for design and construction projects; expenses for operation, exploitation and maintenance; and, expenses emerging from a probable underestimation or risky evaluation of economic conditions.

The total of capitalized expenses should include, with wide margins, all expenses for construction, operation, and renovation of the network and can be expressed by the formula:

$$K = \Delta + \frac{\delta}{\alpha} + \delta \frac{I}{(I+\alpha)} \nu - I$$

where K = capitalized expense
Δ = original expense
δ = annual operational expense
α = annual proportion of profit to share or servicing of the original capital in general
ν = number of years for amortizing expenses or contractual duration of enterprise

The profit of the enterprise will result from collections in general, less expenses of every nature, taxes, depreciations, reserves to meet extra needs, as well as the eventual decline in value in general.

Money to finance the project may be formed from various sources. In Greece, the usual form is loans or investments on the part of wealthy

organizations of public law, with or without state guarantee, such as Mortgages and Loans' Fund, Postal Savings Fund, foreign sources, etc. Another source of financing is the direct taxation of the beneficiaries or the establishment of a special tax on income or on the value of buildings supplied.

Likewise, the issue of bonds, with or without state or municipal guarantee constitutes an important and usual method for assembling funds. Moreover, selling in advance, collections and revenues by pledging the works and management may also permit the assembling of funds. Whatever method is to be used, funds will always be controlled both by the shareholders and the supervising authority, which in Greece is the State through the Ministries of Finance and Public Works. Experience has proved that, generally, the public trusts water supply enterprises, since these are almost always profitable, due to the necessity of using a natural resource such as water and its ever-increasing demand by consumers and, especially by expanding industries.

The revenues from the sale of water by municipal or state water supply enterprises leave sometimes considerable profit margins, which can possibly be used to finance the construction of other municipal or semi-governmental projects, having no relation with the water supply works of large cities. The period for amortizing the capital of a water supply enterprise is usually fixed in advance. This period does not usually exceed 20-25 years, since it is considered fair for one generation to sustain the financial encumbrance of works and not to allot it, even partially, to the next generation, which in due time will be eligible for carrying out other projects due to other emerging needs in the future.

With the continuous expansion of the city, the financing of network expansion can become a serious problem. Often, the extension exceeds even the original area of the city. As an example, the original contract signed in 1925 by the Greek Water Company contemplated the installation of a network covering the master plan approved at that time for the capital area of a surface of 27 sq. km.. Today the network has been extended on the actual 220 sq. km. surface of the city, with a number of city districts in Greater Athens supplied as yet. It is clear that extensions on such a scale cannot be covered financially from the original capital or its servicing. It is necessary to proceed with new financing, even in stages, with new enforcement of taxes on new customers, or, as is the case in Athens, have customers participate in expenses for network extensions.

4.5. Consumer Bills -- Rates

Between the consumers, as clients, and the Enterprise a formal contract is signed for the procurement of water, the installation of water meters, and the manner of payment of bills which are issued in the name of the contracting consumer. As a rule the bill gives the address and name of the consumer, his status (tenant or owner), his profession, the number of the water meter, the consumption period covered, new or old installation, and the amount of guarantee deposited.

The calculation of the bill will be based on the water meter readings, the unit price of water consumed on the basis of the category the consumer belongs to, and on any other financial obligations towards the Enterprise. Sometimes a minimum (standard) amount of consumption is charged to meet the general expenditures of the Enterprise. Bills are usually issued monthly or quarterly. If water meters are installed in houses, gardens, yards, etc., specific mention is made in the contract for the entrace access of competent employees at reasonable hours in order to take readings.

Whenever the water meter is found to be forged through deceit or fraud on the part of the consumer, the enterprise, apart from the penal action that may file against the consumer, can charge by estimation the quantity of water consumption or even impose a fine. If the water meter indicates false readings it can be removed, according to the judgement of the enterprise or upon the consumer's request, and be tested and checked at the workshop of the enterprise. The error acknowledged to the detriment of the consumer should not exceed 2%.

The cost of water varies from place to place, according to the nature of works, particularly in the case of external aqueducts, the existence of pumping stations, purification plants, etc. The rates upon which water consumption is calculated are based on various prerequisites. They depend on the cost of water fixed by the amortization of the original capital, by the expense for the maintenance and operation of the network, by fire-fighting expenses, by repairs and work implementation, and by all other general management expenses. In other words, payment of the annuity of original capital, capitalization of collections for future or similar works, by remuneration expenses, etc., by the proportionate expenses for water, granted fees, as well as by a small margin calculated by the depreciation of works or of the currency.

The preparation of the client bill is based mainly on the unit price, i.e., the cubic meter of water consumed. This quantity, if a water meter is not used, is calculated on the volume or the surface of the building, or the number of rooms or of persons permanently residing in the building or the number and diameter of faucets of the internal plumbing installations, or even a lump sum is calculated for each connection. Finally, the calculation of the bill depends on local conditions and practices. The most accurate and widely used method is through water meters, on the basis of which the water consumption and the fair payment of water consumed is fixed. It should not be forgotten, however, that the loss of water from the city network should also be calculated in that price.

As a rule these rates are not uniform for the entire consumption. A standard amount even small is added to the bill of each consumer irrespective ofconsumption, as a basic surcharge for the network maintenance, irrespective of the original amount, which is paid by the consumer for the supply of water to each building constructed. Rent for the water meter which is property of enterprise, may be also collected. Finally, general or local taxes, duties or contributions for the servicing of public utility needs may be added to the bills.

Usually the rates are not proportional but gradual, i.e., the unit price is reduced gradually in relation to consumption. Finally, special rates are granted in cases of big consumptions or special customers, such as the fire-fighting service (where water is usually furnished free), public and municipal institutions, irrigation plants for parks and alleys, big factories with considerable consumption, etc. Generally, however, the matter of rate-fixing constitutes a subject for a more general techno-economic policy of the city and, therefore, various local and social factors occasionally intervene. For this reason rates are usually under State control and supervision.

5. OPERATION AND MAINTENANCE OF IRRIGATION NETWORKS

5.1. Cost of Irrigation Water

With regard to irrigation networks the problem is somehow different because the farmers supplied are at the same time both consumers and directly interested parties. In view of the fact that the amount of water required for irrigation is usually much larger than that for domestic water supplies, and because the cost of irrigation rates will burden production with ramifications on the local and export agricultural market, the unit price of irrigation water should be far smaller than that of domestic water supply. In such a case, and as far as Greece is concerned, the State grants its assistance, by underwriting a large part of the expense for the construction of projects such as the main water supply projects, main and auxiliary channels, draining facilities, pumping stations, buildings, technical works, etc. As a rule farmers pay a small water price corresponding to part of the expense for the construction of smaller channels to irrigate their fields, as well as to the expenditures for management and distribution of water. This is reasonable and it secures assistance to the rural as against the urban population. At the same time, the State through increased production thanks to irrigation and the development of the general national economy indirectly benefits through the collection of various revenues on the products.

In principle when beginning the operation of a newly irrigated area the State legislatively delays to collect the farmers' limited obligations and thus indirectly subsidizes them providing motivation, incentives for the use of irrigation, and time for obtaining experience in crops, which will be cultivated in the irrigated areas.

5.2. Administration and Management Systems

As far as management and administration of irrigation works are concerned, the Greek legislation provides for the construction of works by the Ministry of Public Works, and their delivery to the Ministry of Agriculture, which exercises general supervision on management. Thereafter,

in the area of each large irrigation project it provides for the establishment of General Organizations of Reclamation Works at the provincial level and which have as a goal the general management, planning, operation, and coordination of irrigation enterprises in the area. These organizations are in their majority made up of State employees and by local agricultural officials and constitute the link between Ministries and farmers, applying the ideas and general instructions of the Ministry. Thus, in each province local organizations at the community level are established which manage the irrigation matters of the community and report to the General Organization. In this case the majority in them is made up of local agricultural officials. This system has been in existence for a short time, since it has been established less than ten years ago. Therefore, it is still early to draw conclusions for any success or failure, perhaps also due to the lack of experience on the part of our farmers as to self-administration. Let us not forget that it is difficult for farmers, who had experience for a long time with dry farming only, to rapidly adjust to the requirements for good administration of irrigated lands and to expanded needs of organizational effectiveness.

6. THE POSITION OF SOCIOLOGISTS AND LAWYERS IN RESPECT TO THE USE OF WATER

It is a fact that the technical expert plays the main part in matters of planning, design, construction, and operation of water systems, but his work would be very difficult without the assistance of other scientists. The social scientist should have a principal collaborator since he, more than anyone else, can foresee the significant effects of water on the human community and the long-range consequences of increased water supplies or alternative water uses. Proper and successful use of water resources contribute to the advancement of many social classes through the rise of their standard of living, increases in family and national income, expansion of production, and the further growth of urban constellations. Moreover, through a successful use of water resources housing units, city planning, industry, communication and other facets of social life can be better planned for the collective good.

The lawyer's contribution can be enormous. Despite all the forementioned provisions of the Roman Law, as supplemented in the meantime by other laws, the water lawyer's field is virtually virgin in Greece. Modern rapid technological advances have created many gaps as to the use of water, since the above historical provisions are old and inadequate in legally meeting quite a number of contemporary problems which we, as technical people, dealing with water face everyday. We ask for your full assistance to study from the legal point of view all related water problems which many times lead us to a dead end. Water laws in Greece, as well as in many other countries, need revision and expansion in step with technological requirements and capabilities so as to achieve correct and systematic solutions to the multi-faceted problems of the country. Of course, this task is difficult and complicated, since one has to cope with long-established attitudes growing out of beliefs, practices and traditions of many centuries.

In my opinion, there is a serious gap which the Roman Law does not even in an elementary fashion address in the field of international water law; i.e., the use of water of international rivers and lakes. We will soon have to face squarely this important issue. Already such difficult problems often are either not solved or they are unilaterally met by international agreements, according to political and traditional conditions that exist each time between neighboring nations.

I cannot deal any further in a field outside my specialty or offer advice to legislators of international authority. On the contrary, technical people request the existence of lawyers to solve the complicated problems they face everyday. In conclusion, I hope that this Congress, even if it does not solve, it will at least lay the foundation of a legal plan to face the main problems arising for the use of this divine gift, which is so simply called WATER.

A REPORT ON THE ROLE OF WATER LAW IN RURAL WATER SUPPLY SYSTEMS WITH PARTICULAR EMPHASIS ON NIGERIA

by Jibril A. Andu*

1. INTRODUCTION

I would like to express my appreciation for the invitation to prepare a report on the Role of Water Law in Rural Water Supply Systems with particular emphasis on Nigeria and other countries that I may be familiar with in Africa. It is indeed an honor because I am hardly the right person to talk about Water Law to such a well-informed audience remembering that whatever we in the developing countries know about the practice of modern law has been mainly derived from the codified laws of Europe and America with modifications to suit local conditions.

In view of the fact that there has been no world concensus on the definition of a rural as distinct from an urban water supply, it is necessary to emphasize that this paper would deal mainly with Water Laws generally. For example, in the Western State of Nigeria, large water supply complexes are made to serve both urban and rural communities and their management is governed by the same laws. Moreover, in Nigeria, there are no distinct water laws for rural and urban water supplies. Annex I, which shows the locations of water supply systems in various parts of the Western State of Nigeria, makes this quite clear. Although I am familiar with a few former British colonies in Africa, I am not conversant with their water laws. It may be presumed, however, that these countries also inherited the British legal system to a large extent.

Nigeria, like any developing country, is beginning to find her feet in social, economic and industrial developments. The country is blessed with abundant water resources and what is now required is to harness men, materials and money to accelerate the development of these resources.

Although there are in existence laws for the administration of water supplies constructed by the various State Governments, the Federal Government has recently addressed itself to the problems which may be created by inter-state waters and how to resolve them. To this end, a Ministry of Water Resources has been established and a law may soon be enacted to deal with inter-state water problems.

The primary requirement of the people of the country is sufficient potable water to satisfy their physiological needs. The country is now graduating from the provision of water for domestic uses to agricultural, industrial and commerical needs. Fortunately, the provision of potable water supplies is firmly in the hands of the Governments of the Federation which regard this as their social responsibility. The administration of water laws, in the absence of private water companies, is therefore less cumbersome. Furthermore, they tend to protect rather than subjugate the rights of citizens which could have been otherwise were water supply in the hands of private entrepreneurs.

The report starts with some geographical background information about Nigeria, the available water resources and an outline of the practice before colonization and the introduction of the Waterworks Law of 1915 by the British. It also examines the changes which have taken place since independence in the development and administration of water supply systems in the country.

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The report also considers the law governing the supply of water to the general public and the intention of the Federal Government to deal with inter-state waters through the recently established Ministry of Water Resources. A suggestion is also made for a water resources law. A small section has been devoted to the effects of water law on the planning and design of water supply systems and some difficulties which are experienced in the administration of this law. Some notes have also been added on inter-state waters of Nigeria and international waterways including a summary of the functions of the Lake Chad Basin Commission and the River Niger Commission.

2. GEOGRAPHICAL BACKGROUND

From a study of Figure 1 (Annex II), the greater part of Nigeria lies within the basin of River Niger which rises from Futa Jalon Hills in Sierra Leone and which, with its tributaries, drains an area of more than 1,295,000 sq.km (500,000 sq. miles). The country lies between the latitudes 4°N and 14°N and its total land area if 925,000 sq.km (375,000 sq. miles). Also, Figures 1 and 2 (Annex II), show the physical features of the country. The mean annual rainfall shown in Figure 5 varies from about 508mm (20") per annum in the arid northern part of the country to about 4,000mm (160") per annum in the Niger Delta. Nearly one third of the total surface of Nigeria is covered by forests because of the high rainfall.

The population of Nigeria in 1963 was approximately 56 million. The result of the 1973 population count is still to be published. However, the distribution of population is shown in Figure 4 and the approximate annual growth rate is stipulated at 2.5%. Most people in Nigeria depend on farming for their livelihood. Although Nigeria has made rapid progress in the field of industrialization, yet she would probably remain a predominantly agricultural country.

3. AVAILABLE WATER RESOURCES

3.1 Surface Water Resources

Nigeria is blessed with abundant surface water resources and a considerable amount of groundwater resources. Most of her water resources are derived from local rainfall. This is supplemented with water from River Niger, some 3,700 km (2,300 miles) long - the longest river in West Africa. There are other rivers like the Benue, Kaduna, Gongola, Katsina-Ala, Ogun, Hadeija, Sokoto, many of which are tributaries of Rivers Niger and Benue, the two main rivers.

3.2 Groundwater Resources

Groundwater resources can be found in various locations in the country. The post-eocene (tertiary) coastal plain sands in the western part of Nigeria which extends about 160 km (100 miles) inland contain sand beds some hundred metres thick and is extremely proous. The lignite series

appears in shallow lenticular beds of shales and clays, and often gives rise to springs when they crop out of the surface. When pierced, water could be obtained in quantities sufficient to provide town water supplies. Boreholes yielding 1,365-1,820 cu.meters (300,000-400,000 gallons) per day have been encountered in this belt. Immediately north of the post-eocene bed is the eocene of tertiary age. The composition of the rock in this area varies considerably. Water percolates to a greater depth in this area and can usually be tapped in deep wells and bores. In the northern part of the country, particularly in the Chad Basin, there is a reasonable quantity of groundwater resources. Covering a considerable portion of the country, however, is the precambrian series. Boreholes sunk in this type of strata have not been generally successful.

3.3 Hydrological Information

We are still a long way from being able to assess the water resources of the country. This is because there has been no integrated plan for the collection of hydrological data for the whole country. Efforts so far made are mainly scattered and are carried out by some of the twelve State Governments and by the Federal Government. In fact, the lack of long term hydrological data is having adverse effects on integrated planning and development of the country's water resources. It was not until recently that the Governments of the country, particularly the Federal Government, began to formualte the basis for proper and efficient administration of the nation's water resources. This would be dealt with fully later.

4. OUTLINE OF WATER LEGISLATION IN NIGERIA

4.1 Customary Water Laws

From pre-historic times man has been aware of the vital importance of water as a necessity of life and as a means of directing the growth and development of his environment. Water and civilization have been closely linked throughout the ages, and as a result various societies have developed their own customary laws on pollution, conservation and distribution of this precious natural resource. Like many other African customary laws, Nigerian customary water laws are neither written nor codified but every community has piece-meal rules and regulations which are legislative in effect with appropriate sanctions to regulate the management of water resources under the following heads:

4.1.1 Ownership

Generally, water was and is still regarded as a communal property. No member of the community can claim the sole ownership of a source of water supply. This is to forestall an individual holding the whole community to ransom. Any attempt to do so is visited with dire consequences. This public ownership is jealously guarded even when the source of supply, a pond for example, is strictly within an individual's land. The public is generally granted the right of way and water drawing rights. The only exception to this rule is where an individual digs a well on his own land

for personal use; in such a case, the community at large has not drawing right as it is regarded as private property.

4.1.2 Water Drawing and Riparian Rights

Every member of the community except those suffering from contagious or chronic diseases has water drawing rights for both domestic and agricultural use.

Settlements are founded near sources of water supply hence there are a number of large concentrations of population in the rain-belt of Nigeria where members of the community do not have to travel long distances to fetch water. Drawing of water from nearby brooks and streams is normally undertaken by younger members and women of the community. When a river and its tributaries flow through different community lands, the riparian owners make laws for the judicious administration of such rivers as regards fishing rights, navigation, pollution and agriculture. Where there are navigable rivers, each riparian owner collects tolls from users in cash or kind.

The diversion of a river by a community from its natural channel to prejudice the other riparian owners' rights could become a source of inter-community wranglings. Hence it is regarded as a hostile act which might even lead to war.

4.1.3. Protection from Pollution

As population concentrates round or near water courses, the water becomes easily polluted. The community therefore deems it absolutely necessary to fence off the surrounding area.

The community also provides a guarde to keep an eye on the sources and those who flout community laws are brought before community leaders or heads to account for their misdeeds. Where individuals or groups are found guilty of violating existing community laws, appropriate sanctions are imposed in form of fines which might be paid in cattle, crops or cash. These fines vary from community to community.

Carcasses of animals become regular sources of water pollution but water attendants remove them and the source thus affected declared out of bounds for a stated period of time to enable the danger of pollution to subside. In the meantime, alternative sources of supply are used.

4.1.4 General Maintenance

The community at large is responsible for clearing and dredging of water sources. Organized community labor force made up of able-bodied young men and women is charged with this responsibility and it performs this duty with selfless enthusiasm.

Water is never sold, not even to strangers because the ownership is believed to be universal. Bridge tolls and levies are only collected when a river forms a boundary between two communities. Each community

collects fees on its own side and the proceeds are handed over to the head of the community who accounts to the council of elders.

4.2 Waterworks Law of 1915

With the advent of the British rule in Nigeria, the construction of pipe-borne water supplies started in the country. These supplies were constructed mainly in urban centers and European settlements. In order to regulate the development and administration of water supplies, the Waterworks Law of 1915 was enacted. It was based on the British Law and was directed primarily at regulating the supply of potable water to consumers and to safeguard the investment on waterworks from acts of vandalism and pollution. This law, together with the subsidiary legislation of 1944, continued to be in operation in all parts of the country because the then Central Government had responsibility for water supplies in the country until the formation of regional governments in 1951.

However, with the creation of Regions, the constitution placed the responsibility for water supplies on the Regional Governments. In 1967, the former four Regional Governments were replaced by twelve State Governments. With this arrangement too, each State Government had responsibility for the development of potable water supplies within its area of jurisdiction.

The Waterworks Law of 1915 vested the custody and administration of all waterworks in Water Authorities and prescribed authorities. For the purpose of this Law, waterworks was defined to mean all reservoirs, dams, weirs, tanks, cisterns, tunnels, filter beds, conduits, aqueducts, mains, pipes, fountains, sluices, valves, pumps, steam engines and all other structures or appliances used or constructed for the storage, conveyance, supply, measurement or regulation of water. The powers that were vested in the Authorities were sufficient in scope to perform the expected functions of constructing and maintaining the waterworks.

The Waterworks Law of 1915 which was left largely untouched in its main features was repealed by the then Western Regional Government in August 1964 and was replaced by a law to provide for the establishment of a Western Nigeria Water Corporation.

5. WATER AGENCIES AND POWERS VESTED IN THEM

5.1 General

Ten out of the twelve State Governments have now set up agencies like the Western Nigeria Water Corporation for the purpose of directing and regulating the development of water supplies in the various States. The Laws establishing these bodies have superseded the Waterworks Law of 1915. Two other State Governments are still operating under the Waterworks Law of 1915 and the subsidiary legislation of 1944. However, the ultimate goal of all State Governments is to establish statutory agencies for the regulation, development and management of water supplies within their areas of jurisdiction.

The powers and duties of the various statutory water supply agencies in the different States of Nigeria, in respect of the supply of water for domestic purposes, are clearly defined in the laws of incorporation of the various agencies. The duties of the various agencies are primarily focused on providing potable water in sufficient quantities to the consumers. To facilitate this primary function, the water supply agencies are vested with adequate powers to conserve, develop and distribute water in their respective States. The more important powers that are vested in the various statutory water agencies are discussed hereinafter.

5.2 Right of Way

The law permits the agency to carry any water pipe through, across or under any street or any place laid out or intended as a street, and after giving reasonable notice in writing to the owner or occupier thereof, into, through or under any lands whatsoever without paying any compensation, but making good any damages done. The law also provides for the entry into any land at any time for the purpose of examining, repairing, or removing any water pipe.

Entry is also permitted at any time between the hours of six o'clock in the morning and six o'clock in the evening, or in cases of emergency at any other time, to enter into or upon any tenement into or upon which any service has been laid or into or upon which water from any waterworks is supplied or flows so as:

(i) to inspect any service and to ascertain whether there is any wastage, leakage, obstruction or damage to any service or meter therein and anything in connection therewith; or

(ii) to ascertain the amount of water taken or used; or

(iii) to disconnect the supply of water to any tenement through or by means of any service, either wholly or in part.

For the purposes of this law, a tenement is defined to mean a land with buildings which is held or occupied as a distinct or separate holding or tenancy or any wharf or pier, but does not include land without buildings.

5.3 Compulsory Acquisition of Land

Whenever there is any hindrance to acquisition of land required for the purposes of any waterworks, including any failure to reach agreement as to the amount to be paid in respect of the acquisition, the statutory agency may make application to the State Government for a declaration that the land is required for the service of the statutory agency.

Upon such declaration being made, the land to which it relates shall be deemed to be land required for a public purpose of the State and action would

be taken by the appropriate authority for the purpose of acquiring the land for the State Government. The land thus acquired would be vested in the statutory water supply agency.

5.4. Preliminary Investigations in Respect of Land Required for Waterworks

Statutory water supply agencies are empowered to acquire land either by agreement with the owners or compulsorily. Whenever it appears that any land in the State is likely to be needed for the purpose of any waterworks, the statutory agency may, by its servants and agents, together with all necessary workmen, enter upon any such land to carry out surveys, subsoil investigations and other acts necessary to ascertain whether the land is suitable for the agency's requirements. The law, however, does not permit entry to any building or upon any enclosed court or garden attached to a dwelling house except with the consent of the owner or occupier, unless at least seven days notice of the intended entry has been given to such occupier.

The law requires the payment of compensation to the owners for all damages arising out of the exercise of the foregoing powers. In the case of dispute as to the amount of any compensation payable, the amount may be determined by the High Court or a Magistrate's Court having jurisdiction in respect of the area where the land is situated.

5.5 Abstraction of Water

The statutory water supply agencies are empowered to abstract water from any lake, river, stream or other natural source forming part of the state waters and do likewise in respect of waters in other States by arrangement with the appropriate authority under and in accordance with the provisions of any law in that behalf. The method of abstraction and the quantity of water taken from any source is left to the discretion of the water supply agency. In this regard, it is the usual practice in Nigeria to acknowledge the riparian rights under customary water laws of the community affected. As the customary water laws of Nigeria regard a source of water as communal property, no great difficulty is encountered in taking over any source of water for the development of a water supply.

5.6 Control of Abstraction

Where it is necessary to take special measures for the conservation of state waters in any area, there is provision in the law to define such an area. Thereafter, no person shall, without obtaining a license from the Minister:

(a) construct any well, borehole, or other work for the purpose of abstracting underground water; or

(b) extend any existing well, borehole, or other work for the purpose of abstracting additional quantities of underground water;

(c) abstract water from any river, dam or lake;

(d) construct any works capable of providing water in excess of 4.55 cu. metres (1,000 gallons) per day.

These provisions, however, do not apply to the construction or extension of any well, borehole or other work by any individual for the purpose of abstracting water solely and to the extent necessary for a supply of water for the domestic purposes of his household.

5.7 Duties of a Water Agency in Relation to Supplying Domestic and Other Water Consumers

The regulations governing the supply of water entitles the people, on an application made for supply of water, to a connection in any part of an area where a water supply is maintained; provided that in the case of a new connection adequate water supply can be made available without detriment to existing supplies.

It is also the responsibility of the water supply agency as far as possible to maintain a continuity of supply. The obligation to provide a continuity of supply of water is not absolute but it is limited to the exercise of all reasonable care and skill to fulfill this obligation.

An agency is, however, empowered to suspend the supply of water for such periods as may be necessary for carrying out inspections, tests or repairs and for the making of new connections. They also have the right to suspend or discontinue any supply where the payment of any water rates, dues or charges is in arrears.

5.8 Water Rates and Charges

The statutory agency has power to levy reasonable rates and charges but should avoid excessive profit.

5.9 Responsibility for Accident or Injury to Workmen

During construction of water supply projects, regulations are enforced to safeguard the interest of the workmen in case of accident or injury. It is normal practice to accept responsibility for damages or compensation payable

at law in respect or in consequence of any accident or injury to any workmen arising from any act or default by the agents or servants of the water supply agency.

On construction works carried out under contract, the conditions of contract are so enforced that the contractor is obliged to insure all workmen in his employment against liability for payment of damages or compensation at law.

5.10 Factory Regulations

It is appropriate to mention that most of the modern waterworks are governed by the Factory Acts. Factory Inspectors are very vigilent on matters affecting safety and comfort of the workers and the public.

6. OFFENCES UNDER THE WATER LAW

6.1 Damage to Waterworks

The law declares it an offense for any person to willfully or negligently damage any waterworks, public fountains, services or meters, or unlawfully draw off, divert, or take water from any waterworks, or from any stream or waters by which any waterworks are supplied.

6.2 Bathing, Washing, Etc.

The law provides that any person who:

a) bathes in any part of any waterworks; or

b) washes, throws or causes to enter therein, any horse, dog, goat, pig, or other animal, or any bird, or any clothes, materials or thing; or

c) wrongfully opens or closes any waterworks appurtenances, shall be guilty of an offense which attracts, on conviction, a fine of forty naira ($60).

6.3 Waste and Altering Service

It is an offense for any person to willfully or negligently misuse or waste or cause or allow to be misused or wasted any water passing into, through, upon or near any tenement from any waterworks.

It is also an offense for any person to alter or cause, or permit to alter, any service without the consent of the statutory water agency.

6.4 Pollution and Foul Accumulation

It is an offense for any person to put or allow to be put, or cause to remain, or to accumulate on any tenement occupied or owned by him or his servants, or fail to remove or to cause to be removed, or to take such steps as may be necessary to prevent, any foul, noxious or injurious matter, or any earth, deposited or excavated material in such manner or place that it may be washed, or be carried into any waterworks or the gathering grounds thereof.

6.5 Penalty for Refusing to Pay Water Rates

Any person who, without lawful justification or excuse, the proof of which shall lie on the person charged, refuses or fails to pay any rate or charge payable by him, shall be guilty of an offense and shall be liable on conviction to a fine of two hundred naira ($300) or to imprisonment of one year. It is also an offense to incite any person to refuse to pay any rate or charge payable by him or to incite or assist any person to misrepresent in any way his rateable capacity or any information material to the assessment of a rating upon any tenements of which he is owner or occupier.

7. INTER-STATE WATERS OF NIGERIA

There is no legislation presently in force governing the basis for agreement on equitable apportionment of inter-state waters. With many rivers and streams crossing State boundaries, it is inevitable that disputes will arise between States. Although such disputes have still not occurred in Nigeria, the Federal Government has taken cognisance of the need to formulate the Water Resources Act. As a first step in this direction, a Federal Ministry of Water Resources has been created. It is hoped that this Ministry would take necessary steps to cause the Water Resources Act to be promulgated.

8. SUGGESTIONS FOR A WATER RESOURCES ACT

8.1 General

The provisions of a Water Resources Act ought to apply to all water resources declared by the Federal Government, i.e., to the sources affecting more than one State. Under the provisions of such an Act, a Water Resources Authority should be established. The functions of the Authority would be exercised by the Federal Commissioner for Water Resources. The

Authority should also be charged with the responsibility for promoting the conservation and proper use of water resources. The Act should provide for the establishment of a Water Resources Committee, whose main function will be to advise the Water Resources Authority on the formulation and execution of water resources conservation policy.

8.2 Declaration and Control of Areas, Sources and Licensing

If a source is declared by the Federal Government to be a source affecting more than one State, the Commissioner should be empowered, with the consent of the Governors of the States affected, to delegate to the Water Resources Authority of each State, control of that part of the course falling within its State to the extent to which he deems it unnecessary for the Federal Government to retain control thereof.

When it appears to the Water Resources Authority, after consultation with the Committee, that measures for the conservation of water in any area or source are necessary in the public interest, it should be empowered, with the consent of the Governor of the State in which the resource passes, to declare it a controlled area. Once a source is declared a controlled area, the provisions of the Act should forbid the construction of any works for the abstraction of water or the discharge of effluent into the waters of such an area without a license.

8.3 Inter-State Disputes

Up till now, matters connected with inter-state waters have been resolved by negotiations conducted on the basis of inter-state cooperation and trust. The Water Resources Act, however, should establish specific procedures for resolving inter-state disputes on water rights. The law should be introduced in the very near future as inter-state disputes may occur as a result of the vast water resources development programes presently being undertaken by the States of Nigeria.

8.4 Water Resources Tribunal

For the purpose of determining disputes, the Water Resources Act should provide for the establishment of a Water Resources Tribunal. Under the provisions of the Act, the Tribunal should be empowered to decide on any appeal or dispute arising from the operation of the Water Resources Act. The decision of the Tribunal on any matter referred to it for adjudication should be binding upon all parties concerned and the Water Resources Authority be empowered to give effect to such decisions.

8.5 Water Resources Officer

A Water Resources Act should vest on a Water Resources Officer wide powers directed at effectively implementing the water conservation and development policy of the Federal Government. Such functions delegated to the Water Resources Officer under the provisions of a Water Resources Act will be an attempt made to centralize the collection and documentation of hydrological data. Until now these functions were carried out by various Federal and State Government functionaries. The main functions of a Water Resources Officer should include the establishment and maintenance of hydrometric and hydroclimatic installations on inter-state waters, the assessment of water resources and water demands and the formulation of proposals for action to be taken in areas where the adjustment of water resources availability to demand is likely to prove difficult.

8.6 Powers of the Water Resources Officer

The powers vested in the Water Resources Officer under the Water Resources Act should permit him or his representatives to enter any land for making investigations in connection with the conservation and proper use of water resources. He should also be empowered, at all reasonable hours, to inspect any hydrological data kept by any person in respect of a declared area or source. Having given written notice to any person having control of works licensed under the Water Resources Act, which in the opinion of the Water Resources Officer constitute a danger to life, health, or property, he should be empowered to cause the works to be modified or demolished and, in the event of non-compliance with such requirements, the Water Resources Officer may cause the works to be modified or demolished and recover the reasonable cost of doing so as a civil debt.

In connection with the provisions of the Water Resources Act, pertaining to the discharge of effluent, the Water Resources Officer or his duly authorized representative should be empowered to enter any land, to ascertain whether there is any contravention of the Water Resources Act.

9. WATER LAW AND THE PLANNING, DESIGN, OPERATION AND MANAGEMENT OF WATER SUPPLY SYSTEMS

In Nigeria generally, there has not been much emphasis on the effect which water laws could have on the planning, design and construction of water supplies. While it is admitted that water laws can contribute tremendously to the effective planning, conservation, development and management of water resources, it is equally true to say that "legal-necessities" such as the prevention of pollution, waste, tampering with water installations could be overcome by judicious planning, design, construction and management of water supply systems. In this context, no one type of water supply system can be ideal for all situations: the topography of the area to be served, the physical, chemical and bacteriological characteristics of the raw water, the social and cultural background of the consumers, all exert a decisive influence.

9.1 Planning and Design Considerations

In present day waterworks planning, design, construction and maintenance, emphasis is mainly placed on the broader issues of avoiding haphazard and wasteful development in order to ensure that the available water resources are utilized according to needs and are exploited to the best advantage in the national interest. While there is no doubt that this should be so, it is also up to the planners and designers to use their expertise to cause the least possible inconvenience to individuals. In this respect, more consideration should always be given to the social problems of consumers and communities than at present, and cover should not be sought under laws and regulations which permit inconvenience to consumers and communities. Examples of such laws are the carrying of water mains in private property, inspection of dwelling places, land acquisition, discontinuance of water supply for maintenance, etc.

9.2 Right of Way and Compulsory Acquisition

As regards the issue of compensation, one has to examine whether the powerful arm of a government, after enacting a law, can entirely safeguard the rights of a citizen because, generally, the amount of compensation paid for these acquisitions is determined by an arm of government instead of an independent valuer. Although the law permits aggrieved landowners to appeal against unfair compensation, these people often refrain from doing so because of the length of time it would take to receive a verdict and the cost of such proceedings. In many cases, these compensations are not paid until many years after because of the legal and other complications involved in making payments. Here, although the law gives one the right of way, if one attempts to apply the law to the letter, the landowners could resist and thereby delay the implementation of the project.

In applying the law, one has to consider the customary rights of the people and their economic and financial status. It is unfair to displace farmers from their land with a promise of compensation when their source of subsistence has already been taken away. It is therefore necessary that before applying the provisions of the law, an agency or government should ensure that those to be displaced are rehabilitated and necessary compensations are paid with despatch.

I would give one particular illustration which proves conclusively that the government and the people must reciprocate to their mutual advantage in their dealings inspite of what provisions there are in the law. When the government of the Western State of Nigeria planned to build the multi-million dollar water supply project at Asejire (Ibadan), the owners of the land which was required for this purpose made spurious promises that they would make available all the land required, at a token fee, provided they would benefit from the water supply. Several meetings were held with them and, in the normal manner, right of way was granted. However, after the Corporation took possession, all economic crops were counted and the land was surveyed. Thereafter, the Corporation

experienced untold molestation from the landowners who, on many occasions, besieged the offices of the Corporation and insisted on full compensation for both land and crops. An effective cooperation between the parties could have eliminated or minimized the gravity of the situation.

9.3 Economic and Social Considerations

Water supply planning and design involves many choices among physically and economically feasible alternatives. The final choice among these alternatives should be the most economic. Although the importance of sound economic evaluation is universally recognized, engineers and others responsible for water supply project policy formulation do not always appreciate the social problems attendant on water resources development. There has recently been an increasing concern about the state of man's environment. Population growth with the attendant increase of per capita consumption and consequent waste water production threaten severe environmental pollution whilst engineering structures such as dams and other installations drastically alter the natural landscape with resultant changes in the ecology.

The general awareness of the changes in an environment resulting from water resources development has introduced a new dimension to the overall planning of water supply systems. Henceforth, engineers and planners of water supply systems should have a new set of social, moral, philosophic and aesthetic values to consider along with design factors and economic considerations when planning projects. Although some legislative sanctions may disfigure man's environment, others would enhance it. It would, therefore, be unwise to depend on legislation alone to overcome any problem associated with the disfiguration of environment caused by development activities. It is also necessary that citizens be associated from the planning stages and their opinion sought before final decisions are taken on projects which may create this type of problem. Furthermore, engineers and planners should be more creative and more critical in project formulation so as to develop plans which would have minimal detrimental effects on the environment.

9.4 Influence of Water Law on Water Supply Administration

Having outlined the powers given to state government agencies for the development and administration of water supplies in the States, it is necessary at this juncture to comment on how effective provisions of the law have been able to help in the administration as well as acceleration of water supplies development in the country.

Potable water supply is one of the greatest yearnings of the people. When water is required, there is no sacrifice that the potential beneficiaries would not promise in order that a water supply may be constructed for them. However, immediately the supply is made available, they regard water as their inalienable right and many of them would shirk their civic responsibilities by failing or refusing to pay a token sum for the supply.

It is then that a rigid application of the provisions of the law comes under severe tests and strains. In this regard, the provision in the law cited in paragraph 49, page 15, has helped to serve as a deterrent to perpetual rate defaulters and, as a result, many people who would have defaulted have been responding to the payment of rates and charges.

As water supply installations are financed and run with public funds, there are provisions in the law which make it obligatory for statutory agencies to ensure that as many people as possible benefit from the supplies. Therefore, water agencies are duty bound to continue to improve and extend the supplies to meet increasing demands. This is an aspect which helps in the acceleration of water supply development. In order to minimize or eliminate violation of water laws, special fittings may be designed and installed in water undertakings. A good example is the use of waste-not taps. Where terminal pressures are high, particularly in public standpipes, designers must take cognisance of this to ensure that appropriate terminal pressures are allowed.

Some of the provisions of the law have proved to be quite useful in the development and general administration of water supplies in the country. The people are made aware that if they offend against the provision, they would be apprehended and punished. For example, there has been no reported case of vandalism or destruction of waterworks property since the Western Nigeria Water Corporation was established in 1966. However, there have been minor cases of thefts or losses of taps from public standpipes which, as a rule, are frowned upon not only by the waterworks agency but also by the general public.

10. INTERNATIONAL CONVENTIONS ON WATER RESOURCES

Nigeria is a signatory of two conventions on international cooperation for the development of water resources. These are the convention and statute relating to the development of the Chad Basin and the convention and statute relating to the River Niger Basin.

10.1 The Lake Chad Basin Commission (May 1964)

10.1.1 The Lake Chad Basin Statute

The signatories to the convention, namely, the Federal Republic of Cameroon, the Republic of Chad, the Republic of Niger, and the Federal Republic of Nigeria agreed to formulate principles for the economic utilization of the resources of the Chad Basin. The member states further agreed to create a Commission to prepare general regulations for ensuring the effective use of the resources of the Chad Basin to the mutual benefit of member states. Under the Statute, the Chad Basin is open for the use of all member states to the convention, without prejudice to the sovereign rights of each member state. The member states have agreed to abstain from taking any measure, on any portion

of the Basin subject to their respective jurisdiction, likely to have an appreciable effect on the flow of surface and groundwater in the Basin without adequate notice to and prior consultations with the Commission.

10.1.2 Composition and Powers of the Commission

The Chad Basin Commission consists of eight Commissioners, two from each member state. The Commission is also charged with the responsibility of collecting, evaluating and disseminating information on proposals made by member states and recommending plans for common projects and joint research programs in the Chad Basin. The Commission is expected to maintain liaison between member states to ensure efficient use of the water of the Basin and also follow progress of surveys and works in the Chad Basin as envisaged in the Convention. The Commission is also empowered to examine complaints from member states and to promote the settlement of disputes and the resolution of differences.

10.2 The River Niger Commission (November 1964)

10.2.1 The Act of Niamey

The Act signed at Niamey by Ivory Coast, Dahomey, Guinea, Upper Volta, Niger,Nigeria and Chad, and later by Cameroon and Mali, provides for free navigation for merchant ships, pleasure craft, and ships transporting merchandise and travellers, with complete equality for all nations. The signatory states agreed to cooperate on the study and execution of all projects which might affect significantly the regime of the river; its navigability, agricultural and industrial potential, the sanitary condition of the river and the biological characteristics of animal and plant life. This cooperation was to be facilitated by the establishment of an inter-governmental organization to be charged with encouraging, promoting and coordinating studies and programs for the development of the resources of the river basin in cooperation with the specialized agencies of the Organization of African Unity, the United Nations and other international organizations. The Act provides that if disputes as to the interpretation and application of the Act among member states could not be settled amicably, such disputes should be referred for arbitration by the Organization of African Unity or for judicial settlement by the International Court of Justice.

10.2.2 Composition and Powers of the Commission

The Commission is composed of nine Commissioners, one from each riparian state. Its decisions are taken by a two-thirds majority of those present and voting. The functions of the Commission are to prepare elaborate regulations for the implementation of the Act of Niamey, to maintain liaison among the riparian states, and together, examine and distribute data concerning the entire basin. It is also charged with the responsibility of examining plans presented by member states, and recommending to them, coordinated study programs for the development and rational exploitation of the basin's resources. It should also follow the execution of studies and projects and keep member states informed about them. The Commission is empowered to examine complaints and assist in the settlement of disputes.

11. CONCLUSION

Nigeria is blessed with abundant water resources which have hardly been tapped. The customary laws on the preservation of water resources still exist in many rural areas. The concept of riparian rights on water courses is still maintained throughout the country.

Since potable water, produced in accordance with modern scientific techniques was introduced into the country, there have been laws to govern its construction, operation and maintenance. In recent years, these have given way to laws establishing statutory water agencies for the rapid implementation of water supply projects so that, eventually, all the inhabitants of the country will have access to this important commodity.

There has not been any serious competition for the use of water because Nigeria has not yet been highly industrialized. Moreover, there are no private water companies which would compete for the available water resources. Therefore, the Governments do not have disputes on allocation of available water resources.

The immediate concern, however, of all the Governments of the Federation is to make potable water available in reasonable quantity to the teeming population in both urban and rural areas. Hitherto, these governments have been unable to shoulder the full financial burden from their own resources. Therefore, the Federal Government has come to the aid of all State Governments by granting 50 per cent of all capital expenditure on water supplies which would be implemented by the State Governments during the 1975-80 Development Plan. It can therefore be presumed that a Government that has decided to spend so much money on water supplies would equally be interested in ensuring that the law for the administration of the supplies when constructed should be modernized.

In line with Federal Government intention and concern for its water resources, it has recently set up a Ministry of Water Resources which would, amongst other things, adjudicate on disputes arising out of the use of inter-state waters and ensure that necessary hydrological data are collected and processed. It is expected that the Federal Government would soon enact a law which would govern the administration of inter-state water resources in keeping with its policy of judicious management of water resources.

It is not sufficient for the Federal Government to content itself with what happens internally because there are a number of waterways which derive their sources from outside the country. It is on record that the Federal Government is an active member of two international commissions, i.e., the Lake Chad and the River Niger Commissions. It is hoped that Nigeria would continue to participate effectively, as hitherto, in the works of these and other commissions set up on international waters.

Thank you.

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MULTI-DISCIPLINARY APPROACH TO CONJUNCTIVE USE OF SURFACE AND UNDERGROUND WATERS - CASE STUDY

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INTRODUCTION

Laws governing the conjunctive use of surface and underground waters in the State of Colorado, U.S.A., had their genesis in the doctrine of prior appropriation, the basis of all Colorado Water Law. The successful promulgation and implementation of these water laws require a thorough understanding and knowledge of the history of water use as well as the various disciplines involved. These disciplines, not necessarily in order of importance, include surface and ground water hydrology, engineering, geology, politics, legislation and law, economics, environment, interstate compacts, climatology, institutions, international treaties, and public relations. Without consideration of each of these disciplines, any attempt to integrate surface and underground water into a common priority system probably would result in political chaos and economic disruption, doomed to failure.

An early diagnosis of deleterious effect of ground water on surface rights facilitates the solution with minimal disruption to the status quo. In the Colorado case under study, ignorance and neglect of the problem for some 35 years resulted in polarization of conflicting interests and opinions, making the solution

extremely difficult and involving costly, counter-productive litigation.

If this presentation assists others in avoiding some of the pitfalls inherent in devising conjunctive use laws for this most valuable resource, it will have served its purpose.

ENVIRONMENT, GEOGRAPHY, POLITICS, AND ECONOMICS

The State of Colorado is somewhat unique. The great Continental Divide splits the state, geographically, almost in half. Any water generated on the west side of the divide drains into the Colorado River and ultimately to the Pacific Ocean. That generated on the east side drains into the Mississippi River and the Rio Grande and ultimately into the Atlantic Ocean. The Rocky Mountains forming the Continental Divide are characterized by high peaks with fifty-four of them at an elevation over 14,000 feet above mean sea level. These elevations contrast to the lowest on the Arkansas River at 3,350 feet. The environment ranges from alpine to desert, running the gamut of intermediate conditions. The eco-systems of such a range of environments are extremely delicate and interrelated. Disturbance of eco-systems, especially the mountainous areas, can have profound effects on those at lower elevations. These effects need not be adverse if careful planning and legislation recognizes and evaluates the effects, prudent protective laws are enacted, and physical scientists develop natural resources accordingly. The advent of man superimposed on the pristine environment can enhance rather than destroy that environment if the legal framework is wisely enacted and physical scientists conscientiously work within that framework.

The Continental Divide splits the state not only geographically, but politically and economically. A great majority of the population of the state resides east of the mountains where the preponderance of agricultural and industrial development exists. While 80% of the population resides east of the divide, only 30% of the total state's water supply originates in that area. Massive diversions of water, present and prospective, from the western half to the eastern half of the state have raised the spectre of what was once a water-surplus area becoming a water-deficient area when imminent economic development occurs west of the divide. When planned agricultural and mineral resource development and increasing tourism occur in the western half of the state, Colorado's allocation of the Upper Colorado River Compact will have been fully utilized. Ever-increasing population and industrial development in the eastern half of the state generate increased demands for additional transmountain diversions. The inevitable political conflict between representatives of the two areas is further complicated by an awakened concern for the environment and eco-systems in the water-losing western streams. The environmental concern exists on both sides of the divide and creates interesting alignments within the body politic.

Climatic factors predominate in determining usable water supply in semi-arid areas, especially so when high mountain ranges interrupt and control the flow of air masses, creating erratic precipitation and runoff patterns. Except on rare occasions, accumulated snow pack and precipitation in the form of rain in high mountain areas account for most of the annual runoff. Unfortunately,

the snow pack melts concurrently with spring rains, creating flood damage and causing high runoffs to occur during the periods of the year when water is least in demand. From midsummer to early fall, when water need is the greatest, runoff has diminished to a stage where only the most senior water rights may divert from the surface flow. Upstream storage reservoirs have helped resolve this imbalance somewhat, but they are inadequate and it is doubtful that enough potential dam and reservoir sites exist in the mountains to ever completely resolve the problem. The greatest potential for storage of water during the periods of surplus surface runoff appears to be underground aquifers capable of recharge for withdrawal during periods of diminished surface flow. This is the very essence of good water management through a concept of conjunctive use and will be discussed in greater depth later in this presentation.

Agriculture is the largest consumer of water, accounting for about 90% of all water consumption in the state. Since agriculture is the largest water user in the economic sectors as well as the largest income producer, this water deficiency profoundly affects the very base of the state's economy. When an economic activity multiplier of 3.5 is applied to agricultural production, the adverse effect of a short water supply year is devastating to even the city dweller dependent on this activity for his livelihood.

HISTORY OF DEVELOPMENT

The earliest known attempt to establish irrigated agriculture in Colorado occurred in 1787 when Juan Bautista de Anzi (or Anga), Governor of the Spanish Province of New Mexico, sponsored a delegation of twenty farmers to initiate an irrigation project on the St. Charles River, a tributary of the Arkansas River

about eight miles east of the City of Pueblo, Colorado. In 1832, the Bent Brothers constructed a ditch taking water from the Arkansas River for the irrigation of approximately forty acres and in 1841 an enterprise for irrigation development was begun near the mouth of the Fountain River, a tributary of the Arkansas River, at the present site of the City of Pueblo. In 1852, construction was commenced on the Peoples' Ditch in the Rio Grande Valley, Colorado. This ditch is still in operation, making it the earliest Court decreed ditch in the state. About this same time, several projects were initiated on El Rio de Las Animas Perdidos en Purgatoirio, now called the Purgatoire River, a tributary to the Arkansas River about twenty miles downstream from the City of Trinidad.

Circa 1859, gold was discovered in the State of Colorado followed by a great influx of people seeking fortunes in gold and silver, and concentrated in relatively small areas. Mining operations required large amounts of water and oftentimes diversion of water from a stream denied the use of this water to a downstream miner. A loose system of water rights was worked out between the various miners which can generally be stated as "first in time, first in right." Since this was the first experience in the State of Colorado with competition for meager supplies during the late summer and fall months, this negotiated policy was probably the genesis of the doctrine of prior appropriation as it was incorporated into the State Constitution when Colorado became a state in 1876. This then became the foundation for subsequent legislation and the standard for litigation over water rights. Because of the ephemeral nature of stream runoff and drouth cycles, the riparian doctrine, as applied in those states lying east of the 98th Meridian and adopted from the Common

Law of England, did not meet the needs of consumptive water rights. This matter was addressed by the Colorado Supreme Court in 1882[1] with the following statement:

> "We conclude, then, that the common law doctrine giving the riparian owner a right to the flow of water in its natural channel upon and over his lands, even though he makes no beneficial use thereof, is inapplicable to Colorado. Imperative necessity, unknown to the countries which gave it birth, compels the recognition of another doctrine in conflict therewith. And we hold that, in the absence of express statutes to the contrary, the first appropriator of water for a beneficial purpose has, with the qualifications contained in the Constitution, a prior right thereto, to the extent of such appropriation."

With few exceptions and some variations, those states west of the 98th Meridian have adopted what has become known as the "Colorado Doctrine," with appropriations tabulated into a priority system.

As the water supplies in the upper basin states were progressively depleted, downstream states and the United States of Mexico recognized the imminent threat of economic strangulation unless some agreement between the states could be reached whereby the downstream states could be assured of a water supply to maintain existing economies and provide for some expanded development. The U. S. Supreme Court in 1922[2] asserted that the doctrine of prior appropriation applied across state lines with the following conclusion:

> "We conclude that Colorado's objections to the doctrine of appropriation as a basis of decision are not well taken, and that it furnishes the only basis which is consonant with the principles of right and equity applicable to such a controversy as this is. The cardinal rule of the doctrine is that priority of appropriation gives superiority of right. Each of these States applies and enforces this rule in her own territory, and it is the one to which intending appropriators naturally would turn for guidance. The principle on which it proceeds is not less applicable to interstate streams and

1. Coffin v. Left Hand Ditch Co., 6 Colo. 443, 447 (1882)

2. Wyoming v. Colorado, 259 U.S. 419 (1922)

controversies than to others. Both States pronounce the rule just and reasonable as applied to the natural conditions in that region; and to prevent any departure from it the people of both incorporated it into their constitutions. It originated in the customs and usages of the people before either State came into existence, and the courts of both hold that their constitutional provisions are to be taken as recognizing the prior usage rather than as creating a new rule. These considerations persuade us that its application to such a controversy as is here presented cannot be other than eminently just and equitable to all concerned."

This provided impetus to upper basin states to agree to enter into interstate compacts, resulting in Colorado agreeing to compacts involving every stream which leaves or enters the state with the exception of the North Platte and Laramie Rivers which are apportioned by decrees of the U. S. Supreme Court. The state now is committed to delivery of specific amounts of water at the state line, by various means of apportionment, under provisions of eight interstate compacts[3], one international treaty with Mexico[4], and U. S. Supreme Court decrees[5]. These commitments have a very profound effect on the availability of water for economic development and the need for close administration of waters of the state. One case of alleged violation of a

3. Colorado River Compact (45 Stat. 1057, 1064)
La Plata River Compact (43 Stat. 796)
South Platte River Compact (44 Stat. 195)
Rio Grande Compact (53 Stat. 785)
Republican River Compact (57 Stat. 86)
Costilla Creek Compact (60 Stat. 246)
Arkansas River Compact (63 Stat. 145)
Upper Colorado River Basin Compact (63 Stat. 31)

4. Rio Grande, Colorado, and Tijuana Treaty, 1944 between the Governments of the United States of America and the United Mexican States.

5. Wyoming v. Colorado, 259 U.S. 419 (1922)
Wyoming v. Colorado, 286 U.S. 494 (1932)
Wyoming v. Colorado, 298 U.S. 573 (1936)
Wyoming v. Colorado, 309 U.S. 572 (1940)
Nebraska v. Wyoming, 295 U.S. 40 (1935)
Nebraska v. Wyoming, 325 U.S. 589 (1945)

compact has been heard by the U. S. Supreme Court;[6] however, the issue of alleged violations of the compact were not resolved since a motion for continuance by the three states was granted. The terms of the continuance specified that Colorado would subsequently meet its annual commitment each and every year and exercise its best efforts to seek administrative solutions to abide by the terms of the compact.

Dryland farming was attempted over many areas of the state; however, the vagaries of nature proved to be an insurmountable hazard in most areas of the state and irrigation began to flourish in the late 1800's. The collapse of the gold and silver market and the need for production of winter feed for the livestock industry stimulated the interest of many people engaged in mining and livestock ventures to obtain their livelihoods from irrigated agriculture. With the increased use of direct flow from ephemeral streams and the undependable supply during late summer months, storage reservoirs were constructed to capture the abundance of water during early spring runoff from snow melt to be used during the latter months of the growing season when stream flow diminished to the point where all irrigation rights could not be satisfied. With the increased economic activity generated by an expanded agricultural economy, there was a concurrent increase in municipal growth and agri-business. The favorable living conditions in Colorado, including a healthy environment and favorable climatic conditions attracted industrial development and people seeking to escape the crowded conditions in the eastern half of the United States. These ever increasing demands for an adequate water supply resulted in diversions of water from that part of the state west of the Continental Divide, where the

6. Texas and New Mexico v. Colorado, 391 U.S. 901 (May 6, 1968)

demand for water had not yet developed. When these relatively inexpensive trans-mountain diversion projects had been utilized and the demand for water in the western half of the state was increasing, it became apparent that the development of vast underground water supplies provided a new frontier to be exploited. In the early 1950's, a drouth cycle generated considerable interest in underground water to supplement the diminished surface water rights. The success of these ventures in utilizing underground water for supplementing diminished surface supplies in turn generated new development totally dependent on underground water and the well drilling business flourished, assisted by development of more efficient pumps, sprinkler systems and inexpensive electric energy supplies. This happy set of circumstances was shattered when it became evident in the early 1960's that the flow of the surface streams was being diminished by the interception of tributary underground water which otherwise would have reached the surface stream, thereby denying historic water supplies to earlier surface water rights. Many studies by federal and state agencies reinforced the contention by these earlier surface water rights that they were being injured and property rights were deteriorating. The controversy between the surface and underground water rights polarized the two parties in conflict to the point of near chaos by the middle 1960's.

HISTORY OF GROUND WATER LEGISLATION

Historically, ground water has been divided into two categories: (1) Ground water which contributes little or no flow to surface streams and does not affect vested surface water rights came under the jurisdiction of the

Colorado Ground Water Commission (State Engineer acts as Executive Director and furnishes staff) and is termed "Designated Ground Water" and (2) all other underground water comes under the direct jurisdiction of the Colorado State Engineer.

All ground water which is not included in the definition of designated ground water is further categorized as: (1) Tributary to a surface stream and (2) Not tributary to a surface stream. Tributary underground water is amenable to conjunctive use with surface water and subject to the same priority system. Since this presentation is devoted to such conjunctive use, the subsequent discussion will be limited to tributary underground water.

1953 Underground Water Law

The first legislation dealing with underground water was enacted in the 1953 Session of the General Assembly[7]. It provided for licensing of well drillers and creation of "Critical Ground Water Districts" in an area of proven underground water supply. The law simply provided that a well driller, before commencing work of drilling, redrilling, recasing, or deepening any well would file a written notice of intention to commence such operation; however, even the notice of intention was not required in an area outside a district. The law was silent on denial of such well drilling in case of injury to a prior vested water right and proved to be ineffectual. It is difficult to explain the neglect by the General Assembly to enact legislation to reflect the Colorado Supreme Court pronouncements[8] in 1902 as follows:

7. Article 18, Chapter 147, Colo. Revised Statutes, 1953.

8. Medano Ditch Co. v. Adams, (1902) 29 C. 317, 69 P. 431

> "Underground currents of water which flow in well defined channels, the course of which can be traced, are subject to the same rules of law as streams flowing upon the surface; the existence of such streams are defined and known within the meaning of the law, though invisible, where the course and flow are determined by reasonable inference."

In addition, the Supreme Court stated:[9]

> "In Colorado it is the presumption that all ground water situated in the basin or watershed of a stream is tributary to the stream and subject to the appropriation of the water of the stream; and the burden of proof to the contrary is on the one asserting that such ground water is not tributary."

1957 Ground Water Law

The 1957 Session of the General Assembly enacted legislation[10] to create the "Colorado Ground Water Commission" to designate "Critical Ground Water Districts" where no new wells could be drilled. It also established a permit system for new, increased, or additional supply of ground water use; however, the granting of permits for wells outside critical ground water districts was a ministerial function of the State Engineer. It also required existing ground water uses to be registered with the State Engineer within a period of three years, with failure to do so constituting prima facie evidence of an intent to abandon such use. Once again, the law was silent on the adjudication of tributary underground water rights to determine relative priorities with surface water rights and the administration of underground water appropriations within the priority system.

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9. Safranek v. Town of Limon, (1951) 123 C. 330, 228 P.2d 975
DeHaas v. Benesch, (1947) 116 C. 344, 181 P.2d 453
Dalpez v. Nix, (1935) 96 C. 540, 45 P.2d 176
Leadville Mine Co. v. Anderson, (1932) 91 C. 536, 17 P.2d 303
Nevius v. Smith, (1929) 86 C. 178, 279 P. 44
Comrie v. Sweet, (1924) 75 C. 199, 225 P.2d 214
In re German Ditch Co., (1914) 56 C. 252, 139 P. 2
Comstock v. Ramsay, (1913) 55 C. 244, 133 P. 1107

10. Article 19, Chapter 147, Colo. Revised Statutes 1953, as amended

1965 Ground Water Management Act

The first significant legislation recognizing the deleterious effect of tributary ground water withdrawal on surface water rights was enacted in the 1965 Session of the General Assembly.[11] This legislation provided:

> "From and after May 17, 1965, no new wells shall be constructed outside the boundaries of a designated ground water basin, nor the supply of water from existing wells outside the boundaries of a designated ground water basin increased or extended, unless the user shall make an application in writing to the state engineer for a 'permit to construct a well', in a form to be prescribed by the state engineer . . ."

In addition, the following condition to be considered in approving applications for well permits was established:

> "Upon receipt of an application for a replacement well or a new, increased, or additional supply of ground water from an area outside the boundaries of a designated ground water basin, accompanied by a filing fee of twenty-five dollars, the state engineer shall make a determination as to whether or not the exercise of the requested permit will materially injure the vested water rights of others. If the state engineer shall find that there is unappropriated water available for withdrawal by the proposed well and that the vested water rights of others will not be materially injured, and can be substantiated by hydrological and geological facts, he shall issue a 'permit to construct a well', but not otherwise . . ."[12]

For the first time in the history of water law, a statute was enacted to require that underground waters tributary to a surface stream would be administered in accordance with the right of priority of appropriation in the same priority system with the surface water rights, provided that rules and regulations were enacted by the State Engineer for the performance of these duties.[13]

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11. Section 148-18-36(1), Colo. Revised Statutes 1963, as amended

12. Section 148-18-36(2), Colo. Revised Statutes 1963, as amended

13. Section 148-11-22(1), Colo. Revised Statutes 1963, as amended

1967 and 1968 Legislation

When the large magnitude of well development became evident, as a result of the requirement of registration of wells and the applications for new well permits, the General Assembly was moved to adopt stricter and more definitive administrative controls over the withdrawal of tributary underground water to require adherence to the priority system in common with surface rights. It was recognized that any such requirement for administration in the same priority system with very senior surface water rights would place an impossible burden on the large economy, based on the use of underground water. It was also recognized that the ground water law, as it existed in 1967, had been promulgated in such a piecemeal fashion that complete recodification of both surface and underground water law was necessary. The 1967 Session of the General Assembly directed the Coordinator of the Department of Natural Resources to conduct a study[14] leading toward recodification and appropriated $ 50,000.00 to initiate the study. In the 1968 Session, this study was further funded with an appropriation of $160,000.00.

A committee of water attorneys and consulting engineers was formed to conduct studies and submit proposed recodified legislation for consideration by the 1969 Session of the General Assembly.

1969 and Subsequent Water Legislation

The Water Right Determination and Administration Act of 1969[15] was enacted into law after months of hearings and debate. Because of the long delay in resolving the injurious affect of tributary underground water withdrawal

14. Senate Bill 407 - Water Study (1967)

15. Article 21, Chapter 148, Colo. Revised Statutes, as amended

on prior surface water rights, the two parties in conflict had polarized their positions with the underground water appropriators denying any injury to surface water rights, and the surface water rights demanding remedy for injury to their prior vested surface rights. The following excerpts from the Declaration of Policy[16] are the best indications of the intent of the General Assembly to accomplish the conjunctive use of surface and underground water:

> "It is hereby declared to be the policy of the State of Colorado that all waters originating or flowing into the state, whether found on the surface or underground, have always been and are hereby declared to be the property of the public, dedicated to the use of the people of the state, subject to appropriation and use in accordance with law. As incident thereto, it shall be the policy of this state to integrate the appropriation, use and administration of underground water tributary to a stream with the use of surface water, in such a way as to maximize the beneficial use of all of the waters of this state." (emphasis added)
>
> "The existing use of ground water, either independently or in conjunction with surface rights, shall be recognized to the fullest extent possible, subject to the preservation of other existing vested rights. . ." (emphasis added)
>
> "The use of ground water may be considered as an alternate or supplemental source of supply for surface decrees heretofore entered, taking into consideration both previous usage and the necessity to protect the vested rights of others."
>
> "No reduction of any lawful diversion because of the operation of the priority system shall be permitted unless such reduction would increase the amount of water available to and required by water rights having senior priorities."

In reading the above excerpts from the Declaration of Policy, it was apparent that the General Assembly intended to accomplish two superficially incompatible purposes: (1) preserve the existing economy which was dependent upon the withdrawal of tributary underground water and (2) preserve the integrity of prior vested surface water rights. In stream basins where there was sufficient

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16. Section 148-21-2, Colo. Revised Statutes, as amended

water annually available in the total water budget to supply existing demands, these two purposes could be accomplished by better water management based on highly technical analyses and implementation of complex water development planning. Any such conjunctive use planning required a thorough knowledge of the geology of the aquifer, the behavior characteristics of both surface and underground water involving geohydrology and surface water hydrology, persuasive public relations to "sell" conjunctive use plans, institutional arrangements to accomodate financial considerations, and the environmental impact of such plans.

Some guidelines are provided in the 1969 Act to assist in solving the problem of conjunctive use. An important provision is found in the permissive legislation for senior surface rights to use wells as alternate points of diversion. In a majority of cases, the owner of a well also owned senior surface water rights and used the well as a supplemental supply during periods of diminished surface runoff. The following provisions are germane to this situation:

> "In every case in which the owner of an appropriative right to divert water shall supply his water needs by the use of a well, the water diverted by that well may be charged to its own appropriation; or it may be used to divert water under the provisions set forth in paragraph (c) of this subsection . . ."[17]

Subsection (c) as referred to above is stated as follows:

> "In any case in which the owner of an appropriative right to divert water at the surface of a stream or to have water so diverted delivered for his use or benefit shall have a well so situated as to draw water from the same stream system, that owner may secure the right to have such well, or more than one if he has more than one such well, made an alternate point of diversion to said surface right by procedures provided in this article for securing alternate points of diversion." [18]

17. Section 148-21-17(3)(b), Colo. Revised Statutes 1963, as amended

18. Section 148-21-17(3)(c), Colo. Revised Statutes 1963, as amended

"In authorizing alternate points of diversion for wells, the widest possible discretion to permit the use of wells shall prevail. In administering the waters of a water course, the withdrawal of water which will lower the water table shall be permitted but not to such a degree as will prevent the water source to be recharged or replenished, under all predictable circumstances, to the extent necessary to prevent injury to senior appropriators in the order of their priorities, with due regard for daily, seasonal, and longer demands on the water supply."

Under an idealized situation and total participation by all those water users similarly situated, the provisions for alternate points of diversion would have solved the majority of the problem of conjunctive use and maintained the integrity of the priority system. However, if a senior surface water right were to obtain alternate points of diversion for his wells and the surface supply was not available in the stream to fill that decree, he would then be required to pump his wells, as a part or all of that surface decree. Only if the well capacity could not completely satisfy the decree, could he demand his water from a junior appropriator, and then only in the amount that the combined surface diversion and well yield fell short of the total decreed right. This inhibited the owners of combined surface and underground water rights to utilize the provision for alternate points of diversion. Some of the more junior surface water rights were likewise reluctant to assign their wells as alternate points of diversion, since the law requires that if the junior surface right is not in priority, the well, as an alternate point of diversion, is also curtailed. This situation is expressed as follows:

". . .If a well has been approved as an alternate means of diversion for a water right for which a surface means of diversion is decreed, such well and such surface means must be utilized to the extent feasible and permissible under this article to satisfy said water right before diversions under junior water rights are ordered discontinued."[19]

19. Section 148-21-35(2), Colo. Revised Statutes 1963, as amended

Since the alternate point of diversion does not provide relief for all of the underground water appropriators, the General Assembly assigned the responsibility to the State Engineer to enact rules and regulations for the administration, distribution, and regulation of ground water appropriations. Some guidelines were provided for the promulgation of such rules and regulations, the basic guideline stating that:

> ". . . It is the legislative intent that the operation of this section shall not be used to allow ground water withdrawal which would deprive senior surface rights of the amount of water to which said surface rights would have been entitled in the absence of such ground water withdrawal, and that ground water diversions shall not be curtailed nor required to replace water withdrawn, for the benefit of surface right priorities, even though such surface right priorities be senior in priority date, when, assuming the absence of ground water withdrawal by junior priorities, water would not have been available for diversion by such surface right under the priority system. The state engineer may adopt rules and regulations to assist in, but not as a prerequisite to, the performance of the foregoing duties." [20]

In interpreting the above legislative intent, it was recognized that if ground water withdrawal had not been made; i.e., the wells did not exist, the only water which was being denied to the surface stream was that water which was being consumed by the application of that underground water to a beneficial use. This was an entirely new concept in Colorado Water Law in that an appropriator could continue to divert; providing, remedy of injury to a senior vested right was made in the amount of his consumptive use. This recognized responsibility for only that portion of the consumptive use which would have reached the surface flow at the time of a lawful demand by a downstream senior vested right. This interpretation of the intent of the legislature provided considerable advantage to the underground water appropriator, since a junior

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20. Section 148-21-34(1), Colo. Revised Statutes 1963, as amended

surface water right does not enjoy the advantage of diverting out of priority by replacing only his consumptive use. When a senior downstream surface right is not being satisfied, he places a demand on upstream junior rights and the most junior surface water right is deprived of his entire diversion if that amount is required to satisfy the downstream senior right. This advantage to the underground water appropriator has generated considerable concern and interpretation by Division Water Courts as well as the Colorado Supreme Court, and will be discussed later in this presentation.

Another provision in the law recognizes the "lag-time" of effect of interception of return flow on the surface stream; ergo, injury to senior surface water rights would simply be delayed to a later point in time. In order to require remedy to this delayed injury, the following provision was added:

> "Consideration of the relative priorities and quantities of all water rights and the anticipated times of year when demands will be made by the owners of such rights for waters to supply the same;"[21] (emphasis added)

The above language was considered necessary in order to prevent ex post facto injury, which could not be remedied by administrative curtailment of that ground water diversion since the damage was already done. The propriety of anticipating time of demand was the subject of litigation and was adjudged proper by the Colorado Supreme Court.[22]

Special provisions were made for water users to initiate "Plans for Augmentation" designed to provide means by which junior water rights, primarily underground water appropriators, could augment the total water supply of the river basin, including both surface and tributary underground water and claim

21. Section 148-21-34(2)(d), Colo. Revised Statutes 1963, as amended

22. Hall v. Kuiper - Colo.-, 510 p. 2d. 329 (1973)

such augmentation as a remedy for injury to senior water rights. The definition of a plan of augmentation is as follows:

> " 'Plan for augmentation' means a detailed program to increase the supply of water available for beneficial use in a division or portion thereof by the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water or by any other appropriate means." [23]

It should be noted that an alternate or change in point of diversion is included in the definition of the plan for augmentation and appears to be an unfortunate inadvertency by the General Assembly. Many very perceptive water users discovered that using a well as an alternate point of diversion to a surface decree had certain advantages in filing such a change for adjudication in the Water Courts as a plan of augmentation. The advantage in such a filing is that when the original decreed water right is not in priority, the owner may divert from his alternate points of diversion, i.e., the well, and provide replacement water in the amount of the consumptive use rather than being deprived of the entire diversion, which would occur if he only had the decreed surface priority. A further inadvertent advantage to apply an alternate diversion as a plan for augmentation is that he may use the well and claim the surface water as replacement water for the injury by the well diversion in the amount of the consumptive use from the well diversion. This, of course, permits the owner to expand his water consumption to the detriment of other vested water rights. This inadvertency created litigation in a district water court when the Kelley Ranch attempted to obtain approval for a multitude of wells in a subdivision and replace the consumptive use of those wells with water diverted from a

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23. Section 148-21-3(12), Colo. Revised Statues 1963, as amended

surface decree formerly used for irrigation of the Kelley Ranch. This case, Numbered W-4039 in the District Court for Water Division No. 2, State of Colorado, was protested as not being, in fact, a plan of augmentation as defined above,[24] but was a simple change of point of diversion and should be considered as a "Change of Water Right" as defined in the statutes. In the Conclusions of Law by the District Court, the following statement appears:

> "The proposal appears to be a 'plan of augmentation' under C.R.S. 1963 148-21-3(12). However, no new water is to be added to the river system, there being no 'augmentation' apparent, so, the proposal amounts to a change of point of diversion or change of water right under the provisions of C.R.S. 1963 148-21-3(11) as amended, and should be governed by the rules applicable thereto."

This case is under appeal to the Colorado Supreme Court with the basic issue being the above citation from the Conclusions of Law.

ADMINISTRATIVE EXPERIENCE AND LITIGATION

1966 Attempt to Regulate Wells

The first attempt to administer tributary ground water appropriations within the priority system with surface appropriators, resulted in the Division Engineer issuing cease and desist orders to stop diverting from wells located adjacent to the Arkansas River in order to satisfy a demand by a downstream senior surface water right. The well owners affected filed an action in the District Court to obtain an injunction against such action by the Division Engineer. The District Court denied the motion for such injunction, upholding the authority of the Division Engineer to curtail the diversions of tributary underground water. This opinion was appealed to the Colorado Supreme Court,[25] which reversed the judgment of the District Court on the basis that the State Engineer had not

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24. No. 23 Supra

25. Fellhauer v. People, 167 Colo. 320, 447 P.2d 986 (1968)

promulgated rules and regulations as required by law:

> "The State Engineer or his duly authorized representative shall execute and administer the laws of the state relative to the distribution of the surface waters of the state including the underground water tributary thereto in accordance with the right of priority of appropriation, and he shall adopt such rules and regulations and issue such orders as are necessary for the performance of the foregoing duties."[26] (emphasis added)

The Supreme Court, however, did not question the fact that tributary ground water was subject to curtailment when such curtailment would provide partial or complete remedy for injury to a senior downstream right. Some of the findings of the Colorado Supreme Court regarding the matter of showing injury to a specific appropriation by a specific junior well is worthy of consideration.

> "However, we hold that, whenever a court or water administration official can make a finding that the pumping of a junior well materially injures senior appropriators who are calling generally for more water, there exists a legitimate and constitutional ground and reason for the regulation of the well, and a showing of a call against that well by a particular senior user is not necessary." (emphasis added)

Further guidlines were expressed by the Supreme Court with the following language:

> "It is implicit in these constitutional provisions that, along with vested rights, there shall be maximum utilization of the water of this state. As administration of water approaches its second century the curtain is opening upon the new drama of maximum utilization and how Constitutionally that doctrine can be integrated into the law of vested rights. We have known for a long time that the doctrine was lurking in the backstage shadows as a result of the accepted, though oft violated, principle that the right to water does not give the right to waste it." (emphasis added)

The major lesson to be learned from the attempt to regulate tributary ground water is that advance notice must be provided to those ground water appropriators through rules and regulations in order that their rights are clearly defined and

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26. Colorado Revised Statutes 1963, 148-11-22(1), as amended in 1965

that notice be given sufficiently in advance of any such curtailment so that well owners may plan their operations, knowing full well the risk involved in total dependence on ground water diversions.

1969 Rules and Regulations for Administration of Underground Water

The above mentioned Fellhauer v. People case was not decided by the Colorado Supreme Court until late in 1968 so that there was no attempt to regulate withdrawal of underground water from 1966 to 1969 pending the findings of the Supreme Court. Immediately following receipt of these findings, promulgation of rules and regulations for the administration of underground water was initiated. This was complicated by introduction of eight bills, for consideration of the 1969 Session of the Colorado General Assembly, which completely recodified water laws. The new water laws enacted by the 1969 Session of the General Assembly were silent on the requirement for rules and regulations; however, the above mentioned finding by the Colorado Supreme Court were considered to be a mandate for rules and regulations to be adopted prior to the regulation of underground water appropriations. Rules and regulations were adopted in accordance with the Administrative Code[27] on July 14, 1959, to be effective on August 8, 1969. Well owners in the South Platte River Basin formed a "Well Owners Conservation Association" which filed an action for an injunction and a declaratory judgment against the State Engineer on July 29, 1969. A temporary injunction was issued against the State Engineer on August 27, 1969, and after a second hearing, the injunction was made permanent on November 20, 1969. The plaintiff in this case, made twenty-four allegations which were considered to be sufficient reason for declaring the rules and regulations null

27. 1963 Colorado Revised Statutes 3-16-1, as amended (State Administration Procedure Act)

and void. The Division Water Court upheld the plaintiff's claim in each of the twenty-four allegations. This case was appealed to the Colorado Supreme Court[28] by the State Engineer, resulting in a reversal by the Supreme Court on each and every one of the twenty-four allegations. In this reversal, the Colorado Supreme Court expounded, at great length, on the theory of water right administration including underground water, and provided many guidelines for subsequent action by the water officials of the state.

Among other things, the proposed rules and regulations provided for a graduated curtailment of underground water diversions providing several years for these underground water appropriators to organize an entity through which they could provide plans of augmentation and replacement water so that injury to prior vested rights could be remedied. The Colorado Supreme Court has this to say about the graduated curtailment:

> ". . . We refer to the aphorism that 'Rome wasn't built in a day' and hold that under the record as submitted the predominant showing was that the State Engineer proceeded in good faith to follow the policy of the statute and that he did substantially follow that policy."

The Court further said that:

> "In Fellhauer, we attempted to sound the note of a new era in the utilization and optimal use of water. It appears to us that the General Assembly reacted favorably to that attempt and in turn sought to promote in detail the general thought of Fellhauer. We have the same view of the acts of the State Engineer. We suggest that there is a slight indication of a feeling upon the part of the plaintiffs and on the part of the trial court that changes should not be required in the operation of wells on the Platte River. There must be change, and courts, legislators, the State Engineer and users must recognize it. We recognize that future research and testing may prove erroneous some of the things that we found were predominately shown in the record. By the same token, further research and testing will not only result in correction of past mistakes, but also will lead us closer to the goal of minimal waste of water." (emphasis added)

28. Kuiper v. Well Owners Conservation Association, 176 Colo. 119, 490 P.2d 268 (1971)

One other allegation made by the plaintiffs was that "Shutting down of wells will not cause water to reach the stream to satisfy any call in time of need." In its findings, the Supreme Court took judicial notice of a 1971 amendment to the 1969 recodification of the water laws, by quoting from this amendment as follows:[29]

> "2(a) In the adoption of such rules and regulations the State Engineer shall be guided . . . by the following:
>
> * * * * *
>
> (d) consideration of the relative priorities and quantities of all water rights and the anticipated times of year when demands will be made by the owners of such rights for waters to supply the same." (emphasis added)

This finding by the Supreme Court took judicial notice of the requirement in the law for the State Engineer to anticipate the effect of withdrawal of ground water at some time in the future. This requirement for anticipated future effect, both in time and quantity, placed unprecedented responsibility on the Office of the State Engineer in conducting comprehensive and detailed analyses of the characteristics of the aquifer and the direction and rate of movement of underground water through various media of the aquifers, in justification of any curtailment of underground water diversions. These technical studies and analyses will be discussed in more depth later in this presentation.

The requirement for anticipating demands of senior water rights on underground water appropriators was addressed by the Colorado Supreme Court in 1973[30] in an appeal from a District Court decision which upheld the State Engineer in denying an application for a well permit. This case involved a permit

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29. Colo. Revised Statutes 1963, 148-21-34, as amended in 1971 Perm. Supp.

30. Hall v. Kuiper - Colo.-, 510 P.2d 329 (1973)

for a well which would be located thirteen miles from a main surface stream. Geohydrologic computations on the time of effect of pumping this well revealed that it would take some forty years for this effect to occur. The facts of the case were uncontested· however, the case was a matter of interpretation of the requirement for anticipating a demand by a senior water right.

1972 Rules and Regulations for Administration of Underground Water

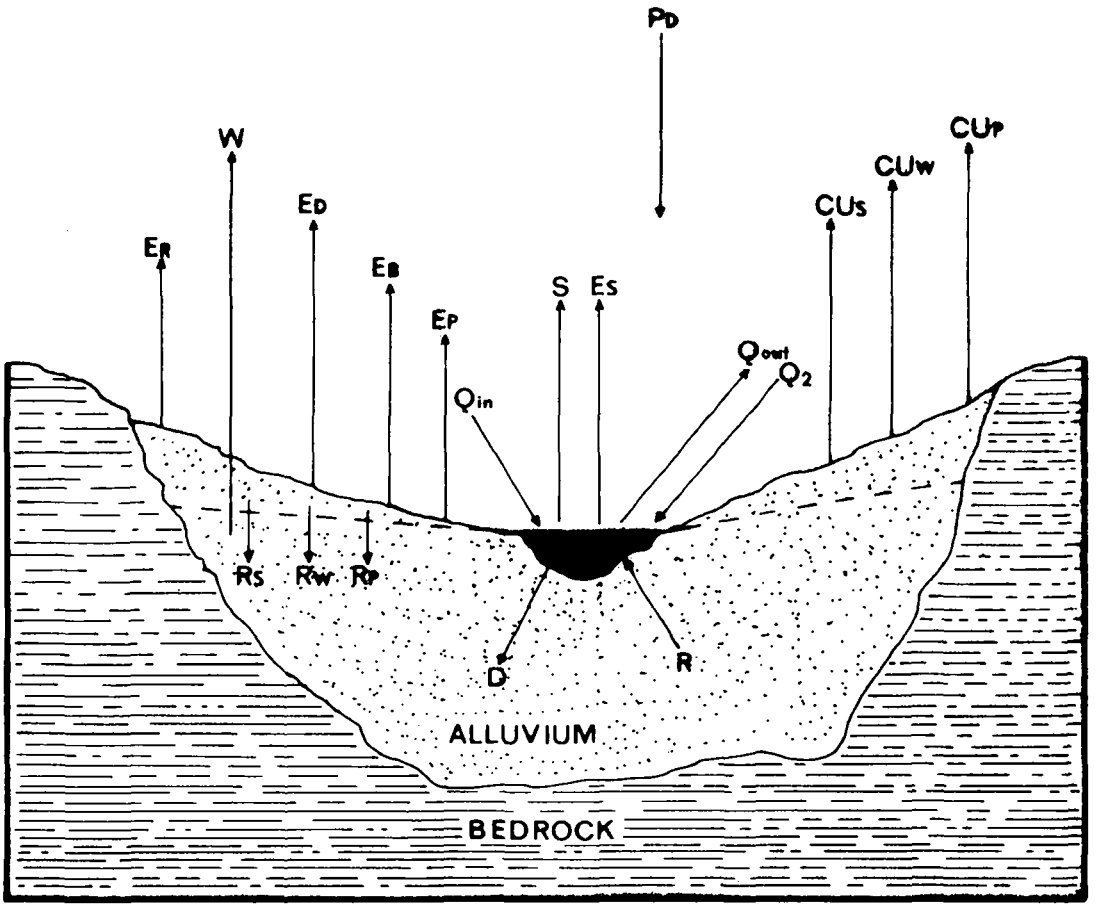
Implementation of the 1969 rules and regulations became impossible since the injunction and declaratory judgment against the State Engineer were in effect from July 29, 1969 until the reversal by the Colorado Supreme Court in late 1971. Since the 1969 rules and regulations expired by their own terms, there was no regulation of underground water during the interim. New rules and regulations were promulgated for administration of surface and ground water rights on the South Platte River and its tributaries to become effective on February 19, 1973. These rules and regulations were proposed under new procedures which were established in the 1971 amendment to the "Water Right Determination and Administration Act of 1969".[31] This procedure provides for publication of rules and regulations once in the county or counties affected, filed with the Water Clerk of a Water Division in which they will be effective, mailed to all persons on the mailing list of such Division, and subject to any protest filed by the end of the month following the month in which such proposed rules and regulations are published. This new procedure replaced the historic procedures as specified in the State Administration Procedure Act. There were

31. Colo. Revised Statutes 1963, 148-21-34, as amended in the 1971 Perm. Supp.

thirteen protesting parties,[32] running the gamut of water users in the South Platte Basin ranging from the City and County of Denver and small communities of a few hundred people, to major underground water user associations, large industries, and surface water rights. For the first time in the sordid history of litigation on the administration of underground water, all parties of interest were represented. The objections ranged from the contention by the underground water users that there should be no regulation of underground water appropriations, to the contention by large cities and surface water right owners that all wells should be completely shut down. In preparation for the inevitable protests to the rules and regulations, as filed in the Division Water Court, the staff of the State Engineer undertook the documentation of studies which had been made on the effect of withdrawal of tributary underground water on a reach of the South Platte River and the adverse affect on prior surface water rights. These studies were documented and submitted to the American Water Resources Association which accepted for publication this report, as a Water Resource Bulletin, Volume 8-2-April 1972. The report was prepared by Deputy State Engineer, Dr. Jeris A. Danielson, and Dr. A. Raziq Qazi, Chief of Surface Water Planning. This report provided the foundation for most of the evidence and testimony presented to the court in support of the rules and regulations, primarily to convince the court that the withdrawal of tributary underground water did, indeed, mitigate the value of the very early surface water rights.

Figure #3 from the AWRA report is presented below to point out the many facets of hydrologic effect and how a mathematical approach can be made in

32. Case Nos. W-7209, W-7232, W-7249, W-7289, W-7290, W-7295, W-7296, W-7298 in the District Court in and for Water Division 1, State of Colorado



WHERE:

S	=	SURFACE DIVERSIONS
Q_2	=	SIDE CHANNEL INFLOW
R_S	=	SURFACE WATER RETURN TO ALLUVIUM
R_W	=	WELL WATER RETURN TO ALLUVIUM
R_P	=	PRECIPITATION PERCOLATION
W	=	WELL EXTRACTION
D	=	STREAM LOSS TO ALLUVIUM
R	=	STREAM GAIN FROM ALLUVIUM
P_D	=	DIRECT RAIN ON STREAM
CU_S	=	CONSUMPTIVE USE OF SURFACE WATER
CU_W	=	CONSUMPTIVE USE OF WELL WATER
CU_P	=	CONSUMPTIVE USE OF PRECIPITATION
E_P	=	USE BY PHREATOPHYTES
E_R	=	RESERVOIR EVAPORATION
E_D	=	DITCH EVAPORATION
E_S	=	STREAM EVAPORATION
E_B	=	BARE SOIL EVAPORATION

Fig. 3. STREAM-AQUIFER CROSS-SECTION

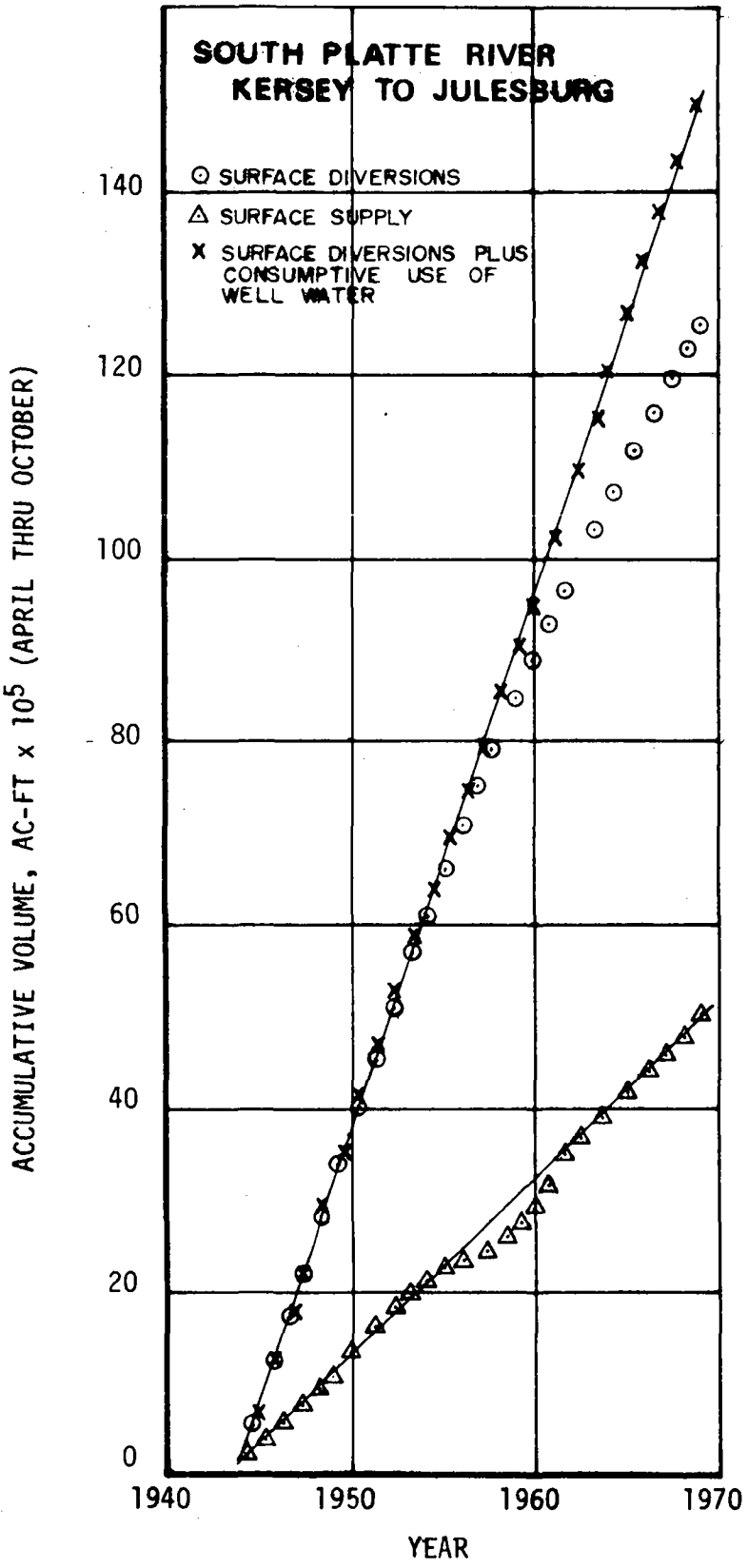


Fig. 5. MASS DIAGRAM OF SURFACE DIVERSIONS

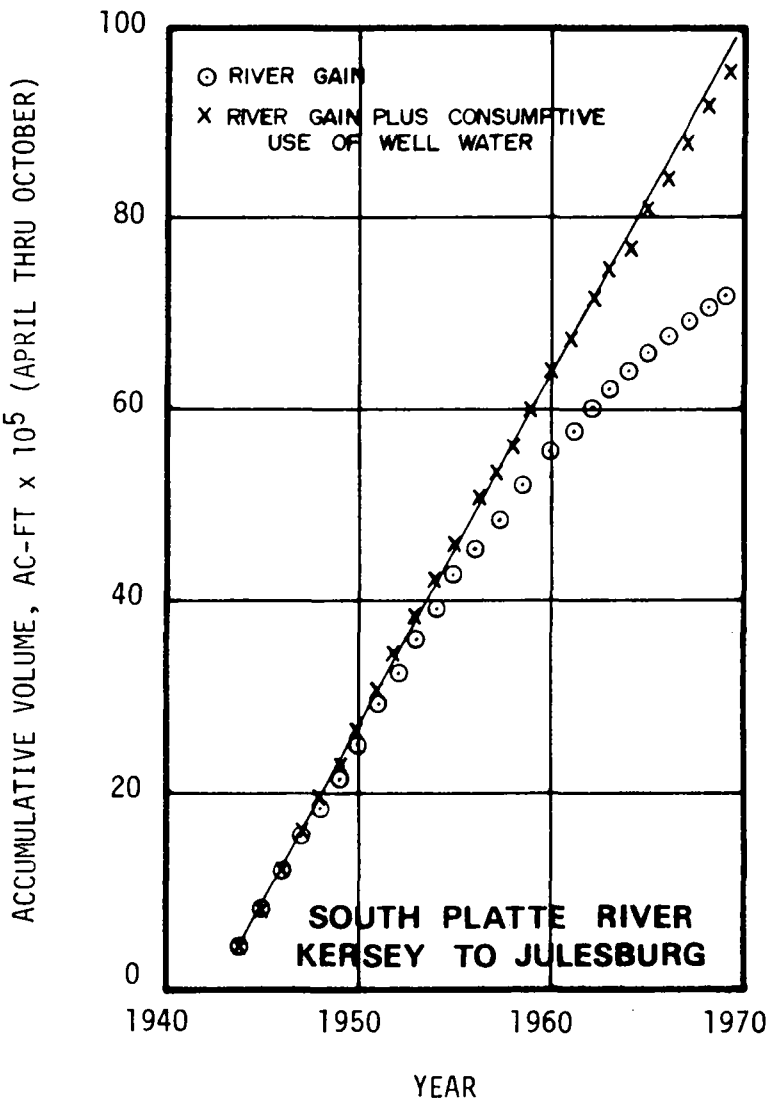


Fig. 4. MASS DIAGRAM OF NET RIVER GAIN

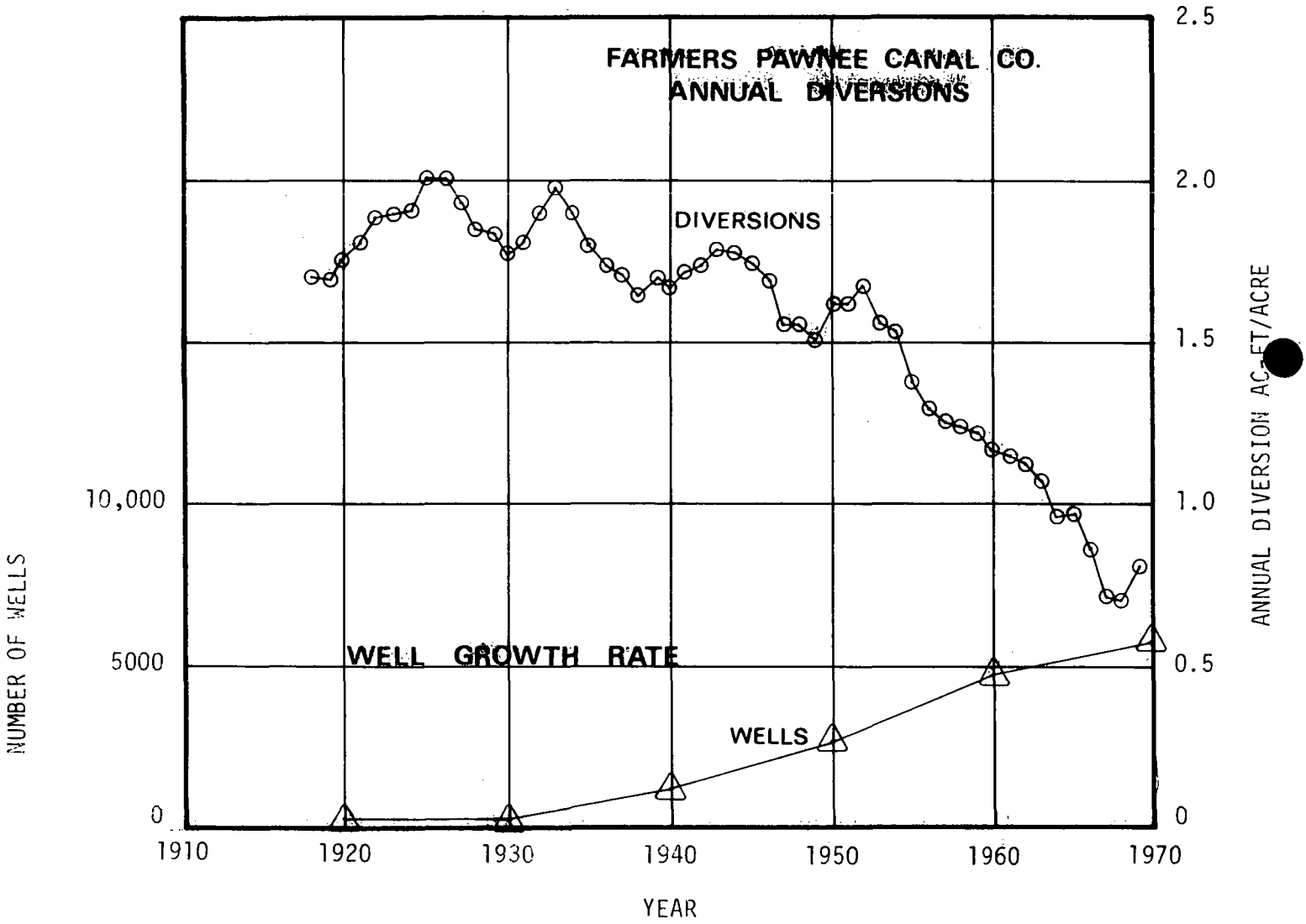


Fig. 1. ANNUAL CANAL DIVERSIONS AND WELL GROWTH

such an analysis. It will be noted that all of the arrows pointing upward are depletions and those pointing downward are accretions to the total water budget of this particular reach of the stream. Q_{in} is the measured flow of the surface stream at the upstream end of the study reach and Q_{out} is the measured outflow at the downstream end of the study reach. A balanced equation can then be derived by equating the accretions to the depletions and solving the unknown, which in this case is CU_w (Consumptive use of well water). Figure #5 from the AWRA report, shown below, demonstrates the effect of the consumptive use of underground water on the historic surface diversions for a period of some 25 years. The measured surface supply at the head of the study reach was plotted to demonstrate that the diminished surface diversions did not result from a diminished surface supply at the head of the reach, but rather the consumptive use of underground water, which would, in its natural course, have reach the stream within the confines of the study reach, was a dominating factor.

Figure #4 from the AWRA report, shown below, demonstrates the historic river gain from the beginning of well development in 1943 through 1969. It will be noted that the river gain continually trended downward as well development proliferated. If the consumptive use of tributary underground water is added to the points on the river gain curve, it will be noted that this curve is a straight line, indicating a direct relationship between the magnitude of ground water use and depletions to the stream.

Figure #1 from the AWRA bulletin, shown below, presents an analysis of the surface water diversions of a relatively junior surface water right as they relate to well development for the last fifty years. The reason for analyzing a relatively

junior surface water right is that, even though the surface water right is junior in relationship to the senior water right, it is senior to almost all of the wells in the South Platte River Basin. The most senior surface rights are not so adversely affected since the surface water which remains in the stream is utilized to satisfy those more senior surface water rights while the more junior ones suffer a major part of the injury caused by ground water consumptive use.

A considerable amount of evidence, above and beyond that shown above, was entered into the record to demonstrate the "state of the art" in forecasting behavior characteristics of various aquifer media and predicting future effect of intercepting return flow to the surface stream. The mathematical calculations and geohydrologic factors involved in these computations are highly technical and beyond the scope of this presentation. Those interested in these exhibits and evidence can acquire copies of the exhibits and transcript of the evidentiary material from the District Court in and for Water Division No. 1, Greeley, Colorado.

The culmination of this case[33] was a stipulation among all party litigants to an amended set of rules and regulations. These amended rules and regulations were republished to provide interested non-participants an opportunity to object to the terms of the stipulation; however, no protests were filed and the rules and regulations were finalized by court decree. The State Engineer presented extremely detailed and highly technical factual evidence with a minimum of legal argument. Cross examination by the 13 plaintiffs was extremely lengthy with technical advisors to the plaintiffs' attorneys in abundance. At the

33. No. 32 supra

conclusion of about 3 1/2 weeks of trial, the plaintiffs, without presenting a shred of evidence, requested and were granted a continuance to attempt to negotiate a settlement. It is ironic and unfortunate that the terms of the settlement incorporated the concept and most of the detailed provisions of the original rules and regulations which were proposed in 1969. With the final decreed settlement, dated March 15, 1974, some five years later, the long neglect of implementing conjunctive use of surface and tributary underground water bore bitter fruit in the form of time consuming, expensive and counter-productive litigation, but should provide a lesson in the efficacy of solving water problems as they develop, rather than procrastinating on consideration and action.

INSTITUTIONAL POLITICAL AND PUBLIC RELATIONS PARAMETERS

Political

The political ramifications of incorporating conjunctive use of surface and underground water factionalized the General Assembly into three broad categories:

1. Legislators from areas where ground water withdrawal had not yet become a problem;

2. Legislators from areas where ground water use was a major economic factor; and

3. Legislators from areas where surface water use was of prime importance.

Party lines were never of prime importance in consideration of this problem, with geographic location and economic factors dominating the issue. A proliferation of amendments and competitive bills prolonged the 1969 Session of the General Assembly into the longest session in Colorado history. The

bitterness and animosity generated during this debate in 1969 continues to exist among those involved legislators to this day, some six years later. The 1970 and subsequent elections reflected some of the dissatisfaction in those areas of self interest, resulting in the defeat of legislators on both sides of the controversy.

Public Relations

Before the wounds of battle in the 1969 Session could be healed and positive steps taken for the implementation of the new water law, a public relations program was necessary to depolarize fixed and unreasoning positions. A multitude of public hearings were conducted in areas where the controversy was the most heated. The initial public hearings were conducted by an interim committee of the General Assembly, accompanied by water officials of the state to explain the ramifications and offer solutions to the problems created by certain provisions of the recodified water law. These public hearings were conducted across the entire state in one "grand tour" by bus.

Following the "grand tour" mentioned above, a series of public meetings were held by the State Engineer, accompanied by technical members of his staff, to present in more detail the effect of the new law, the geological and hydrological aspects in each area, the economic impact and feasible solutions to the problems of integrating the use of surface and tributary underground water. These meetings provided the opportunity to correct much misinformation, dispel unfortunate rumors, explain the behavior characteristics of tributary underground water and the difference between tributary and non-tributary ground water. It is the opinion of this writer that these public hearings prevented complete chaos and near anarchy among the water users and assured them that

prudent interpretation and implementation of the new legislation would not jeopardize their livelihood.

Institutional Arrangements

From the public hearings mentioned above, local input was provided to the water officials of the state to ascertain the nature of public entities for implementing the integration of surface and ground water that would be acceptable to the water users and viable from the standpoint of enforcement of the law. It soon became evident that the water users were most reluctant to impose another tax-levying public entity on the already overburdened taxpayers. The general consensus was strong opposition to further taxing powers by a public entity, which amounted to a lien on their property. Further provisions generally favored in the formation of a water user entity was the membership to be voluntary and that the directors of any such entity be elected by the water users themselves. This is in complete contravention to the procedures for naming directors to water conservation and water conservancy districts and river basin authorities, whose directors are appointed by a district court, or by boards of county commissioners. The innate mistrust of an appointed board of directors was very evident. Reevaluation of statutes establishing water conservancy and conservation districts and river basin authorities may very well be in the best interest of the State of Colorado

Legislation was introduced into the General Assembly in 1969 and in subsequent sessions which would have assigned to the State Engineer the responsibility of planning, constructing and operating water resource development projects to integrate the use of surface and tributary ground water, with repayment of these costs to be borne by the beneficiaries of such projects at a low interest

rate and making it possible for the State of Colorado or other public entities to share in this repayment through non-reimbursable grants. Two proposed bills which were introduced were defeated primarily because legislators from those areas where ground water withdrawal had not yet become a problem were reluctant to appropriate money from the General Fund for the benefit of a specific geographic area or a limited class of the state's citizens. A rather compelling argument in rebuttal to this position was that the problem resulted from years of neglect by the elected members of the General Assembly and that those persons whose livelihoods were jeopardized by the restrictive legislation were entitled to some assistance from the State of Colorado through the General Assembly in resolving the problem and assuring the many ground water appropriators an opportunity to survive in the priority system

The opponents of placing this responsibility on the Office of the State Engineer argued further that those water officials charged with the responsibility of administration and distribution of water supplies should not be given the responsibility of water resource project development as it might result in a conflict of interest. The proponents of this legislation argued that the administrators of water were more aware of local problems and the possibilities for promulgating localized projects to resolve the problems of conjunctive use which would be acceptable to both parties in controversy. The State Engineer, as ex officio Executive Director of the Division of Water Resources, had access to the expertise and experience of seven Division Engineers in all the major stream basins in the state, and Water Commissioners on every tributary as well as the main stem of every stream in the state. The close working relationship

between the field personnel and water users would provide ideas and concepts at the grass root level for the expert technical staff in the headquarters office of the State Engineer to formulate projects which would be viable from the standpoint of law, geology, surface and ground water hydrology, engineering design and construction, operational procedures by computerized techniques and enforcement of repayment by water administration enforcement procedures. The General Assembly opted for the first position, i.e., that a state entity not charged with administration and distribution of water be assigned the responsibility for water resource project development.[34] Since enactment of this legislation, not one single project has been initiated to facilitate projects to accommodate ground water appropriators in remedying injury to senior vested rights and thereby survive in the priority system.

In its pronouncements it was evident that the State Engineer was expected, by the Supreme Court of Colorado and through provisions in the statutes, to give every assistance to water users throughout the state to accomplish conjunctive use and to "maximize the beneficial use of all the waters of this state" through administrative procedures and technical assistance. These pronouncements by the Colorado Supreme Court and the General Assembly prompted the public hearings mentioned above under the subtitle "Public Relations." Lacking the authority to initiate projects, the failure to act by water conservation or conservancy districts, the failure to form river basin authorities by uninterested Boards of County Commissioners and the failure of the State of Colorado to act under the statutes providing for project development with state funding[35] made it necessary to explore other means of implementing development plans. Personnel of the Division

34. Sections 149-19, 20, 21 and 22, Colorado Revised Statutes 1963, as amended

35. No. 34 supra

of Water Resources made a multitude of suggestions to water users through the public hearings referred to above for physical solutions for conjunctive use and institutional arrangements to accomplish these physical solutions. These suggestions resulted from staff analysis of local input from water users, the experience of field administrators, geologists and ground water and surface water hydrologists, engineers, attorneys, computer programmers, economists and legislators. The consensus favored the formation of non-profit corporations by the ground water appropriators, the membership of which would be voluntary, lacking the power of eminent domain and ad valorem taxing authority, with the boards of directors elected by representative groups of ground water appropriators. The first such organization was initiated in the South Platte River Basin under the corporate title "Ground Water Appropriators of the South Platte, Incorporated", with Articles of Incorporation filed with the Secretary of State on March 10, 1972. Means of augmenting the surface flow of the stream and furnishing replacement water to remedy injury to senior appropriators were suggested by the State Engineer's office to include the following:

1. Obtain rights for wells to be used as alternate points of diversion to surface water rights.

2. Obtain the right to use a well as a change of point of diversion for a surface water right.

3. Purchase storage rights in existing reservoirs for replacement water.

4. Purchase direct flow rights for use as replacement water to the stream.

5. Claim salvage water by eliminating non-beneficial consumptive use of phreatophytic growth.

6. Claim salvage water for replacement as a result of eliminating evaporation loss from areas of exposed water surfaces or lowering the water table.

7. Purchase rights to transmountain diversion or "developed" water.

8. Provide replacement water from non-tributary aquifers.

9. Recharge tributary aquifers during period of surplus surface water for pumping during periods of surface water deficiency.

10. Develop wells to pump water directly into ditches serving senior vested water rights during periods of demand by these senior rights.

11. Compensate senior surface water rights for the cost of pumping their own wells to remedy the injury caused by upstream wells and satisfying the senior surface water right, and

12. Develop upstream surface storage reservoirs to store water during periods of demand by downstream senior rights injured by upstream pumping.

The assistance of the staff of the State Engineer's office is freely given in providing data, ideas, concepts, reviewing locally initiated plans and formulation in the reconnaissance phase of project development. Detailed formulation of plans, designs, cost estimates and legal counsel for court adjudication must be provided by private engineering consultants and private legal counsel. It continues to be the policy of the State Engineer to provide a cadre of expertise for assisting water users and their consultants in the final phases of any plan of development, augmentation or replacement water plans.

At the instigation of the State Engineer and in recognition of the complexity of the problems involved in the conjunctive use of surface and underground water, the General Assembly appropriated funds to establish, maintain and operate a "Computerized Water Data Bank." To illustrate the magnitude of the problem of integrating surface and tributary ground water, the number of diversion structures to be administered by water officials of the state was increased from 21,000 to 85,000 as a result of the recodification of the water laws in 1969. The complexities of conjunctive use and quadrupling the number of structures to be administered

were such that manual record keeping, manipulation of surface and underground water supplies to maximize the beneficial use of both and general distribution of water supplies had become an impossible task. The Computerized Water Data Bank provided not only a tool to retrieve records on adjudication of water rights and diversion records, but also programs for conducting water supply studies, flood studies for defining flood plains and designing spillway and outlet works for dams, provide analyses of the transient character of underground water, define the effect of withdrawal of underground water on the surface stream, provide evidenciary and exhibit material in court cases, forecast the character and magnitude of runoff, monitor water quality of both surface and underground water supplies and ultimately control the administration of the waters of the state. The Water Data Bank contains records of all adjudication proceedings on water matters, historic runoff data for most streams of the state, 6700 volumes of historic diversion records, historic climatological data, aquifer characteristics, logs of well drilling activities, characteristics of each and every well in the state and characteristrics of some 3000 jurisdictional dams and their corresponding historic storage records. A cursory, simplified computation could indicate that quadrupling the number of structures to be administered would be accompanied by quadrupling the number of administrative water officials; however, the use of the Water Data Bank enabled the Division of Water Resources' officials to accomplish this task with an increase in personnel of about 45 percent.

CONCLUSIONS

1. The earliest possible resolution of the problem of tributary ground water withdrawal effecting surface stream flow will minimize polarization of conflicting interests and counter-productive litigation.

2. In devising legislation for the conjunctive use of tributary ground water and surface water, consideration must be given to each and every one of the disciplines involved by experts in each in order to avoid chaos and nonviable legislation.

3. Because of the intricacies of determining behaviorial characteristics of ground water and ascertaining the effect on the surface stream, computerized techniques are necessary. Manual manipulation of determining injury to a surface water right is so cumbersome and time consuming that rational decisions cannot be made in time to remedy injury to a senior vested right.

4. Institutional arrangements must well thought out, viable and acceptable to the general public in order to provide a healthy economic environment.

5. In arid and semi-arid areas, where reuse of water is a necessity, extreme caution should be exercised to assure that water quality is maintained below the limits of toxicity and usability.

HYDROGRAPHIC TRANSFERS IN SPAIN

by Jose Maria Martin Mendiluce*

1. SPAIN'S HYDRAULIC PROBLEMATICS

As a whole, Spain cannot be considered a dry country, within the world context. The total surface and underground mean runoff is 110.000 Hm3/year for an area of approximately 500.000 Km, which means a specific runoff of 220 mm. per year. This figure is very close to the 240 mm. of the European and world average.

For the present population, 35 million inhabitants, the total natural resources are 3.150 m3/inhab./year, and estimates for the beginning of next century with 52 million inhabitants would be 2.100 m3/inhab./year. These are comforting figures considering that a highly developed country such as the United States has a water derivation figure per inhabitant for all uses today and in its future provisions of around 1.300 m3/inhab./year. This figure may be considered a satisfactory demand ceiling for an adequate mean standard of living.

However even considering Spain as a geographic unit, it has natural resources that are considered sufficient in quantity but to be able to use a substantial part of these mean water volumes two serious hydraulic irregularities or defects that are found in our hydrography must be corrected: irregularity in time and irregularity in space.

Regarding the first point, our rivers are not actually rivers but torrents, the product of a most uneven rainfall system throughout the year and from one year to another. The practical water possibilities depend on the storage capacity available at each moment, to accommodate the natural irregular systems to human demand. Table No. 1 shows the contributions in the ten hydrographic regions dividing up Spain (See figure No. 1) and availabilities in the different situations foreseen, for two demand system types: uniform representing domestic and industrial supplies and variable corresponding to irrigation demand.

An examination of this Table shows the prime importance of regulation in Spain. If we take the uniform system as representative, we find that were there no reservoirs, out of the 106.000 Hm3/year that make up the hydraulic assets of Spain's rivers, only 9.200 Hm3/year would be useable with the guarantee that modern life requires, or in other words scarcely a 9 per 100 of our theoretic ceiling of availabilities, which would mean only 260 m3/inhab./year for the present Spanish population. This is really a narrow figure to meet modern life requirements. Thanks to the storage capacity available today (approx. 40.000 Hm3) more than 43 per 100 of this ceiling could be used for consumption if demand so requires, which represents 1.300 m3/inhab./year availabilities for the present population. Future perspectives are also encouraging, since if we double the present storage capacity, 60% of the theoretic availabilities ceiling can be regulated, which would mean an analogue figure (1,230 m3/inhab./year) for the estimated population at the beginning of next century. It may be affirmed that Spain's hydraulic economy depends basically on its regulatory reservoirs, a challenge of nature which the Spanish hydraulic Engineer accepted many years ago developing a gigantic dam construction work to tame our adverse hydrology.

* Dr. Engineer Roads, Canals and Bridges.

Secondly, we have irregularity in space. Table No. 2 summarizes the hydrological characteristics of our natural regions or basins that our Country is administratively divided up into.

The irregular runoff can clearly be seen, varying between a fourth and more than three times the average, or in other words from 1 to 13, from certain basins to others. A general observation shows that with the exception of the basins in the North of Spain, where the runoff is very high, the remainder are close to or below the average. This factor leads to a clear, traditional separation of Spain into two regions, which have been considered for many years now: Humid Spain and dry Spain. The mean runoff for the first is 67.8 cm., and for the second 15.6 cm. In other words, the difference of specific contributions is more than four times as much. Consequently, if we make an abstraction of the Northern Spain basins due to their singularity, as they produce over a third of the total river contribution in 11 per cent of the surface, the rest of the country, with almost 90 per cent of the area, does not present such a favourable situation regarding hydraulic resources, and falls within the semi-arid region category.

This is the first main feature of irregularity in space being analyzed: over one third of our natural resources are concentrated in a small area reaching slightly more than 10 per cent of the total area.

Within the so-called dry Spain (see Table No. 3) it can be seen that the basins of the Ebro, Duero and Tajo present the most favourable hydrological conditions. Effectively, these basins present runoffs that are higher than the mean and have over 65 per cent of the dry Spain contribution.

From this first hydrological analysis we find that the spacial irregularity of our resources is accentuated from North to South, with the North, Ebro, Duero and Tajo basins figuring as abundant, in principle. To move to the operative field of correction of this off-balance, in addition to the hydrological factors representing availabilities, the geo-economic factors must be used, and which are materialized in demands, in order to define, through the hydraulic balances, what the long term foreseen situation is in the different basins.

In Figure 2 a summary of the national hydraulic balance is compiled, according to basins and which has recently been up-dated by the Hydrographic Study Centre. For a correct examination of this, the following indications are essential:

- The balance refers to a temporary, relatively distant horizon which, in principle may be assimilated at the end of this century or beginning of next century.
- For resources available the regulated surface resources are computed exclusively, estimated at river outlet or international border and duly considering future regulation census possibilities, and the predominant nature of demand in the basin (constant or variable system depending on whether this is basically supplies or irrigation).
- Water demand for supplies is estimated according to the National Supply and Sanitation Plan and restricted to an estimated population of 52 million inhabitants (approximately year 2000). Industrial consumer provisions and a certain degree of reutilization is included in this demand.

- Water demand for irrigation is based on the exhaustive consideration of all the currently exploited irrigations, those under development or under project and also those plans that have in some way been subject to official consideration. This reasonably represents an irrigation potential measurement of the country which would be reached at approximately the beginning of the next century (4,300.000 hec.) should the area under irrigation be expanded at the present rate. Irrigation demand has been estimated without considering all technological progress effects regarding reducing consumption, in respect of the present irrigation practices.
- The balance is established excluding the underground water resources and demands currently attended to with this procedure. The reason for this is that there are no total evaluations of this resource, additional to the surface ones that are homogeneously feasible with estimates made for surface ones, although the additional underground resources apart from the ones computed are of little national importance, since these have been estimated at river outlets. According to the above mentioned figures, these resources may be around 4,000 hm3/year, in other words, 3-4 per cent of the total resources. The balances may therefore be considered perfectly valid from a national point of view, since differences of this kind fall within the error margins in the estimates.

The hydraulic balance clearly shows the main features of the national hydrographic off-balance, and in particular the situation disparity between the Atlantic and the Mediterranean coast, respectively characterized by each mass of resources localized in the North (North-west to be precise), and in the Ebro. It may be seen that 75 per cent of our natural resources are poured into the Atlantic, and almost half of these correspond to the North, and only 25 per cent to the Mediterranean. If we exclude this last figure, those corresponding to the Ebro basin, we find that our Mediterranean coast has less than 10 per cent of the Country's hydraulic resources and contains over 30 per cent of the population, which places it in a clearly deficitary position for the future.

In short, the most obvious conclusions derived from the balance would be the following:

(a) Spain as a whole can count on a comfortable quantity of hydraulic resources, at least well into the next century. It would not be of any use to state until when, since highly uncertain prevision factors must be considered for such widespread horizons: for example, the effects of technological progress, even if it is as regards irrigation technification, lowering the current water consumption. Observe the importance of this factor in the extrapolation of a balance as shown herein, where the irrigation demand is approximately 80 per cent of the total demand, and the consumption figure is even higher.

(b) With a forecast fixed until the end of this century, we must consider that based on local resources, all the Mediterranean coast (except the Ebro outlet) would be extremely deficitary. This is a factor that assumes importance if complemented by the fact that it is an area subject to a strong development rate (industrial, agricultural, touristic, etc.).

(c) There is no reasonable possibility of attending to the deficitary basins unless water is taken to them from the nearest surplus basins.

This latter point has led to planning the hydrographic transfers as being an adequate solution to solve the problems involved in the spacial off-balance. In theory the possibility of proposing as alternative solutions those derived from risking resources not accounted for in the balance could be objected to: sea water potabilization and additional exploitation of underground waters.

Regarding potabilization of sea water, the only realistic approach to the proposition is that if the deficient areas are coastal zones the sea would be relatively near. However, it is widely known that the most daring prospections into the future of seawater desalinization techniques do not offer hopes of reaching costs per cubic metre at levels such that the potabilization may be absolutely considered as an alternative to the transfers in correcting the nation's hydrographic off-balance. This does not mean denying that potabilization is, in fact an essential resource nowadays in supply problems raised in other, very different contexts to those now under discussion. And it does, of course, represent the "safety" that technology offers us to avoid restricting development through lack of water.

With reference to intensifying underground water exploitation, we can say that at the time when the national hydraulic balance was raised, it was impossible to quantitatively incorporate the value of these resources as there were no sufficiently feasible inventories available to be used when plotting the general features of the hydrographic off-balance correction. This was not, however, considered essential since the underground water survey work carried out in the Mediterranean deficitary basins, even though they were of certain intensity, offered no basis to expect future exploitable resources above the present ones, and whose size could influence substantially in a balance as mentioned. Consequently, adopting a prudent attitude towards the problem, the eventual local underground resources (in many areas over-exploited) were rejected when plotting a correction of the hydrographic off-balance in order to make the plans more flexible and safer; development would necessarily be long and initiated within an inevitable margin of insecurity.

More recent studies on total hydraulic resources have shown that this plotting had been right, revealing that the basic correction skeleton of the peninsular hydrographic off-balance must be made up of the transfer diagrams to which incorporation of the underground aquifers may provide a marked help, but they will never signify alternative solutions.

To summarize, Spain's hydraulic policy has been imposed and will be imposed in the future by these two hydrographic conditions, which in turn signify other challenges of nature:

- Irregularity in time which must be overcome by building regulator dams. This has been massively done during the last thirty years, and

- Irregularity in space which must be met with that great hydraulic surgery known as transfers between basins. This work was initiated on a large scale in the course of the past ten years.

We are going to dedicate the following chapters to discussing this second facet of Spain's hydraulic development.

2. TRANSFERS BETWEEN BASINS--PRESENT DEVELOPMENT AND FUTURE PERSPECTIVES

When talking of transfers between basins, we refer to those raised between different administrative regions, as the examples of small transfers between branches and main river or vice versa are very numerous within the same hydrographic region. In addition, there is no hydraulic diagram of certain importance that does not entail transfer of different rivers between basins. This same need that the hydraulic diagrams raise has therefore made the transfer between basins of a same region quite normal without these being considered actual "transfers" from a practical point of view.

The ones that do present problems, and which we are specifically going to refer to here, are those made between two or more of the ten hydrographic regions into which the Spanish peninsular territory is divided.

These transfers emerge from the hydraulic balance outlined in the previous chapter, permitting an overall picture of the Spanish situation, planning the possibilities that the hydrographic basins offer to be complemented in availabilities and demands on an interregional scale.

2.1 The Mediterranean Coastal Basins

2.1.1 General Outline

From a global future balance, we reach the conclusion that in the long term, all the Mediterranean coast (basins of the South, Segura, Jucar and Pirineo Oriental) will be deficient in water with a non-satisfied demand slightly higher than 5,000 Hm3/year.

As we have already seen, the surplus basins are Norte, Duero, Ebro and Tajo.

The North basins concentrate the most important surplus mass of the Country, but it is precisely localized in the North-west, to such an extent that the Eastern part of the basin, which has dense industry and population, is claiming water from the Ebro basin, which can grant it same according to the traditional diagrams, as we shall see later on. Under these conditions, should the North basins be included in the hydrographic off-balance correction scheme, work of unmeasured importance would be required. In a first stage it is not necessary to consider the real timeliness of this. This basin is left as a large reserve for the future.

Although to a notably smaller extent the same occurs with the Duero basin, although a transfer Duero-Tajo cannot be discarded for the near future.

With its plentiful surplus resources at the outlet, the Ebro presents the most important possibility of contributing towards the hydrographic off-balance correction. This has been recognized ever since the first diagrams were raised almost 40 years ago. The Ebro's resources should be taken practically at the river outlet, which in principle represents an advantage in plotting, since it does not permit physically exploiting the water to be deviated in service; nor should it logically arouse concerns over the future development of the Ebro basin, since the plentiful regulated resources in the interior part of the Ebro river are mainly due to the basin's special geographic shape. Compared with the other large Spanish rivers, this has permitted the large regulation dams of Mequinenza and Ribarrcia to be built, just a few kilometres from the river mouth. The volumes to be derived are regulated in the span itself and do not come from works located up-stream which may present another use alternative. This basin is the one that is nearest those of the Pirineo Oriental and Jucar, and its surplus is far above the demand that is not satisfied with the resources of these basins themselves. It should logically therefore meet these demands preferably and help where possible those of the South-east (basins of the Segura and Sur).

Of all the surplus basins, the Tajo basin is the nearest to the South-east, but its total surplus in the international frontier cannot be considered apt for transfer to the Mediterranean coast. The fact there is an adequate connecting point at the upper section of the Tajo, immediately downstream from the Entrepeñas-Buendía hyper-reservoirs system, permits the Tajo basin to be considered as a source of transfers towards the more southerly zones, but restricting the derivable volume to the amount of the real surpluses at the connecting point.

Consequently, the most suitable feeding basins to correct the hydrographic off-balance in a first stage are those of the Ebro and Tajo. This theory has been maintained for over forty years, but both are not alternatives as was initially plotted, but are closely complementary.

Effectively, the technical restrictions imposed by the correction diagrams do not permit the whole estimated deficit to be attended to with any of these sources isolatedly. This leads us to the clear conclusion that both are necessary. The Tajo basin does not have more regulated volume than some 1.200 Hm3/year at the tapping point for transfer, and of this, 1.000 Hm3/year may be considered surplus, if we consider the hydrographic modifications that the Madrid supply is going to introduce in the basin, progressively reestablishing the off-balance that the transfer could introduce. These transferable resources therefore can only satisfy approximately 45 per cent of the potential demand of the South-east, which cannot be satisfied with its own resources (approximately 2.250 Hm3/year). The remaining demand in the South-east and that corresponding to the basins of Jucar and Pirineo Oriental approximately 4.000 Hm3/year, whould be met with the resources over from the Ebro, which are in a quantity (6.100 Hm3/year) far in excess of this figure. However, there are other limitations making it impossible to establish the complete correction of the possible off-balance.

The Pirineo Oriental, to which approximately 1.400 Hm3/ year must be transferred according to the recent detailed studies to meet the requirements foreseen up to the year 2010, has a practically constant flow demand, as this is 80 per cent industrial and domestic supply. It is located at the most important and final stage (Barcelona) at a reasonable distance from the Ebro (approximately 160 Km). Use of the water is prioritary, with high payment capacity and there is therefore no other restriction than a comparison between availability and demand. Consequently, it is clear that the 1.400 Hm3/year foreseen deficit should be wholly provided for from the lower part of the Ebro.

The unsatisfied demand of the basins of the Jucar, Megura and Sur, however, are of eminently agricultural nature (approximately 80 per cent), and the large transport lengths required to reach the South-east as final objective (500 Km) do not permit a traditional irrigation diagram to be contemplated from the Ebro river, drawn up independent to the self resources, as it would require enormous costs and conduit capacities. It is here that a greater coordination between own resources and imported ones is required to make a feasible correction diagram possible. The Jucar basins (see Figure No. 3) may be grouped into three very different zones: Castellon in the North, Valencia in the Centre and Alicante in the South. The Valencia zone is practically self-sufficient with its own resources and the estimated deficit is divided between the Castellon and Alicante zones. Because of this, the correction of these basins is planned by a direct correction of the Castellon zone with flows from the Ebro, and replacing the self resources of the Valencia zone with waters taken from the Ebro, so as to use the freed resources in the Alicante and South-east zones.

Consequently, the flow derivable from the Ebro for these areas would be restricted because of this to the volume of resources that can be freed from the Central zone (Valencia) increased in the deficit of the North zone (Castellon).

On the other hand, the precise modulation in the consumer zones must be foreseen so that water transported to such long distances is carried out in a continuous way throughout the year, and the necessary storage capacity for this purpose may be another limiting factor, as we have discussed above. The reservoirs pertaining to the central zone, located at a low reading (Tous and Villamarchante) offer a solution to this problem by providing sufficient capacity so that the derivable flow limit is conditioned by the first hypothesis.

The volume released in the central zone has been estimated at approximately 1.150 Hm3/year, and the deficit of the Castellon zone at 600 Hm3/year. Consequently, the Ebro should provide 1.750 Hm3/year whereby the total derivation of this river for the Mediterranean coast would be 3.150 Hm3/year, which is approximately half the availabilities regulated in the lower section.

The correction diagrams of the hydrographic off-balance based on using the controlled surplus waters of the Tajo and Ebro do not therefore permit more than approximately 80 per cent of the long term demands to be met, which are not covered with self resources (100 per cent of those

corresponding to the Pirineo Oriental and almost 70 per cent of those of Jucar and Sureste). This clearly shows the need for both supply sources. Hopes are that the remaining 20 per cent can be compensated with the integral use of underground waters coordinating them with the surface waters, and to some extent reusing the resources available.

2.1.2 Correction Diagrams (See Figures Nos. 4 and 5)

To use the surplus waters of the Tajo and Ebro on the Mediterranean coast, three fundamental diagrams are proposed:

Tajo -- Segura
Ebro -- Pirineo Oriental
Ebro -- Jucar - Segura

TAJO-SEGURA DIAGRAM

The Tajo-Segura Aqueduct consists of connecting the Bolarque reservoir in the Tajo river with that of Talave, in the Mundo river using a 286 Km. long conduit in order to transfer a maximum flow of 33 m3/sec. from the Tajo to the Segura basin.

To carry this out, the Aqueduct works have been divided into four stages:

Stage I -- Elevation of Altomira
Stage II -- Canal of La Buieda-Alarcón
Stage III - Canal of Alarcón-La Mancha
Stage IV - Talave Tunnel

Stage I -- The river Tajo waters are taken from the foot of the Bolarque dam, which creates the counter-reservoir of the large hyper-reservoirs of Entrepenas and Buendia.

The Aqueduct is initiated taking the water at this reservoir, using pipes that cross the dam block. A reversible 202,000 Kw. power elevator plant is located at the foot, and drives the water to the top of the Altomira mountain via a double steel pipeline, with a variable diametre between 3.15 and 3.45 m., which clears a gradient of 210 metres with a total length of 1.025 metres.

The pipeline is followed by a pressure gallery 5.35 m. in diametre and 14 Km. in length, perforated throughout the mountain crest and at source it has an equilibrium chimney 75 m. high and 25 m. in diametre. This constitutes a record work and is singular in its kind. The pressure gallery, completely lined with reinforced cement has its outlet in the reservoir of La Bujeda and is made up of three dikes of loose materials. This reservoir capacity, slightly more than 6 million cubic metres, will permit the pumped water to be stored during the minimum service demand hours, to be continuously injected to the Stage II and to the Altomiro power station during the peak power demand hours.

The water is located in the origin of Stage II through a second pumping station which only consumes power when the reservoir level of La Bujeda is below the water bar in the canal.

The Bolarque-Bujeda system has been designed to lift up to 66 m3/sec. in pumping system and turbine up to 99 m3/sec. when operating as power production station.

When the 1.000 Hm3/year of transfer foreseen as maximum limit are eventually pumped, 1.100 million Kwh. per year will be consumed and 200 million Kwh/year of peak power will be produced.

This State constitutes the first example of reversible modern harnessing in Spain, where a subsidiary accumulation station function to produce peak power has been incorporated to the primary flow elevation function of the transfer.

Stage II -- A conduit is initiated in La Bujeda reservoir which clears the distance of 90 Km. up to the Alacon reservoir by means of alternating stages in canal, aqueducts and tunnels. The passes of rivers Riansares and Giguela should be given special mention among the aqueducts. With lengths of 2.900 m. and 6.300 m. respectively, with foundations in difficult land and supported by up to 50 m. high pillars, they constitute real records of their kind. Likewise, out of the twelve tunnels built in the span, special mention should be made of the Villarejo one (crossroads of the Guadiana-Jucar divide), 4.735 m. in length, in view of the difficulties found in perforation.

Stage III -- Stage III, 106 Km. in length has been initiated in the Alacon counter-reservoir. In the first phase of the transfer plotted for 600 Hm3/year, it makes use of the Picazo tunnel which was built for the water-head bearing the same name. The canal has an important Aqueduct, Santa Quiteria, which is slightly more than half a kilometre in length, supported by 15 piles up to 30 m. high.

Stage IV -- This stage without doubt is the masterpiece of the Aqueduct. It consists of clearing the Jucar-Segura divide, and by means of a 32 Km. long tunnel crosses the Hellin mountain range. The tunnel is drilled at depths of between 200 and 300 m. in an essentially jurassic block of winding, difficult geology, with very important underground flows. This tunnel may be classed as one of the world records in view of its geological difficulties. It is also an absolute record in Europe for its length.

EBRO-PIRINEO ORIENTAL DIAGRAM

The Aqueduct spreads over a length of 160 Km. between the Ebro river and Llobregat basin, across the provinces of Tarragona and Barcelona. In view of the large transport length and demand feature, predominantly supply, it is plotted for an extraction at constant flow throughout the year, with the necessary modulator dams, which are mostly near to the consumer centres. Designed in this way, a minimum perturbation is obtained in the power exploitation of the reservoirs of the lower span of the Ebro, along with a more complete use of the conduit works.

The water intakes are found in the Ebro river, near the town of Benifallet. The supply of the necessary flows (45 m3/sec. on average) is basically guaranteed by the large reservoirs of Mequinenza and

Ribarroja, located in the Ebro river itself, upstream, which have an overall capacity of 1.740 Hm3. The low water level at the tapping point (10 m.s.n.m.) makes an important pumping necessary to gain sufficient height to permit the water to be transported to its points of destination. From the pumping station, the water is driven to the Rasquera dam, 9 Hm3 capacity approximately, located at almost one kilometre from the Ebro river, clearing a maximum gradient of 240 m. The reduced distance between the pumping station and the head reservoir offers a very attractive possibility to adopt a reversible pumping solution, for better power harnessing of the system. The working system is foreseen on the basis of weekly regulation, pumping at low hours (eight on working days and twenty-four on public holidays) and turbined at peak hours (four on working days). The forced discharge is 180 m3/sec. and turbined discharge is 225 m3/sec. The precise capacity for weekly regulation is 15.5 Hm3. The Rasquera reservoir is complemented with that of Burgans, in the Compte valley, and both are connected by a 5.10 m. diametre tunnel, 9 Km. long which permits a discharge of 101 m3/sec. to be handled. 480 MW is the power to be installed, with a final consumption of 1.800 Gwh/year and production of 500 Gwh/year. Of these 1.800 Gwh/year approximately 1.050 Gwh/year correspond to the pumping of the 1.400 Hm3/year foreseen for the year 2010 to meet the supply and irrigation demands. By that date, this could represent a figure of around one per thousand of the total electric power consumption in Spain.

The origin of the main conduit of the Aqueduct is found at the Burgans reservoir, which with 27 Hm3 capacity provides the necessary complement for a weekly regulation of the reversible pumping and 20 Hm3 to complete the 170 Hm3, which the annual modulation of the irrigation demands requires, as it is not possible to exceed the 150 Hm3 with the route and tail reservoirs of Gaya, Castellet and Noya, which form part of the system. This conduit starts out at reading 190 m.s.n.m. with capacity for 47 m3/sec. and after travelling 68 Km (26 Km. in tunnel and 42 Km. in open conduits) it places the waters at the level of the Francoli river, after supplying agricultural demands and the supply requirements of the Campo de Tarragona.

From the Francolí river, the canal's capacity is cut to 42 m3/sec. and after travelling 15 km. (1 Km. in tunnel and 14 Km. in the open) it reaches the basin of the Gayá river, feeding the reservoir bearing this name. This, with a maximum level at reading 128 and useful capacity of 57 Hm3, will be the origin of the supply conduits for Tarragona and its area of influence, and those of local irrigations.

From the Gayá basin, the conduit continues with a capacity of 36 m3/sec. and after running 35 Km. (23 Km. of tunnel and 12 Km. of open conduits) it stops at the river Foix basin, tipping the discharges into the Castellet reservoir which has a useful modulation capacity of 40 Hm3. for level 133 maximum reservoir.

From the Castellet reservoir two main conduits start. Their purpose is to locate the necessary discharges in adequate points to meet the Barcelona zone demands. The first starts at reading 100, approximately, with capacity for 13 m3/sec. and after running 32 Km. in tunnel, crossing the Garraf massif, it places the waters by gravity opposite the Llobregat river near to the town of Gava, where the treatment stations will be installed, from where the pressure conduits will leave, to inject the necessary discharges in the Barcelona distribution system and nearby areas, to meet demands below the 70 reading, approximately. The second conduit of 17.5 m3/sec. which also starts at the

foot of the Castellet reservoir, with a drive 1.200 in length and 85 m. in height, 33 NW power and an annual consumption of 130 Gwh, is developed in the Penedés region and after running 27 Km. (9 Km. in tunnel and 18 Km. in open ducting) tips the water at reading 180 in the Noya reservoir, 51 Hm3 capacity, where the discharges will be modulated for a continuous delivery of 15 m3/sec. to the purifier stations, from where demands of the Barcelona area at a higher reading can be attended to, and which are not supplied with self resources.

From the Ebro river, the water delivered to the Gavã zone will cover a conduit length of 160 Km (1 Km. in impulsions, 90 Km. in tunnel and 69 Km. in open ducting) and the one placed in the Noya reservoir will have run across 156 Km. (2 Km. of impulsions, 67 Km. in tunnel and 86 Km. in open ducting).

EBRO-JUCAR-SEGURA DIAGRAM

It has already been mentioned that this diagram has been designed as total of two transfers: one of the Ebro to the Valencia zone and the other of the Jucar to the areas of Alicante and South-east. The Ebro-Jucar diagram is fundamentally supported on the Tous and Villamarchante reservoirs, located on the Jucar and Turia rivers respectively, which with 500 Hm3 total capacity permit over 1.500 Hm3/year to be modulated for irrigation. Since the maximum storage level in Tous is 133 m. above sealevel, an important pumping of the Ebro in Cherta is also necessary, which places the water above level 140-150 at origin. The total transport capacity of the diagram has been preliminarily estimated at 1.750 hm3/year, or 56 m3/sec.

However, it does not seem justified to program a sole diagram of the capacity mentioned at the present moment, since the self resources of the Mijares and Valencia zone are not completely used (the Arenõs reservoir construction on the Mijares river will mean additional yield of 65 per cent of the currently regulated resources; the Valencia zone today does not use more than a scanty 60 per cent of its possibilities), and the South-east, as tail user of the Jucar-Segura scheme, has resolved its medium term expansion problems with the Tajo-Segura Transfer. The replacement of discharges involved in the wide Ebro-Jucar-Segura scheme should be a later step towards completely using the self resources; its cost is less than that of the large Ebro transfer, coordinating development of these self resources with the said substitution, in the best way possible. The cost of the large scheme of the Ebro will be reduced to useless intercalated interests if effected at the right moment for a quick use of the discharges.

If, however, we wait until a favourable time presents itself to develop the large Plan, the irrigation scheme of wide areas such as those between the Ebro and Mijares rivers will be delayed, and which have to be supplied directly from the Ebro and those between the Mijares and Turia which have been programmed to be supplied with discharges from the Mijares today assigned to this river's holm and which will in future be fed with discharges from the Ebro. For this reason, the large Ebro-Jucar scheme has been fractioned into two phases, such that a first one permits discharges from the Ebro to the Mijares to be reached in the necessary amount to permit a partial development of the

the areas between the Ebro, Mijares and Turia. In a parallel way, the termination of the Jucar-Turia Canal currently underway for a short term use of the regulated resources available in the Valencia zone, will permit the Mediterranean coast between the Ebro and Jucar to have reasonable expansion possibilities, without having to resort to very important investments. Likewise, the anticipation of an Ebro-Mijares part scheme will at medium term permit the feeding problems of water to the IV Integral Siderurgics of Sagunto to be resolved.

The first of the schemes currently under construction has the purpose of reaching the low area of the Mijares (reading 60 approximately) releasing 24.500 Hec. of irrigation assigned to own resources. Throughout the layout, another 25.000 Hec. can be irrigated, establishing a route modulation in the San Miguel river to accommodate the discharge extracted from the Ebro in a constant way according to irrigation requirements. Some 350 Hm3/year are needed for irrigation, to which 40 Hm3/year must be added to supply populations and 200 for the IV Integral Siderurgics of Sagunto in its widest supply version.

The capacity of the scheme works out at 600 Hm3/year or 19 m3/sec. which would have to be pumped from the Ebro in Cherta to reading 150 approximately.

The second scheme would be 1.150 Hm3/year capacity, namely 37 m3/sec. with pumping from the Ebro in Cherta up to reading 24- 250 and a canal which would tip into the Tous reservoir in the Jucar river, releasing discharges in the Villamarchante reservoir when passing through the Turia. Sections of this reservoir when passing through the Turia. Sections of this, such as parts of the Mijares-Turia and Turia-Tous can be built immediately after the first above mentioned scheme, and the Jucar-Turia Canal, to use discharges released with these works.

The Jucar-Segura Transfer, foreseen to use the waters released from the Jucar with the grand Ebro scheme, has been studied placing the connection at level 300 approximately, in the conflunce of the Jucar and Cabriel rivers, where most of the regulable volumes of this basin by the Alarcón and Contreras reservoirs are available. The zones of Alicante and Sureste are fed with these waters, and the volume assigned to this latter zone depends on the underground waters available which are determined in this area. The scheme includes an important pumping of 300 metres to clear the divide with the Vinalopó river,and a later energy recover, in 400 m. gradient with modulation in the Cid reservoir located in the lower section of this river.

2.1.3. Situation of the Schemes

The Tajo-Segura Aqueduct is today at an advanced stage of construction, and over 90 per cent of the works have been concluded. It is expected by 1976 that the first discharges from the head of the Tajo river to the Mundo river in the Segura basin will start beging transferred.

The works corresponding to the first phase (Ebro-Mijares Scheme) are initiated in the Ebro-Jucar-Segura scheme and are scheduled to be concluded by the eighties. The rest of the large scheme has not been initiated and will not be started until the middle of the nineties.

The Ebro-Pirineo Oriental scheme is currently at final decision phase after being subject to public information to notify the country accordingly. The proposal is that it will be built such that it can go into service by the beginning of the eighties.

2.2. The Cantabric Coast Basins

Although it seems a paradox, the North of Spain which has the Peninsula's maximum hydraulic riches has been the first to receive water transferred from another hydrographic basin: the Ebro. It must be explained here that although all the North basins have a plentiful rainfall, and as a whole the regulated and regulable volume yields are very much higher than necessities, the narrow coastal stretch between the Cantabric mountain range and the sea presents a special hydraulic problem which is different from the rest of the region. The hydraulic systems of these rivers are far more regular than in the rest of Spain and with moderate regulation capacities, use of a large part of their resources would be possible. However, due to its mild climate it is an area of large demographic concentration, where the industrial development has reached very high levels. The uneven topography has compelled the valleys to be occupied with a large number of villages, industries, communication means, etc., which makes the construction of regulator reservoirs practically impossible today in the topographically ideal places in view of the wealth they would destroy. Because of this, transfers exist and have been planned in this narrow strip from the Ebro basin to meet the water requirements, although future planning is designed in a more rational way, as we shall see later on.

2.2.1. Ebro-Nervión Transfer

The Gran Bilbao district where the Nervión river has its outlet gives a clear example of the current problematics, with an annual mean yield of over 1.100 Hm3/year. However, the yields that these mean resources could guarantee were only around 2 m3/sec., or less than 10 per cent of the natural resources. To solve the supply, long term problems, a transfer has been necessary from the Zadorra river in the Ebro basin, since the regulation possibilities with our resources within the basin were practically exhausted, and the transfer in its double use aspect (hydroelectric and water supply) proved to be the cheapest and most feasible solution.

The transfer work in itself was constructed by the energy sector to produce electric energy at peak hours. It went into service in 1957. It consists of two reservoirs in the Zadorra and Santa Engracia rivers 230 hm3 capacity, communicating via a 3.551 m. tunnel, a pressure gallery, 12.50 Km. long and 4.25 m. in diamatre, which has its outlet in a charge well 431 m. in length, producing a maximum gross jump of 329 m. (see Figure No. 6). The power station today has an installed power of 86.500 Kw. and the annual mean production is 225 Gwh., but its expansion up to a total power of 175.000 Kw. has been foreseen.

The conduit water supply works have been constructed from the water return points in the Nervión basin, with a capacity for 9 m3/sec., which will permit the district's needs to be met until the end of the century.

Last year, 1974, a water demand of almost 51 Hm3 was met with this scheme, namely a volume similar to that of the other supply sources.

2.2.2. Ebro-Besaya Transfer

Some years ago, in the same way as the Bilbao supply was resolved, a transfer was planned from the Ebro reservoir in the basin of that same name, to the Basaya basin, in the North of Spain, for the purpose of resolving future water supply problems for the industrial zone of Torrelavega, and other nuclei in that region.

To give some idea of the high hydraulic output of this transfer, which was only planned to derive at the most 22 Hm3/year from the Ebro basin to the Basaya one, it permitted the current yields estimated at 16 per cent of the natural mean resources to be increased up to 28 per cent by merely detracting 2 per cent of these mean resources to the Ebro basin.

A hydroelectric company raised a concession application for a reversible installation in the Basaya basin, which with a 430 m. gradient could provide 1000 installed MW and its connection has been studied with the proposed transfer such that without detracting any water volume from the Ebro reservoir and only using it as an inter-annual accumulation deposit of the Besaya waters, it can in time regulate between 60 and 70 per cent of the natural mean flows, by merely conditioning the Ebro-Besaya transfer so it can operate in both directions. The proposed scheme can be seen in Figure Number 7.

2.2.3. Future Perspectives

Evidently at long term, the way of most intensively using the important resources of this coastal strip of the Cantabrian coast must be found.

Considering the sharp gradients of the rivers at their head in this area, they are recommended to install pure pumping and energy production power stations in closed cycle, with large gradients and short conduit lengths. Combining these installations with transfers between the Cantabrian slope and the plateau (basins of the Duero and Ebro) in times of high waters it is possible to transfer discharges from the North to these other basins, where their storage is far easier, taking them back in low water times in the necessary amount to meet the demand supply, and letting the surplus run off via the Duero or Ebro basins if necessary to meet demands of same. The average yeild of the rivers in this zone is 12.500 Hm3/year, of which it is only estimated possible to control just over 20 per cent with reservoirs. Hence, the enormous potential of possibilities that this yield system offers to increase the country's assets in the North of Spain basins, where the discharges flow at present, and in the neighboring ones of the Ebro and Duero is evident, contributing in a very substantial way to correct the nation's hydrographic off-balance.

3. CHARACTERISTICS PECULIAR TO THE TRANSFERS IN SPAIN

Perhaps the most distinguishing characteristic of the recent transfers made and proposed in Spain is that the modern reversibility techniques have

been introduced in them, opening new horizons in the hydraulic resources field.

The traditional hydroelectric potential has been used in an important percentage. Of the 150.000 Gwh/year in which the gross Spanish lineal potential has been assessed, 45 per cent is considered useful today from a technical and economic point of view, namely 70.000 Gwh/year approximately, of which slightly more than 50 per cent has already been taken advantage of, which represents almost 45 per cent of the country's electric energy demand last year, 1974.

Although the energy volume demand growth is making it necessary to establish an increasing number of conventional and nuclear thermal stations, it is also true that the power and regularization needs of the load curve advise that our hydraulic stations should be over-equipped and reversible pumping and production stations should be installed as the necessary complement of the large thermo-electric units. This today is a far more evident necessity than it was several years ago, since forecast development for nuclear power technically speaking requires the pumping complement for an adequate exploitation.

The National Electric Plan estimates that important powers will be installed in reversible stations, and at the beginning of the next decade this will reach 8.000 MW.

In view of this perspective, and as important pumpings are needed in the hydrographic off-balance correction schemes, they have all been planned as reversible. This will permit 1.150 NW to be installed, or almost 15 per cent of this type of power foreseen for the beginning of the next decade. This is not at all a bad contribution towards the national electric market's peak coverage which makes this modern multiple yield form a reality, matching development of the hydraulic resources with the power sector.

Looking towards the future and considering the low marginal cost of fuel in nuclear plants, which must predominate in the power to be installed in the next few years, if pumpings are made during off-peak hours, as these reversible installations require, this must very considerably cheapen the exploitation costs of these transfers.

Reversibility will also contribute decisively towards solving the Cantabric coastal problems and increase the yields of the neighboring basins (Ebro and Duero). It will permit the combined technique of regulation by pumping and transfer between basins in both directions to be economically applied.

4. DIFFICULTIES FOUND IN PLANNING THE TRANSFERS

As scarce natural resources, our river water in Spain is a public asset, which should be used to meet the growing demands of use in the most economic way possible whenever possible. This theoretically logical principle encounters large difficulties when being put into practice,

when transfers are required between various hydrographic basins, detracting yields from the best hydrologically equipped areas to benefit the scarcer ones, since the inhabitants of the basin affected by the transfer are very strongly opposed to renouncing this resource even if it is over-abundant, and at least claim they want their possible potential development fully guaranteed.

Consequently, and even for the sake of common welfare, the fresh water should be used where it is needed at each moment. The first phase of national hydraulic planning in Spain to correct the hydrographic off-balance has been made based on using only surpluses taken from the abundant areas, in the deficitary zones, adopting a realistic attitude to make the planning humanly feasible and avoid unending polemics which end up in paralyzing the success of the foreseen objectives. Based on this criterion, which goes further than Spanish legislation currently rules in water matters, it was easy to refute any essential argument, as nobody could have convincing reasons to oppose using surplus waters which would otherwise run unproductive into the sea.

Notwithstanding this very objective planning, procedures for the recent transfers have met with opposition and difficulties. The first Ebro-Nervión transfer did not meet with any difficulty and developed in a simple and normal way as any other hydraulic use expedient granted in accordance with the current waters legislation. This perhaps was because it was proposed at a time when the value of the water had not penetrated the conscience of its citizens so deeply, or because the progressive shortage of this vital element was not so clearly evident as it is today.

4.1 Tajo-Segura Transfer

In 1968 the General Draft Project of the Tajo-Segura Transfer was submitted to public information.

Since the connecting point is at the head of the basin, detailed balances had to be made of the Tajo basin in the present and future situations, in order to check that the foreseen discharges would not affect the basin's potential development. The extension of the area to be irrigated (366.000 Hec. compared with 145.000 Hec. today) was not a reason for substantial objection, but the effects that the transfer could have in the potential demands, considerating the availability of water at that moment, were a reason for concern. In other words, the basin agreed that in the future situation there would be regulated water for all potential uses that would not at long term be affected by the proposed transfer, but this would need a series of construction works which, if not suitably coordinated, could involve a delay in the potential development, and they were not prepared to accept this risk. The likelihood of this coming about was very small, as the Draft Project warranted that the hydraulic off-balance that the Tajo-Segura transfer could produce in the mean section of the Tajo river, would be progressively corrected by the Madrid supply. These scaled execution plans consist of transferring surplus waters from the east zone of the basin, to put them in the middle section, whereby this will receive supplementary regulated yields the same as those derived from the South-east. Since the Nation's capital's increase in consumption is fast, there is no

danger in this discoordination coming about. However, the Tajo basin persisted in its demands, and to satisfy them the transfer was divided into two phases: a first one where the derivable volume did not exceed 600 Hm3/year--this figure represented the surpluses on the potential demands at that time. To tackle the second one, 400 Hm3/year, prior to new public information it would be necessary to show that the regulated volumes available had been increased in this amount.

The attitude of the users of the Tajo basin shows they do not want to give in whatsoever to anything involving a reduction in their current work possibilities, even though they are sure that the hydraulic balance can be restored, but this would involve investments, and if these are not available, the exploitation of these possibilities could be delayed.

The assurance that no hydraulic incompatibilities were going to be produced between the transfer and development of the Tajo basin, advised the transfer scheme construction for the 1000 Hm3/year final capacity proposed, which is what is today being done.

Apart from the physical assurances that the Tajo basin introduced in conditioning the transfer, regarding compatibility of same with development of its potential possibilities, they also wanted this development to be programmed temporarily as far as possible by means of a special law.

The Tajo-Segura Joint Use Law, approved in 1971, in addition to comprising the division in phases as mentioned above and to sanctioning the surpluses for the transferred waters, concentrated the works and studies to be made within the basin. This Law basically constitutes a commitment on the part of the State towards the attention it must give in the Tajo basin development.

4.2 Using the Ebro Surpluses

In the case of the schemes to use the surplus water of the Ebro, in principle it seemed that things would be more simple. This is the river with the greatest discharges in the country and the proposed transfer take is near the outlet, namely downstream from all the important present and future uses of the basin. The question of these transfers to use surplus waters could not in the future involve any concession denial upstream due to being affected by the lower derivations proposed. On the other hand, the current yields situation in the lower section of the river is very plentiful, thanks to the important regulation works existing there, and no arguments similar to those of the Tajo could therefore be used that it would affect the current yields situation on the development potential, as this requires specific and concrete regulation works within the basin for execution.

Objectively speaking, therefore, there are no problems, as this involves intercepting waters which would otherwise run improductive into the Mediterranean sea, regulated by the reservoirs built in the lower section of the Ebro which guarantee its existence, no

matter the use of discharges made upstream. In spite of this, however, more serious difficulties have been raised than in the Tajo-Segura case, no doubt because the subject of water is making itself more and more aware to the citizens, and in during recent years has aroused a real national awareness of its worth.

By reason of the Ebro-Pirineo Oriental Aqueduct notification to public information, at the beginning of 1974 the opposition has written about the Ebro basin on numerous occasions, basing its reasons on two main points:

a) Doubts as to whether surplus waters exist;

b) Priority in executing the development works of the Ebro basin over the transfer ones.

Before the Administration submitted its specific derivation plans of the discharges in its lower section to public information, the Ebro basin planned a potential use that was apparently so exhaustive that it could lead to belief that there would not be any surplus waters in the future.

Studies carried out in the Draft Project and later on, carefully analyzing the detailed balances of the Ebro basin in the maximalist hypothesis of development raised, have shown the existence of these surplus waters and the compatibility of that maximum development foreseen for the Ebro basin and the uses proposed to correct the national hydrographic off-balance.

Although it has proved laborious to try and show the existence of surplus waters, it has finally had to be accepted in face of the consistence of the Administration's technical arguments.

However, the question of priorities is still subject to controversy. The Ebro basin has gone further than the Tajo in asking that the potential foreseen developments be a reality before the surplus discharges are derived. This is because the Ebro basin is a depressed region compared with the Pirineo Oriental, which is already highly developed, and which thanks to the proposed transfer is going to accentuate the present differences even more. This is a higher limit of aspirations, naturally not meriting attention in a logical idea of national development, but which has in short raised the problem of regional off-balances as a leading weapon against the proposed transfer.

The economic planning of the investments is, in short, being debated with this scheme rather than the hydraulic programming to assign resources and its legal repercussions.

5. LEGAL ASPECTS

The present Spanish Law on Waters, which is almost centenary, does not recognize expectancy rights of the riverines and considers all surface waters of public domaine. Without further special requirements it permits any water transfer to be made between basins if the State considers this use convenient

for the common good. This does not mean that whenever possible the interests that the basins reveal to achieve their later development are not protected.

In the same way as transfers are established between rivers within the same hydrographic basin or between smaller independent basins of a same hydrographic region, they can be made between different regions. Since the administrative division by natural hydrographic basins was adopted after the enactment of The Water Law, the law could not consider this issue, but it did consider the country as a hydrographic unit and water as a common good of all Spaniards.

According to these principles, the procedure for the first transfer between hydrographic regions (Ebro-Nervion) was developed with the normal opposition that all hydraulic works come up against, and it was resolved successfully without further popular moves in favor or against.

In the second important transfer (Tajo-Segura) the question aroused serious controversies. Although the Spanish legislation does not cover it, the Tajo basin water users as a whole understood that "the water was theirs." In other words, that the Riparians' rights were a reality. Consequently they wanted guarantees that these discharges were not necessary for the basin. In addition, they demanded compensations for ceding the waters in works and studies which contributed towards the development of the basin, and that these points be compiled in a by-law of maximum legal scope.

These requests need not have been considered in a strictly legal sense, nor the successive steps taken which led to publication of the Law, as recognized by the Spanish Parliament apointed to study and inform about the project Law, which reads textually:

> "This Law is based on article 17 of Law 1/1969 of February 11, approving the II Development Plan which reads as follows:
>
> "The use of the Tajo-Segura hydraulic system shall be rules by a Law."

In fulfillment of this mandate the Government has sent the Parliament a Project Law, which this report is going to omit herein.

Had it not been for the mandate mentioned above, this special Law would not have been necessary whatsoever. Certainly the work itself represents an achievement of immense technical, economic and social importance and demands constructive means and financial resources that are not at all usual. It is also true that the transfer of an important discharge of the basin of one of our large Atlantic rivers to the Mediterranean basin is a realization that is not done every day. But we should not forget that through our General Legislation on large hydraulic works, General Plans of Public Works, Waters, Irrigation Zones of National Interest and Investment Plans, it has been possible to execute the great transformations that are our country's pride, without resorting to special Laws, as in this case. Furthermore, this Law has not been necessary to undertake the Tajo regulation, the works of which permit the transfer.

By applying to a Law, this clearly denotes intentionality, to make the Law be a guarantee, a clear proof, an instrument of self-limitation to the Government itself in the service of juridical safety of the Tajo basin's interests.

Hence, the two zones which the Law affects must therefore be considered in a different way. Regarding the Segura, the Law should merely assure the transfer discharge, but should not prejudge the uses or ends that these waters will be destined to, nor the geographical areas to which they may be ascribed. This is a subject which must be resolved according to the general norms mentioned herein.

The second zone is the Tajo. It is on this that the precept must operate as it must assure that the transfer does not involve confiscation of rights, which would be contrary to the legality that our constitutional system demands, nor does it impair the ones legitimately acquired, nor the impossibility of the foreseen works that the basin waters are destined to, not being carried out because of the transfer. From the point of view of the common welfare of the people, and applying the principle of national solidarity, the public waters should be sent to the place where they prove to have the most beneficial effect in the economic and social aspect, and to improve the living conditions of the whole of the Spanish nation."

However, after publishing this Law, it has been recognized not in a general way but in the specific case of the Tajo basin, that the volumes to be transferred are surplus waters of the present demands and the concrete potentials indicated in same, which could be interpreted as a certain recognition of the river inhabitants' rights. However, this is not a correct interpretation since the Law does not in fact recognize any generic right, and only tries to meet the specific interests revealed by the basin, thus trying to optimize the assignation of available resources, destinating the discharges to specific objectives that satisfy the community.

This specific concession has been carried out without further involvement since there are surplus waters and the guarantee of possible future uses in the basin with the proposed transfer proves to be perfectly compatible. However, this philosophy is not what our Waters Law holds, and in future situations where this compatibility is not possible, this antecedent possibly can be fended off and come to form jurisprudence.

This is in fact happening in this way, since the Ebro-Pirineo Oriental transfer currently under way has taken up the experience of the former, with the opposing parties going even further in their contrary attitudes and demands for compensation. In this case, the flag of the regional off-balance has been the most ponderous reason argumented against the work. This could not be openly exposed in the Tajo-Segura transfer since the beneficiary basin does not really enjoy a great development, but such is not the case of the Pirineo Oriental, which has raised requests of industrial and demographic alternative location towards areas that have water resources and lower development levels.

Of course, it is also legally planned as transfer of surplus waters, and the basin wants this to be guaranteed by Law, although the situation of the connection in itself is the best physical guarantee that only surplus waters are to be taken.

In this case, the specific interests declared as preferent are also recognized, which in pure orthodoxy is not congruent with current legislation as the principal purpose of the proposed transfer is supply, which has maximum priority in our Waters Law.

The matter is still pending a decision, affecting the political decision field more than the technical and legal aspects.

6. FINAL REMARKS

Since this Conference is about the Water Rights Systems in the World, logically the final paragraphs of this study will be basically centered on insisting on the legal aspects of the hydrographic transfers.

We have seen that Spain has total hydraulic resources in a sufficient quantity but that they are poorly distributed throughout the length and breadth of its geography. This makes it necessary to consider the country as a unit when resolving the problems raised by water demand coverage. The Waters Law, which is almost centenary, permits this planning and in our country the transfers have recently been initiated to correct the hydrographic off-balance as far as possible, planning them initially so they meet the non-satisfied needs in areas that have scanty water resources, based on using waters which are not estimated to have a long-term use in the areas where they flow; in other words, taking advantage of the surplus waters.

Notwithstanding this objective planning, the basins which consider they will be affected (Tajo and Ebro) have argued from a legal point of view, fundamentally, that in the proposed water cessions, the basin inhabitants' acquiescence and wishes have not been considered, and their rights have been ignored and sacrificed. It is strange that this Anglo Saxon principle has been fended when according to our legislation (which is almost centenary as we have already said), the waters of our rivers are public goods that are not open to other rights in favour of the private parties other than those derived from the concessions that the Administration has granted them. Consequently, to avoid affecting the present uses with legitimate title, it is in the Administration's power to grant the use of waters not used to the place where it feels they would be most convenient for the nation. It is not possible to allege any exclusive nature with the mere support of the physical neighbouring relationship with the river waters, since the fact that the properties border on the river does not legally grant its owners any priority over the other citizens to consolidate an attitude meriting special protection.

Consequently, there are no legal obstacles opposing the execution of transfers, nor is it necessary to modify the legislation in force for these, and they could be planned preferably for the future uses estimated in the basins from where the discharges are taken from, according to the priorities set out in the Law on Waters. But this does not mean that the requests drawn up by private parties and concerns in the yielding basins, which imply an interest on their part, are not worthy of protection inasmuch as they coincide with the Administration's general interest, and deserve being studied and taken into account by same in order to try and

eventually satisfy same when and in the way the superior demands of public interest require. But they can never be considered with juridical rank as obligations that must necessarily be fulfilled.

The question of transfers has from the start been developed based on this idea, proposing the use of surplus waters. And they are perfectly compatible physically with the basins' development aspirations. There have consequently been no inconveniences in guaranteeing such aspirations, and only the temporary program has now to be resolved, namely the speed of growth of the basins that are considered affected, by means of an adequate and just planning of the State investments.

WATER RESOURCE ECONOMICS, EXTERNALITIES, AND INSTITUTIONS IN THE UNITED STATES

by S. Lee Gray and Kenneth C. Nobe*

1. INTRODUCTION

We begin from the position that there is a natural association and interaction between legal and economic systems. We take our cue from Commons who wrote "scaricty in economics is property in jurisprudence"[1] and:

> both legal theory and economic theory . . . have based their explanations first on Newton's principle of mechansism, then on Malthus' principle of scarcity, then on juristic principles of common rules that both limit and enlarge the field of individual wills in a world of mechanical forces and scarcity of resources.[2]

Legal and economic systems, law and economics, are not viewed as separate and mutually exclusive but as interdependent in regard to form and content and ends and means.

Our purpose is to provide an economic viewpoint of some of the major relationships between the dominant economics and legal elements upon which water resource management decisions are made. The basic philosophical position upon which the paper rests is that of the mixed market in the United States. In practice, this economy relies primarily on the market mechanism but is modified by pragmatic collective action when the market fails to meet the demand for certain goods and services.

The following pages provide what must be considered only summary discussions of several important issues and topics, sacrificing in-depth analysis in favor of breadth of coverage. We begin with a brief statement about the nature of water resources and the economic concept of the water problem. This is followed by a brief description of the market institution as a tool for efficient resource allocation and a discussion of several instances in which this institution fails in its allocative function. Particular emphasis is given to that area of market failure termed "externality." We then discuss some of the major institutional developments in water, with particular reference to the property concept, and isolate both positive and negative features of these developments. Finally, we offer some concluding comments regarding the relationship between water law and economics, again from the economics perspective.

2. THE PHYSICAL NATURE OF WATER RESOURCES

Discussions of natural resources typically distinquish between stock (nonrenewable) resources and flow (renewable) resources. Water, with a few notable exceptions, falls within the latter classification. Since the resource seldom stays in one location for long periods of time, it is further classified as a fugitive resource. The fugitive nature of water is evidenced in both the atmospheric and the land phases of the hydrologic

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cycle. In the former, it may be transported vast distances before entering the land phase of the cycle in liquid or solid form. In the latter, it (1) may almost immediately reenter the atmosphere through evaporation, (2) may percolate through the soil for storage in underground aquifers (3) may be stored for some time in solid form before entering the runoff, or (4) may directly enter surface streams and lakes.[3] Water in the land phase of the cycle becomes available for man's use for a variety of purposes including (1) the withdrawal uses--agriculture, steampower generation, industrial processes, and households and (2) non-withdrawal uses--hydroelectric power, navigation, waste assimilation, and recreation.

In describing water use, analysts generally refer to several dimensions including quantity, time, and location. A fourth dimension, water quality, is becoming increasingly important in modern society. Water quality determines the suitability of the resource for particular purposes and is influenced by both natural factors and manmade factors. Quality degradation by either source may be alleviated by appropriate treatment, but treatment costs and institutional incentives will determine the extent to which treatment will be undertaken.

The demands for water in the multiple uses cited above can be fully satisfied if the resource is available in the desired quantity, at the desired time, at the desired location, and in suitable quality. Deviations in any or all of these dimensions can lead to significant conflicts among alternative uses. In the United States the average annual precipitation rate of 30 inches appears to be more than adequate to meet foreseeable needs. However, geographic and temporal variability in supplies and demands and difference in water quality dispute any conclusion that water supplies are adequate to meet all needs. Shortages are particularly evident in the western part of the United States where irrigation accounts for some 90 percent of water use.

3. THE UNITED STATES WATER PROBLEM: ECONOMIC SCARICITY, CONFLICT, AND THE NEED FOR INSTITUTIONS

Many areas of the United States do, at times, face actual physical scarcity of water supplies. The re-use potential of water renders measured water flows imprecise indicators of the potential for productive use. Even if an absolute limit to the quantity of the resource exists, the amount available to a given user is not fixed. In principle, more is available at a higher price, given sufficient time for developing storage capacity and treatment and conveyance facilities. In these terms, the nature of the water problem is primarily one of conflict stemming from economic scarcity rather than physical shortage. Such conflict may be of various types, e.g., conflicts among users, between locations or regions, between present and future uses, and between water and other resources displaced by water developments.[4]

Scarcity, and resulting conflicts, lead to the creation if institutions designed to resolve problems for the good of society. Institutions function, on the one hand, to grant certain rights and privileges to members of society. On the other hand, they impose duties and obligations on the individual which limit his actions in a manner consistent with the interest of society at large. They serve, in part, to aid in the allocation of scarce resources among competing uses to meet specified social objectives. A major objective is the economically efficient allocation of

resources.* The dominant institution involved in resource allocation in the United States is the competitive market system.

3.1 The Market System and Optimal Resource Allocation

Economic efficiency is defined as the use of resources and the distribution of outputs in such a way that no further reallocation exists which would allow gains to some members of society without accompanying losses to others. Stated alternatively, economic efficiency in general is an organization of production and consumption so that all unambiguous possibilities for increasing welfare have been exhausted. The general structure of the competitive model as a mechanism for achieving this optimum can be fairly simply stated. The basic model is an abstraction from the real world consisting essentially of two organizational forms: the owner-operated firm and households which supply labor and receive final outputs. The market will provide, under a specific set of assumptions and conditions, the desired selection of goods and services at least cost.*

Market prices, determined by the interaction between consumers and producers, reflect both the opportunity costs of producing any good and the marginal values which consumers attach to the good. Prices derived in the market are determined by economic forces or parameters including household preferences, available inputs, and various production processes. Changes in these parameters leading to changes in market prices will thus cause a reorganization in resource utilization and in the production of goods and services and subsequently to a "new" optimum. Prices are the key ingredients of the system and serve to indicate the social significance of factors of production and outputs of goods and services. Interdependencies are transmitted through prices and, under strict conditions, these prices lead society to the Pareto optimum.**

Prices play a similar allocative role in factor use and allocation. In competitive markets, factors will be allocated to those uses yielding the greatest marginal returns. For each factor input, the optimal allocation occurs when the return at the margin just equals the cost at the margin. For a single factor, the marginal return must be the same in all uses in order for an optimum allocation to exist. This condition, in turn, requires that resources be free to move to those areas of employment yielding the greatest returns. Water resources, because of the multiplicity of possible uses, provide an example of that which is required for an efficient allocation of a single resource. In order to have an economically efficient allocation among these uses, the marginal return to water in irrigated agricultural use must be equated with that in industry, power generation, recreation, navigation, flood control, etc. This process, of course,

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*The authors fully appreciate the limitation of assuming economic efficiency as the only major single social objective. Nonetheless, the scope of this paper precludes full consideration of other important criteria such as distribution of income, regional development, and environmental quality.

**The market mechanism functions as stated only if given certain normative postulates with respect to the sovereign position of consumers and the desirability of the existing distribution of income; assumptions regarding consumer and producer behavior; and certain conditions, e.g., large numbers of economic actors on both sides of the market, completely divisible factors and products, independence among consumers and producers, household preferences, technology, and supplies of factors.

***For a detailed analysis of Pareto optimality, see James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach, 2nd ed. (New York: McGraw Hill, Inc., 1971).

reflects the well-known equimarginal value principle for efficient allocation of a resource.

The real world does not conform exactly to the assumptions of the economist's idealized model and, thus, we cannot argue that all interdependencies are transmitted through market prices.* A number of situations may occur, therefore, which may justify some form of public intervention into the market system's operation, as will be discussed in the following section.

3.2 Departures from the Competitive Model

First, there is a class of goods and services termed "public goods" which are not allocated within the market price system. While there are several views as to what constitutes a public good,** we follow Steiner in the following definition:

> Any publicly induced or provided collective good is a public good . . . . Collective goods arise whenever some segment of the public collectively wants and is prepared to pay for a bundle of goods and services other than what the unhampered market will produce.[5]

The requirements which Professor Steiner imposes on a collective good are (1) there must exist some appreciable distinction in quantity or quality between it and the privately produced alternative and (2) there must exist a distinct demand for the difference. Public goods, by definition, must meet the test for collective goods. The fact that cases exist in which a good or service is provided publicly or not at all (flood control and national defense) and the fact that certain goods and services are deemed so desirable as to have quantities in addition to those provided by the market made available (highways, irrigation water, public housing, public education, etc.) indicates that market prices do not always serve to allocate resources in a socially desirable manner.

A second departure from the competitive model, and a source of public goods, is market failure caused by market imperfections. These imperfections include such things as cases of decreasing costs, lack of perfect information and information dissemination, free riders, and the failure of the market to respond rapidly to changing demand and supply conditions. The case of increasing returns (decreasing costs) has particular relevance to the water resource area. Decreasing unit costs are likely to be present in providing for inland waterways where the majority of system costs do not vary with use. Average costs are decreasing and marginal costs

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*In the following discussion we will only briefly cite some of the major market imperfections or failures. We emphasize the externalities issue as the main departure upon which our argument centers. The reader may refer to Francis M. Bator, "The Anatomy of Market Failure," Quarterly Journal of Economics (August 1958) for a more extended discussion.

**See, for example, Richard A. Musgrave, The Theory of Public Finance (New York, Toronto, and London: McGraw-Hill Book Company, 1959) and Paul A. Samuelson, "The Pure Theory of Public Expenditure," Review of Economics and Statistics 36 (4, November 1954).

fall below average costs, perhaps up to capacity. If the assumption of profit maximizing behavior is appropriate, the private enterprise solution is to price according to marginal cost. An additional condition is that total costs of production be covered. Where marginal cost is less than average cost, prices set equal to marginal cost will preclude total revenue in excess of total cost and private firms will not enter production.

Yet another failure in the market system results from violation of the assumed mobility of resources, i.e., resources which are free to move to those activities yielding the greatest return. If resources are in fact immobile, market prices cease to reflect the resource cost. Closely related to this problem is the problem of unemployed or underemployed factors. If unemployment is a widespread phenomenon, the claim that the preferred composition and amount of output is being produced is precluded.

Another problem area has to do with the question of income distribution. The Pareto efficiency model explicitly and intentionally ignores equity considerations on the grounds that interpersonal comparisons of satisfaction cannot be made. The efficiency conditions rest on the ethical judgment that the existing distribution is appropriate. Divergent opinions as to what constitutes an appropriate distribution are normally settled in the political rather than the economic arena. Whether or not this is the correct means to settle these differences is beyond the scope of our comments. Nonetheless, the distribution question--like the other failures noted--does constitute an area in which some institutional intervention with market processes may be justified.

The final market failures are "external" or "spillover" effects arising when interdependence among consumers or producers is not accounted for within the market price system. These effects, termed externalities, emerge whenever the satisfaction (production) function for an individual (firm) depends upon factors beyond the individual's (firm's) control.* In a technical sense, externalities may be defined as uncompensated side effects, either positive or negative, imposed upon producers or consumers as a result of the activities of other economic actors. These impacts may consist of market externalities (pecuniary) occasioned by changes in prices of factors or outputs and non-market (technological) externalities represented by non-monetary changes in utility levels or outputs as a result of the actions of others. We will not enter the debate as to whether or not the distinction is appropriate but will direct our remarks toward the technological externality.**

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*James M. Buchanan and William Craig Stubblebine, "Externality," Economica 29, N.S. (1962), pp. 371-84. In a formal sense an externality is present when $S^a = s^a (q_1, q_2 \ldots q_m, z)$ where S^a is the satisfaction of an individual A which depends on activities (goods) $q_1 \ldots q_m$ which are under his control and also on z which is under the control of a second individual.

**While we do not enter the debate directly, we do feel that--from the social welfare perspective--pecuniary externalities reflect a definite impact on opportunity sets. The tendency in economics is to dismiss these impacts as irrelevant because price changes can be handled through the

4. EXTERNALITIES: A CONCEPTUAL SKETCH

The essential problem emerging from the presence of externalities may be described in the following manner. In typical two-party transactions, one party incurs costs in order to realize benefits while the other party receives payments in return for giving up goods or services. In some cases, however, those who pay the costs do not realize all of the benefits or the payments made do not cover all of the costs. In the former, it is likely that not enough of the good or service is being produced while, in the latter, too much may be produced. In either case--the existence of external economies or external diseconomies, the system is inefficient and resources are misallocated. Both of these may be important, but we will confine our comments largely to the case of external diseconomies.

For explanatory purposes, consider two firms which are interdependent through their cost functions. Firm A's total cost of production depends both on the production of the commodity solely under its control and on Firm B's production of some commodity. As Firm B increases its output q_b, Firm A's costs are increased for each level of its own output. Under independent profit maximization, it will be to Firm B's benefit to ignore the cost of its actions on Firm A (or, broadly interpreted, on society). These costs are, however, real costs to society and may be quite sizable. The end result is a divergence between private marginal costs and marginal costs imposed on society and thus results in a socially inefficient allocation of resources. The situation may be depicted diagrammatically as in Figure 1.

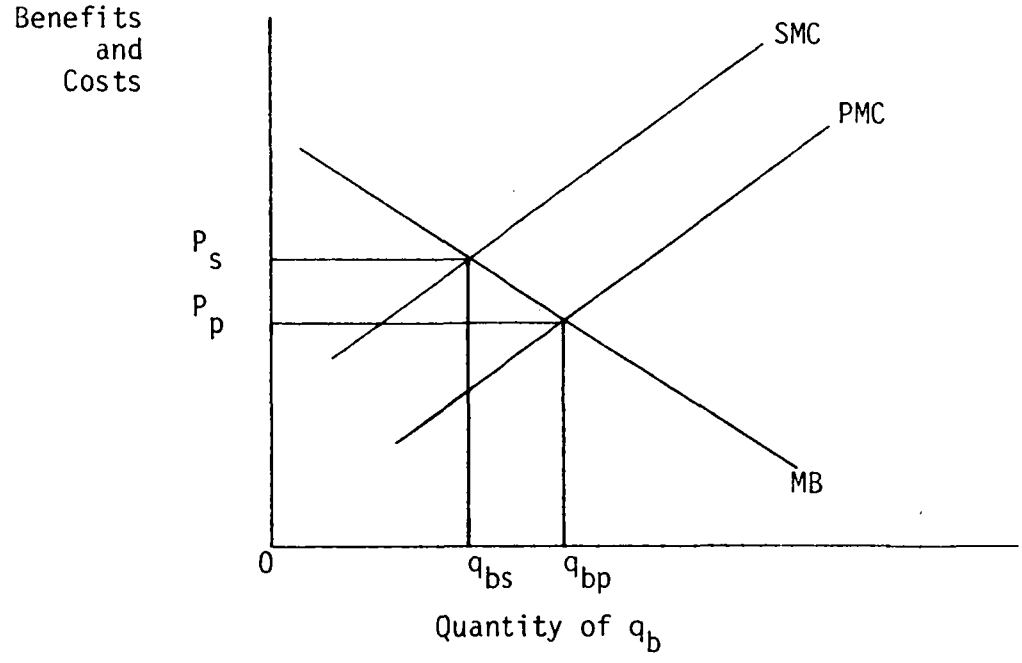

Figure 1. Divergent Social and Private Costs; An External Diseconomy.

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market substitution process. The impact on individual opportunity sets is nonetheless real and uncompensated. Thus, we do not agree that they should be dismissed so lightly as "merely pecuniary."

In Figure 1, the curve labeled MB is the marginal benefit per unit of output q_b produced by Firm B. PMC is the private marginal cost to that firm. The profit-maximizing firm will produce output level q_{bp} at a price P_p. However, when the costs imposed on Firm A are included, the actual costs to society are shown by the curve SMC. Social costs exceed private marginal costs at each level of output q_b by the amount of the cost imposed on A by B. Thus, the optimum output for Firm B exceeds the optimum output, from society's point of view, denoted by q_{bs}. The socially optimal price would be higher than the privately optimal price and the quantity of B produced should be decreased.

This conceptual discussion is easily related to real world situations in the case of water resources. We have cited previously certain physical characteristics of water, particularly its mobile, flowing nature. Therefore, in contrast to most other natural resources, the use of water for one purpose at a specific time and location does not necessarily preclude its use elsewhere, at a later time, for the same or alternative purpose. Water "used" (released from storage), for example, in the upper reaches of a river for power generation is usable downstream in any of the withdrawal or instream uses mentioned previously. Contrast this situation to labor used in producing a consumer good or metal used in producing a stove. Such labor is not available for use elsewhere nor is the metal used in the stove immediately available to make a refrigerator. Thus, water use cannot, in most cases, be viewed independently of potential alternative uses.

In a typical river basin several alternative utilizations may exist and one use may affect other uses through any or all of the quantity, quality, time, or location dimensions. Consider the hypothetical river basin shown in Figure 2.

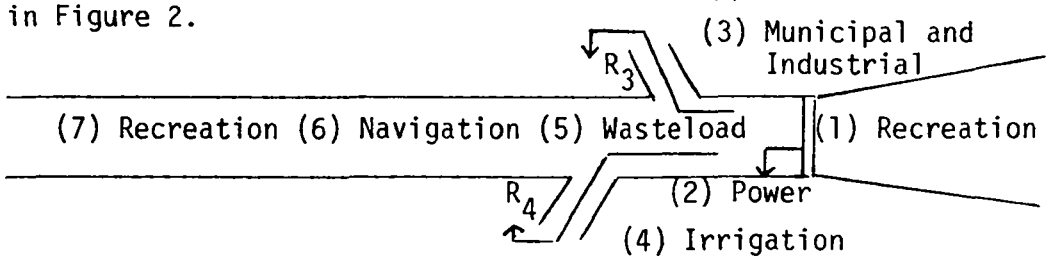

Figure 2. Schematic Diagram of a Hypothetical River Basin.

The uses located in the sequence in Figure 2 suggest several possibilities for interdependence. First, water stored for recreation at (1) or for power generation at (2) may be complementary insofar as increased storage for one increases the potential output of the other and a positive externality may exist. Diseconomies may, however, also be present. Suppose water is retained upstream from (2) in order to provide for peak power requirements and/or reservoir recreation. Retaining water for these purposes may reduce the amount available to satisfy municipal and industrial uses at (3) or irrigation use at (4). A similar type externality may be imposed on navigation and/or instream uses for fish and wildlife propagation. Unless releases of water at (2) correspond with the peak requirements for commercial water transportation, stream flow sufficient to insure adequate channel depth at the time it is needed may not exist. Similarly, storage at (2) may well impose other than quantity externalities on downstream uses.

If water is diverted for municipal and industrial uses at (3), a portion of that diversion will make its way back to the stream. This return flow, denoted R_3, may carry substantial amounts of industrial and municipal wastes. Some of the water normally used for waste dilution is held in storage so the waste assimilative burden falls on water in the stream below (3). Some of the water normally used for irrigation and perhaps downstream recreation is now used for dilution of wastes. Such use may not only reduce the quantity of water available for irrigation (4) and recreation (7) but may also impair the quality of water available for these uses. Numerous alternative interdependencies may, of course, be cited by changing the postulated sequence of use within the system. However, the foregoing discussion should serve to point up the problem.

Physical interdependencies in use lead to economic externalities and to a failure to account for all costs and/or benefits. In the case of complementarity among uses an external economy exists and benefits in excess of those compensated occur. In the case of conflicting interests, however, increased costs (in the form of reduced output or treatment of degraded water) are imposed which are not compensated. Such negative externalities may be quite large and so, if the social well-being is to be maximized, some public intervention may be required. While institutional intervention is, at times, necessary to accommodate external repercussions of economic activity or to effectively serve the social welfare interests, we emphasize that it too has its costs or negative aspects. In the following sections of the paper we present a general statement of the role of institutions and follow this with a discussion of some major institutional developments in water. We attempt to provide examples of both the positive and negative results of specific institutional arrangements to accommodate specific water problems in the United States.

5. THE ROLE OF INSTITUTIONS IN WATER MANAGEMENT

We have shown that the competitive market system, with the objective of economic efficiency, assures the most beneficial use of limited resources under a highly restrictive set of conditions and assumptions. Under these conditions, the market institution allocates and reallocates resources toward their highest value uses. We have also discussed a number of violations of the market model that may preclude an efficient allocation through market prices. These failures, among other things, have led to the development of some complex institutions in attempts to influence resource allocation toward desired social objectives.

Let us distinguish at the outset between organizations and institutions as they function in the area of water resources. Both serve as the interfaces between law and economics.* In this regard, among the more important organizations and institutions are:**

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*The term interface is adopted from J. H. Dales, "The Propery Interface" in Economics of the Environment, Robert and Nancy S. Dorfman, eds. (New York: W. W. Norton and Company, 1972), pp. 308-322.

**Adapted from: Huntington Cairns, Law and the Social Sciences (New York: Augustus M. Kelley Pub., 1969), p. 50; R. T. Ely, Property and Contract in their Relations to the Distribution of Wealth, Vol. I (New York: The Macmillan Company, 1922), pp. 51-56; and Mancur Olson, Jr., The Logic of Collective Action (Cambridge: Harvard University Press, 1965).

I. Organizations

A. Partnerships, Cooperatives, and Corporations
B. Government Agenices (i.e., Irrigation Department and Reclamation Bureau)
C. Special Interest Groups (Farmers' Union, Ecology Society, etc.)

II. Institutions

A. Property: Public and Private Rights
B. Contract and Tenure
C. Inheritance and Succession of Ownership Rules
D. Credit and Money Lending (Sources of Capital)
E. Taxation and Eminent Domain

The organizations, as identified above, are composed of groups of persons who have joined together to serve collective or common interests. Predominantly, organizations operating in the private sector are concerned with promoting the economic interests or welfare of their members. Over time this basic objective has become increasingly true as well of government agencies with development, management, and/or regulatory functions. For example, farm partnerships and irrigation cooperatives strive to maximize profits; farmers' organizations lobby and otherwise seek to promote higher agricultural product prices; and a government agricultural department may be charged with preserving the agricultural sector. References to organizations in conjunction with this section on institutions are made here only to illustrate a key area of interface between law and economics as they relate to water resources. Space limitations preclude an in-depth examination.

From the economist's point of view, institutions are more pervasive in, and critical to, water management than are organizations. They also tend to be more difficult to accommodate and utilize in responding to rapidly changing economic conditions. The term institution is used with a variety of meanings but the most appropriate is the reference to abstractions or the verbalization of a way of thought or action imbedded in group habits which are subject to change over time. The definition and, to a large extent, the development of institutional analysis (in the latter context) are derived from the works of noted institutionalists such as Thorstein Veblen and John R. Commons, each of whom emphasized the influence of man's environment on his social and economic behavior. According to Commons, institutions are "collective action in control, liberation and expansion of individual action."[6] Institutions reflect both the individual's view of himself in the broader context of a social group and the limitations imposed on the individual. The scope of institutions is thus as wide or narrow as man's social and economic interests.

Institutions arise in response to three primary factors: conflict, uncertainty, and a need for order. They function, first, to bestow rights and benefits on the individual and, second, to create duties and obligations to which the individual must adhere. Conceptually, at least, institutions introduce order into a potentially chaotic scheme. With specific reference to natural resources, one of the major institutional developments is that of property rights which define the scope of man's activities regarding the use of property objects.

5.1 The Property Concept

No single institution has received such widespread study and prominence in the literature devoted to land and water as that of property. The concept is receiving this attention in the United States because of the increasing relative scarcity of land and water resources and because of the emerging concern over continuing environmental disruptions. In order to understand why economists consider the property institution so vital to water management systems, a brief review of the broad meanings of property and property rights is in order. Following this discussion, we will turn to a more detailed analysis of their significance in the case of water resources.

Rousseau has credited the formation of civilization and injustice to the creation of property rights.[7] And, according to Aquinas, property was important in the process of human development for the following reasons:

> First because every man is more careful to procure what is for himself alone than that which is common to many or to all: since each one would shirk the labour and leave to another that which concerns the community, as happens where there is a great number of servants. Secondly, because human affairs are conducted in more orderly fashion if each man is charged with taking care of some particular thing himself, whereas there would be confusion if everyone had to look after any one thing indeterminately. Thirdly, because a more peaceful state is ensured to man if each is contented with his own. Hence it is to be observed that quarrels arise more frequently where there is no division of things possessed.[8]

It has been generally accepted that the system of feudalism evolved out of the direct control of lands and other tangible property. Capitalism and industrialized societies, while still basically dependent upon lands and an agrarian economy (as institutionalized in the legal foundation of private property), were built upon a system of nominal values.[9] Industrialism flourished and spread throughout the world through the interaction of producers and consumers, the development of a viable credit system, a division and specialization of labor, and a system of bargaining and trade. The change in the economic order was reflected over time in the legal order by an "expansion of the common law from the protection of tangible property and persons in an age of violence to the protection of business and position in the peaceful expansion of markets."[10] Along with the transition, there was a gradual shift in emphasis from the holding of property in common to the holding of fee simple rights in land by the individual so as to ensure his primary means of making a living and storing his wealth. With the emergence of urban-dominated societies as in the United States, however, there appears to be some resurgence of interest in common property ownership in some land and water resources for non-profit purposes, as we will discuss in more detail below.

Property has come to be viewed as a "bundle of rights"* with some strands held by one or more individuals (exclusive rights) while others are

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*An early reference to the "bundle of rights" concept appeared in Eaton v. The Boston, Concord and Montreal R.R., 51 n. H. 504, 510-12 (1872).

held in the state (absolute). In this context, title held to real property, say land, is only one strand in the bundle of rights in which some strands held collectively by society are overriding. In some cases, the title held by the individual may be "empty . . . in that all rights granting action rights over various land attributes are held by others."[11] Herein lies the continuing concern with efforts to change control in property rights--the question of dominance--that gives the ordinary citizen and title land "owners," in particular, an uneasy feeling whenever proposals are made to change land and water law or to increase public control over these resources.

From the viewpoint of the private individual, the essence of property is the right to exclude others. It not only confers power upon the individual property owner but, more importantly, it determines which men shall acquire wealth via control of productive resources. For example, legal protection of property rights in water gives the owners the right to use water to produce income. Therefore, when the courts make a ruling over property rights in water, they are not only protecting property already held but are also determining that a certain amount of future social product shall accrue to that property owner. But, since property involves "relations among men arising out of their relations to things,"[12] there are also certain limits, rights, and duties associated with property that impose added production costs on the owner and/or protect the welfare of others. For example, under the Riparian Water Law Doctrine of the Western United States, a landowner has the right to the "reasonable use" of water in which he holds a property right which conversely means that his use must not "unreasonably" interfere with the rights of other water users.[13] The significance herein lies in the fact that, for property rights to be an effective means of establishing and maintaining social order, they must be based upon limits or duties of the right holder as well as on protection of his own interests.

Over time, a number of defenses for the existence of private property developed which were based primarily on an economic rationale.* An early view was that the individual was entitled to that which he discovered or physically occupied. Later the dominant principle was that man was entitled to that to which he applied his labor and capital. The economic justification for private property was, in essence, founded on the belief that real property in private control would promote maximum production and economic growth. According to this argument, once property rights are established, the object of the right becomes:

> . . . available for use by individuals to produce wealth. Since each person will try to make the best use of it that he can, the total of individual wealth will approach the production of maximum national wealth.[14]

However, there is a difference between an individual's desire "to produce wealth" and his chosen type of production which may not be socially desirable. In the United States, for example, there is strong evidence that the

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*See, for example, Morris R. Cohen, Law and the Social Order (New York: Archon Books, 1967), pp. 49-57. For a discussion of the occupation theory, see Henry S. Maine, Ancient Law, 10th ed. (Boston: Beacon Press, 1963): pp. 243-248.

concentration of private property rights in water, say for irrigation, has led to private economic gain at the expense of emerging social interests such as more wild and scenic rivers.

Property rights have two basic components: the individual's rights and those of society (the collective public). The individual's rights, as protected in law, prescribe acquisition, possession, exclusion of trespass, use for private gain, and transfer of ownership from one private individual to another. But social rights in property maintain that the individual rights in property were originally established and enforced for the collective social welfare and that individual rights always remain subject to the absolute power of the sovereign or the state.

Within the United States, we are moving into an era of sharp conflict between prevailing views on private property which have particular relevance to use of water. From the pioneering-frontier settlement era on through the end of World War II, private rights were more or less in harmony with social rights and goals that focused primarily on economic growth and development. As more and more property moved from public to private control, individual property rights gained a dominant position. But today the two issues are in conflict, not because the objectives of those individuals holding the property rights have necessarily changed, but because those of the rest of society have.

Traditionally, economists have accepted the prevailing view that property rights were designed to give the individual control over economic goods.[15] In the past, these primary economic goods were land, water, and other natural resources which were used by most of the population as a means of gaining a livelihood. But in the United States, unlike much of the world, we have now moved into an era in which most of the nation's wealth is being produced as a result of huge prior investments in trained human capital and application of highly capital-dependent technology; in most economic activities we are no longer directly dependent upon our land and water base. In order to protect the interest of the individual in these means of making a living, the legal system has responded with a new set of sanctions and controls which are collectively referred to as "new property."[16] These new rights in property include such things as occupational licenses, franchises, contracts, and the use of public resources. As Dales has pointed out, this phenomena may more appropriately be called status rights, since access to these rights depends upon meeting certain eligibility requirements.[17]

In a modernized, affluent society such as prevails in the United States, the number of people holding "new property" rights is growing rapidly while the number of individuals who hold the "old property" rights is declining. For too long perhaps economists have been telling us that shifting to "new property" rights is the necessary price that we have had to pay to make the market system work in a modern industrialized society. We are beginning to recognize that the"new property" right holders are now developing a renewed interest in land and water resources but for other than profit-oriented purposes.

Holders of these "new property" rights are predominantly urban dwellers. As the quality of life in our urban centers continues to deteriorate, these individuals are increasingly seeking a revision in the traditional rights of property in natural resources. They have begun to assert

that land and water resources should provide not only a means of livelihood (for a declining number of individuals) but should also be used as a means of achieving a quality environment for society as a whole. This emerging shift in public opinion, from a dominance of private concerns to social rights in property, will promote new obligations and constraints under which the fee simple owners of land and water property must operate. And, inevitably, a number of conflicts between the rural and urban interests in these property rights will move into the courts. On the one hand, the conflict appears to be primarily between tangible economic interests and intangible, but highly desired extra-market interests. But it would appear also that, perhaps on a higher level, the real conflict centers on the rights of individuals to use land and water resources as only they desire versus following the collective interests of society in maintaining the quality and integrity of the natural and social communities.

Morgan, almost a century ago, seemed to sense this emerging conflict between individual and social rights in property and its projected outcome when he wrote:

> Since the advent of civilization, the outgrowth of property has been so emense, its forms so diversified, its uses so expanding and its management so intelligent in the interests of its owners, that it has become, on the part of the people, an unmanageable power. The human mind stands bewildered in the presence of its own creation. The time will come, nevertheless, when human intelligence will rise to the mastery over property, and define the relations of the state to the property it protects, as well as the obligations and limits of the rights of its owners. The interests of society are paramount to individual interests, and the two must be brought into just and harmonious relations.[18]

A contemporary observer, David Callies, is much less optimistic about the outcome. Recently, he wrote in part:

> The quiet revolution in land use control is taking place in the United States in two phases neither of which, upon close examination, is in fact a true revolution as much as a <u>return</u> to first principles.
>
> . . . The most obvious phase of the revolution in land use control is the relocation of authority. States are taking back the land use controls delegated to municipal governmental units through enabling acts in ever greater numbers.
>
> The more subtle phase of the revolution is a change in the concept of land, from a commodity to be traded for economic gain to a resource which must be preserved for public health and public welfare. In the first phase the struggle is primarily administrative and political; in the second, the struggle is constitutional and judicial. In the first phase, the results are visible; in the second, the battle lines are ill-defined, and the outcome is uncertain.[19]

While Callies was speaking of land in its broad context, the implications are particularly applicable to water resources. And, due to the unique characteristics of water and its primary role in irrigated agriculture, the effects of these emerging changes in social goals will be more serious and likely irreversible.

5.2 Property Rights in Water

A critical part of the broad concept of property rights is that of water rights. Institutional developments in water emerge for the same reasons as those cited earlier. If water of adequate quality and quantity were always available when and where it was needed, there would be no need for a legal system governing its allocation. These conditions, however, are rarely met, even in the humid regions of the United States. Scarcity of the resource, in an economic sense, does exist and gives rise to conflicts and uncertainty regarding tenure and, subsequently, to a need for establishing order in the use of water.

Two essentials of any property rights system are certainty and flexibility of tenure. Certainty of tenure enables the resource user to know how much of the resource he has available at a particular time and place. Flexibility of tenure allows bilateral or multilateral negotiations through which rights to use may be transferred. The fugitive nature of water, regional differences in water problems, and physical interdependencies in use render it difficult to establish these essentials under a single institutional framework.* As a result, two principle doctrines in water rights have developed in the United States: the Riparian Doctrine and the Doctrine of Appropriation.** The former has traditionally been used in the more humid eastern United States while the latter has been employed as the primary basis of water law in the western states.

Rights under both doctrines are usually considered to be usufructuary rights, i.e., rights to use water but not to the physical possession of the resource. However, particularly under the Appropriations Doctrine, once water is diverted from a natural water course, it may be held in storage and is considered the personal property of the owner. It should also be noted that, traditionally, the beneficial use requirement in the Appropriation Doctrine could be established only if that water were physically diverted from the stream channel, but this requirement is now being modified in the case of some public uses such as fish and wildlife propagation.

The Riparian Doctrine, developed under English Common Law, permits land owners contiguous to a natural body of water to use the water so long as use does not unreasonably alter the quantity or quality of water available to downstream riparian users. Rights to use water under this doctrine exist because of the relation of the land to water and are subject to a "reasonable use" concept including water used for domestic, livestock, irrigation, and other commercial uses. Just what constitutes reasonable use is a matter generally left to the courts and so its definition is always subject to change. This introduces an element of uncertainty in tenure associated with the rights. Existing uses may be precluded by a new

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*The following discussion of these concepts draws heavily on Hirshliefer, et al., Water Supply: Economics, Technology and Policy.

**For a general treatment of U.S. water law, with particular reference to the American Southwest, refer to: James A. Null, "Water Use as a Property Right," The Colorado Quarterly 22 (3, Winter 1974), pp. 317-327. For a state by state treatment, refer to Dewsnup and Jensen, A Summary Digest . . . .

use which is considered more reasonable. An additional element of uncertainty of tenure exists because no specific quantity of water is guaranteed. This implies that the negotiation for a transfer of rights is based on judicial discretion rather than economics.

Tenure, under the Riparian Doctrine, is secure against non-riparian uses. Also, tenure flexibility, as between riparian uses, does exist subject to the limitation cited above. The water right may be transferred by the sale of riparian lands so long as the new use is "reasonable." However, flexibility of tenure between riparian and non-riparian uses is virtually nonexistent. This lack of flexibility represents an important divergence between the legal and economic systems. The Riparian Doctrine implicitly attaches economic value only to riparian uses and thus leads to the conclusion that there is no valuable, non-riparian alternative. Restated, it assumes no opportunity cost attaches to the particular riparian use.

Tenure rigidity, particularly with respect to location and the implicit assumption that water in non-riparian alternatives has no recognized value, can lead to a severe misallocation of resources in both a private and public sense. Thus, the riparian rights institution, while perhaps appropriate to matters of equity among riparian uses, may be quite inappropriate in terms of economic efficiency considerations. As the demands for water under the riparian system increase, the inefficiency of judicial decision making may become quite important in such cases.

The Appropriations Doctrine was adopted to meet particular problems in the semi-arid to arid portion of the western United States. Under this doctrine, no preference is given to riparian landowners. Rather, the allocation principle is one of "first in time, first in right." Under the Appropriations Doctrine, water rights apply to "beneficial use" of water and relate to the time of appropriation, to a specific quantity of water to be applied at a specific location, and to a specific purpose. In times of water shortage, older rights (senior rights) have priority over newer (junior) rights. In contrast to the Riparian Doctrine, no limit to the number of claimants to rights to use exist, but there is a physical limit of total water availability as to how many rights can actually be served. Each right holder is protected by the date of his right; tenure security against all other users is thus established.*

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*This statement is subject to the legal specification of priorities. For example, domestic and municipal use is given highest priority, irrigation is given second priority, and industrial and commercial use is given third priority. In times of severe shortage (drought), water may be rationed according to priority rankings regardless of the date attached to senior rights. Compensatory payments are made to senior users deprived of their water in such circumstances, but, as James Null has noted:

> An underlying assumption of prior appropriation is that all water is to be used; no attempt is made to insure the quantity or quality of the flow of the stream. In fact, the water must be used and if the owner of the right fails to do so, he can lose the right. In sum, the appropriated water right is an exclusive one, acquired by law, to divert from a public water supply a specific quantity of water. The water to be appropriated must be available

Since rights to a specific quantity of water and priority according to the date of the right are granted under the Appropriations Doctrine and also because the rights to use may be transferred to non-riparian lands, tenure security and flexibility appear to be much greater under this system. Bilateral and multilateral arrangements for resource reallocation function in part according to the principles of economic efficiency.[20] Hence, to the extent that the system clearly defines the water right and encourages the transfer of rights by voluntary transactions among right holders, the institutional system (legal) and the market system (economic) are conceptually compatible.

The word conceptually is stressed. The reality concerning tenure flexibility under the Appropriations Doctrine is that reallocations generally occur within narrow limits. There is some logic to this, and we present one example in which the judicial process has accommodated departures from the market model so as to protect the interests of society.

Because of the re-use potential of water, physical interdependence among users exists. Reallocations of water rights involving a change in use, location of use, or timing of use may thus affect parties external to those directly involved in transfer negotiations through any of the four types of diversion discussed earlier. Consider Figure 3 which postulates these four diversion points on a simple river system. In general, any transfers will be of benefit up to that quantity at which $VMP_j = VMP_i$. However, Figure 3 shows some additional complications. Assume that the demand for water at diversion (3) expands relative to that at (1). If only the two party interests are involved, a transfer would occur until $VMP_3 = VMP_1$. Diversion (2) represents intermediate uses between (1) and (3) which are partially dependent upon the return flow, R_1, for their water supplies. Diversion (4) represents users who are similarly dependent upon the return flow from (3), i.e., R_3 for their water supplies.

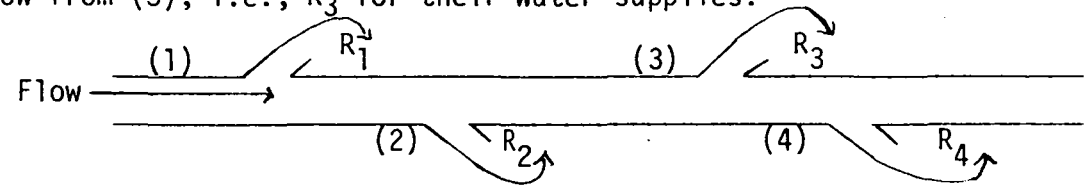

Figure 3. A Hypothetical River System.

[A market transaction involving two parties, i and j, where the demand for water in the j^{th} use is expanding relative to that in use i, will result in a mutually agreeable transactions price. User j will be willing to pay no more than the value of the marginal unit of water in use j, denoted VMP_j. User i will accept no less than the value of a unit of water in use i, denoted VMP_i. So long as $VMP_j > VMP_i$, we have the conditions necessary for an efficient transfer from i to j.]

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in excess of the requirements of all existing vested rights and it must be applied to specific beneficial uses in preference to all appropriative rights of later priority ("Water Use as a Property Right," p. 319).

A transfer without regard to other right holders no longer assures an efficient allocation of water. If the value per unit of return flow at (2) denoted VMP_{R1} is considered, then transfers negotiated on a two-party basis will impose an external diseconomy equal in magnitude to $VMP_{R1} \cdot R_1$ on users at (2). The courts have recognized the existence of this interdependence and the imposition of external costs by restricting such transfers to an amount equal to historic consumptive use. This process certainly protects the rights of intermediate users at (2) and represents a positive response to the externality problem.*

We have noted earlier that institutional control may cause external impacts of its own. The consumptive use limitation on transfers provides an excellent example of both positive impacts and negative impacts. While protecting third party interests on one hand, this limitation may also preclude efficient transfers on the other. For example, suppose the value of the return flow R_1 and the value of the return flow R_3 are equal and that $VMP_3 > VMP_1$. Under these conditions the loss at (2) would be offset by the gain at (4) and a transfer from (1) to (3) would be efficient. The consumptive use limitation, however, precludes realization of the full efficiency benefits of transfer.

Under a different set of legal arrangements than exist now, the full transfer could occur but provision would have to be made to compensate the losers at (2). The issue is that the imposition of controls to protect third party interests may subsequently lead to externalities in terms of reduced efficiency.** It points out that a set of institutional (water law) systems must retain flexibility in order to adapt to changing economic conditions. It is to this latter point that we now turn by describing an ongoing case in Colorado.

5.3 Flexibility in Water Rights: A Colorado Case Study

Members in the legal profession recognize that most water law systems have become rigidly institutionalized and so resist rapid change. This rigidity was not originally intended since, when most of these water laws were adopted, some procedures for providing flexbility and possible future changes in water use were usually incorporated. For example, western states in the United States that operate under the Appropriation Doctrine have a specified rank order of priority uses. Further, over time, these states

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*This response to the externality problem has been employed in a number of western states with Colorado as the leading example. For a more complete discussion, refer to: G. E. Radosevich, K. C. Nobe, David Allardice and Craig Kirkwood, Evolution and Administration of Colorado Water Law: 1860-1974 (Fort Collins: Water Resources Association, Inc., 1975, in press).

**For an extended discussion of efficiency in the transfer of water rights and the transfer process under the Appropriations Doctrine, see: L. M. Hartman and D. A. Seastone, Water Transfers: Economic Efficiency and Alternative Institutions (Baltimore and London: Published for Resources for the Future, Inc., by the Johns Hopkins Press, 1970), Chapters II and III.

have developed rules for the transfer of water from lower to higher priorities of use; i.e., from irrigation to domestic uses.*

What is not so well known or appreciated, particularly within the legislative bodies, is that--because the economy of a region changes over time--the earlier rules may no longer facilitate the orderly and beneficial reallocation of water rights that was originally intended. The major problem with these old rules today is that most were developed at a point in time of low population density when inter-use competition for scarce water resources was not a major issue, when sunk investments in developing the land resource (which, say, irrigation water has made profitable) had not yet been made, and when secondary adverse impacts (on both income distribution and on the environment) resulting from a transfer of water right from one use to another were relatively insignificant.

In a rapidly urbanizing state such as Colorado, where--until recently--irrigation was the only major use made of developed water, the results of transferring water under the old set of rules are now beginning to have major, undesirable effects. And the process is certainly disrupting the economic stability and infra-structure of the region. An ongoing issue of this type, involving the City of Thornton, Colorado, and the local irrigation organizations, will be used to illustrate the issues involved.

On September 4, 1974, the members of the Farmers High Line Canal and Reservoir Company were informed that they were soon to be divested of their irrigation water rights as well as their ditches, canals, and reservoirs. The notification stated in part:

> The Utilities Board of the City of Thornton has authorized and directed me to tender you a cash offer in the amount of $8,000,000 for the purchase of certain properties belonging to you. . . . the City requests that you respond to this offer promptly. In the event that you do not promptly negotiate, . . . the City intends to and will commence eminent domain proceedings in order to acquire said properties. . . .[21]

At the time, the City was already engaged in condemnation proceedings against the Farmers Reservoir and Irrigation Company over 30,000 acre-feet of storage in Stanley Reservoir, their major storage facility. The City had offered $9.3 million; the irrigator's organization had refused to sell and the case was moving into the courts. The City based its case on the fact that, under state law, municipal water needs have a higher priority than agricultural needs while the defense was based, in part, on the argument that just compensation was not being offered.[22] On the surface, the issues at hand in these two cases seemed to be clearcut and, therefore, easily resolvable in the judicial process. But, beneath the surface, a complex set of economic and legal implications that could set a precedent for similar efforts by other growing urban centers was being set into motion.

Before these implications are discussed, however, a brief historical perspective is in order. Thornton had developed rapidly during the 1950s

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*For a comprehensive treatment of the process in Colorado, see: Radosevich, et al., Evolution and Administration of Colorado Water Law: 1860-1974.

as a suburb of Denver, the major metropolitan center of the intermountain region of the nation. Since its incorporation in 1956, the City of Thornton has grown so that it now encompasses 17 square miles and has a population of 27,000 people. During its period of rapid growth, the City of Denver provided adequately for its municipal water requirements so no serious thought was given to whether or not it would continue to do so indefinitely. In recent years, however, proposed additional trans-mountain diversions for augmenting Denver's water supply have been opposed because of adverse environmental impacts. Faced with a potential future limit to its growth due to an upper limit on its source of Denver water, the City of Thornton set out to satisfy its needs from alternative sources. This decision led in turn to the condemnation proceedings filed against the irrigation water users in the vicinity.

The fact that the City of Thornton has resorted to condemnation proceedings is a clear indication of the great difficulty and high cost of obtaining alternative, new water supplies in its region. Thus, it can be inferred that such an option also does not exist for the irrigators if they lose their existing water rights. What are the adverse implications of this situation? First of all, it must be recognized that farmers in the area would not necessarily be forced out of agriculture. They could revert to dryland farming and continue to grow most of the crops now being produced. But yields will decline drastically and so will net incomes per acre (in the order of magnitude of dropping from a long term average of $200/acre under irrigation to $40/acre under dryland farming).[23] In the short run, yields will drop even lower because, under irrigation, plant nutrients are applied in excess of the levels plants can utilize under dryland conditions, and it will take several years to leach out the excess.

In addition, indirect--but nonetheless significant--adverse effects of the transfer of water rights in these cases would result. These are as follows:

1. Since real estate taxes are unlikely to decline in response to lower income yields under dryland farming, there would be abandonment of some farm land (presumably to other uses).
2. There will certainly be a displacement or loss of sunk capital invested by farmers in their irrigation systems, land leveling, and in equipment utilized in irrigated farming in excess of that required in dryland farming.
3. There will be a broadbased reduction in secondary benefits that have been accruing from irrigated agriculture to others in the vicinity, including farm labor jobs, farm machinery and fertilizer sales, plus lower sales volume in the food processing sector.
4. The farms affected are primary grain producers; the Front Range area of Colorado is already grain deficient and subsequent reduction in production will particularly affect a large number of grain dependent industries, including breweries, beef cattle feedlots, feed mills, and elevators.
5. Finally, there will be loss of open space as some of the agricultural area is built up in residential and industrial

> uses which will adversely affect the quality of life of the area via increased pollution and congestion (and will trigger another round of increasing water demand).

According to Radosevich and Sabey, the more significant implications of the Thornton case can be summed up as follows:

> It is apparent that this case has focused on several items far greater than the taking of water and associated systems from these two [irrigation] water entities. The initiation of this action is only the tip of the iceberg as it becomes much more apparent to other municipalities on the front range that their municipal service requirements for water will far exceed the present supply and the ready acquisition from transmountain sources. The real issue concerns the precedent that will suddenly initiate similar suits as these municipalities seek to acquire those waters they feel are necessary to sustain rapid growth. Thus municipal condemnation in this case is of state and public interest and strikes at the heart of the economic base in agriculture and the potential for future resources management in Colorado.
>
> Three legal questions emerge: (1) Does the municipality have the right to condemn water rights and structures? (2) If so, under what conditions? (3) If condemnation is to proceed, what is the basis for compensation?[24]

There is no question under Colorado law that municipalities can legally acquire water rights, systems, and appurtenances of the type in question.[25] But current statutes are unclear in regard to the specifics addressed in the latter two questions listed above. Therefore, acting under his authority to protect the public interest, Governor Richard Lamm early in 1975 appointed an Executive Committee to review the problem with the intent of developing new legislation to clarify these issues raised by the Thornton case. The Committee in turn solicited expert assistance from the faculty in its state university in regard to both the legal and economic issues involved. An administration-supported bill was then introduced into the 1974-75 session of the State Legislature.[26] In regard to the first question, the bill specified conditions for transfer of water rights based on filing an orderly development plan that would protect the public interest and a determination of the necessity to condemn as opposed to other alternative sources of supply. In regard to the second issue, an attempt was made to clarify the basis for compensation beyond a mere statement, as is currently prevalent in western water law, to compensate for the loss of water rights according to the present fair market value of the property taken. In lieu thereof, the following language was substituted:

> . . . in assessing damages, the Commissioners shall apply the following criteria: Compensation shall be paid based upon either the value of water to the municipality or total net adverse effects upon rights and properties including dimunition in irrigation and agricultural improvements, investments and associated opportunity costs of injured parties, stated in monetary terms, whichever is higher.[27]

The theory of this approach, according to Radosevich and Sabey, is as follows:

> It is assumed that acquisition of water and necessary structures by a municipality under condemnation powers is a valid means of acquiring a needed water supply. It is not the intent to preserve water in agricultural use and thereby prevent the free transfer or sale of this water by the owners in the open market. . . . it is an effort to provide a fair advantage to both parties as well as to the entire citizenry of the state. It has the potential of providing a legal tool for municipalities which would allow them to expand and develop according to their capabilities, and thereby provide a variety of municipal services. It could also serve as a justification for limiting growth according to these capabilities and to what is desirable to preserve the present quality of life. The ability to control growth not only will benefit the municipalities but also will protect the agricultural sector from the wholesale intrusion that could result from unplanned and uncontrolled urban growth.
>
> . . .
>
> There is a trend toward this rule of law which was first set down by the Utah Supreme Court in 1942 in Siguaird vs. the State in which the court applied essentially the same criteria as in the proposed legislation. . . . The court went on to state that in condemning water, the value of the land should be considered, and further that using the water for irrigation purposes does not restrict the value of the water to that use since they could transfer the rights to other uses.[28]

The latter point outlined above, as applied in the proposed Colorado law, is the key to the whole issue, particularly since this bill went on to state: "whichever is higher." Heretofore, with the value of the water being transferred tied solely to its value in irrigation use (while ignoring its associated irrigation investments and sunk costs), municipalities were always in a position to bid or condemn water away from agriculture at prices below what the market would dictate, because of the relatively low unit value returns on water in irrigation. The wording in the bill is, therefore, a direct attempt to recognize multiple markets and resulting multiple market values. It attempted to provide a mechanism for transferring the water to the highest bidder while insuring the capture of surplus value, if any, to the seller on the one hand and on the other guaranteeing that, as a minimum, his total opportunity costs would be taken into account in the selling price.

But state legislatures are organizations of men and, as such, carry the fallibilities of men. The new section setting forth procedures for determining whether or not a proposed condemnation would serve the public interest survived legislative debate by a narrow margin of three votes. But, for one reason or another which we will not attempt to speculate upon here, the legislature in its wisdom did amend the bill by reverting to a precedent in law that they felt more comfortable with. Specifically, the wording was changed back to "compensation at fair market value" (whatever that may mean in this context) and the amended bill became law in June of 1975. One defeat does not necessarily lose a war; in the future, more and more legislatures will be faced with resolving the kinds of issues raised in the Thornton case. We predict that, with time, more of the economic rationale

for changing water law in response to changing economic conditions will appear in emerging water legislation.

6. CONCLUDING REMARKS

We have pointed out previously the conditions necessary to an efficient allocation of water among competing uses, using as a frame of reference the mixed market economy of the United States. We have shown also that the special characteristics of water--particularly its mobile, flowing nature, interdependencies in supply and use, and uncertainty of supply--cause some serious problems for making evaluation and allocation decisions. While these problems must be taken into account in applying the economic principles that we have outlined, they do not invalidate the theory. The efficiency objective emphasized here continues to guide the allocation of water supplies to their most productive uses. Achieving optimum efficiency remains the basic problem, regardless of whether water use decisions are made privately or through collective (centralized) operation. A basic economic requisite to efficient development and allocation of water supplies is that the benefits of any action must exceed the costs of the action.

The legal system, from our perspective, has a number of functions to perform in the allocation of water that are necessary for achieving economic efficiency in any competitive capitalistic system. First, the primary purpose of a system of water law is to promote security and flexibility of tenure in water rights. But this purpose does not imply complete discretion of control manifested in the hands of a centralized management agency. What it does require is an explicit statement of property rights in water with respect to quantity, quality, timing, and location of use.

Second, and closely related, the legal system should provide a definite basis for transferring water rights between all economic actors; i.e., individuals, firms, and public bodies. Our bias is that such transfers should be allowed under voluntary transactions with respect to sale and purchase price. Involuntary transfers of rights may be necessary; e.g., from private to public agencies; but should be undertaken in light of just compensatory payments. The interface between law and economics here should be clearly understood. We contend that a centralized agency administering water rights and their transfers according to arbitrary statements of priorities cannot have the detailed knowledge of the returns to resources in alternative use necessary to efficient allocation decisions. This is the forte of economics and a tool which should be utilized in the decision making process.

Third, water law should be flexible in regulating two-party market transactions where cases of interdependence or commonality of use leading to divergence between social and private resource valuation are important. This problem may be partly alleviated by a more precise definition of property rights in terms of all dimensions of water. Other means of protecting third-party interests from these spillover effects include the use of zoning restrictions, the use of quotas, appropriate use taxes, and compensation for damages. Again, the economic input to an assessment of the magnitude of such spillovers, a determination of the incidence of benefits and costs, and recommendations as to the appropriate remedial actions necessary to promote efficient use must be recognized.

The wide range of political-economic systems throughout the arid and semi-arid parts of the world render it difficult to be specific in recommending changes and/or additions to water management systems from our economics perspective. Nonetheless, the following observations and suggestions are given in the hope that they may have some general applicability.

1. Irrigation is a major water use in most of the arid and semi-arid areas of the world. Whether the agricultural lands being irrigated are held privately or collectively, they rely on varying forms of public irrigation systems. In the process of using water for agricultural purposes within these systems, some types of economic externalities inevitably result in the sense that there are impacts on third parties and other water users whose views are largely ignored. We argue for greater recognition of the existence of such externalities and for taking them into account in the legal water systems and in water distribution systems as well. For water managers and public policy administrators, we offer the classic recommendation of economists for dealing with their water problems--adjust the systems so as to internalize the externalities to the degree possible.

2. Dating back to the Flood Control Act of 1936, national water resource development projects in the United States have been subject to varying degrees of economic analysis. These procedures for comparing expected benefits with costs, while far from perfect, have nonetheless been useful in the decision making process on which projects to build, where, at what scale, and for what purposes. We recommend continued economic analysis of benefits and costs, modified to reflect other than efficiency considerations, and that similar economic analyses be made of water development projects in other nations.

3. Public water resource development projects in which irrigation is a major project purpose have been developed throughout the arid and semi-arid areas of the world. In most cases, such projects have later been plagued with associated adverse effects, often--but not always--associated with a lack of adequate drainage facilities for the irrigated lands. Examples of such adverse impact areas include the Welton-Mohawk project in Arizona, the lands developed for irrigation by the British over a hundred years ago in the Indus Plain of India (now Pakistan) and the rather recent irrigation expansions below the Aswan Dam in Egypt. In most cases, such projects were designed to provide a maximum quantity of irrigation water but little attention was paid to the water quality aspects. We strongly recommend postmortem studies of such projects, with particular emphasis on the costs and benefits associated with salinity and waterlogging, so that future project design can benefit from such information.

4. Our final recommendation stems from a recognition that all developing economies are subject to change. Quite often such changes are in directions that cannot be anticipated or forecast accurately in advance. But, as a general observation, we note that developing economies sooner or later will be faced with major urban and industrial demands on their water supplies. Such changes in the economic infrastructure lead to competition and conflicts between emerging and current uses and to efforts to reallocate some of the water supply from irrigation to other uses. We think such reallocations are inevitable and should be encouraged rather than constrained by the legal system, provided such actions are shown in advance to be in the public interest. These reallocations, however, can lead to significant third party impacts and these must also be considered. We recommend, therefore, that efforts be undertaken to retain and expand the flexibility of water law systems so that these changes and their impacts can be accommodated with a minimum of disruption. Economic analysis should be a key input for decision making in this process so that not only the benefits in the new use, but also the opportunity costs of the irrigation or other displaced uses, are fully taken into account.

We conclude our paper with a reassertion of the close association between law and economics necessary to effective water resource management. The economist's role is to provide inputs into the decision making process and into legislation in the form of analyses of alternative courses of action to meet desired social ends. Equally important is the decision maker's consideration of sound economic principles in devising legislation to minimize uncertainty and to maximize social well-being in the use of scarce water resources.

7. FOOTNOTES

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[23]Melvin Sabey, "Sell Us your Water or We Will Take It," unpublished manuscript (mimeographed), Department of Economics, Colorado State University, Fort Collins, Colorado, March 1975, p. 17.

[24]G. E. Radosevich and M. B. Sabey, "Stability of Agricultural Water Rights," paper prepared for delivery at the 48th Annual Meeting of the Western Agricultural Economics Association, Reno, Nevada, July 1975 (Proceedings, forthcoming).

[25]31-12-101 Colorado Revised Statutes, 1973 and 38-6-101 to 122, Colorado Revised Statutes, 1973.

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[28]Radosevich and Sabey, "Stability of Agricultural Water Rights," p. 4.

THE ROLE OF NEW TECHNOLOGIES FOR IMPROVED WATER MANAGEMENT AND RELATED EFFECTS ON WATER LAW SYSTEMS

by Lucien Duckstein*

1. INTRODUCTION

The purpose of this paper is as follows:

(1) To define and identify the new technologies for improving water resources management.

(2) To introduce a problem-oriented viewpoint on the set of technologies which seem crucial for future water resources development in developing countries.

(3) To present a systems viewpoint on the long-range consequences of alternative technologies.

(4) To review the uncertainties in decision-making with emphasis on technological and strategic uncertainties.

(5) To present the problem definition phase of a rigorous systems design methodology that places elements of the decision-making process, such as goals, constraints, decision variables, in a proper perspective.

The outline of the paper follows approximately the above five points. Chapter 2 presents a background of the study in terms of principles and standards, criteria, and problems of importance (irrigation, flood control, and water quality problems). Current research needs are presented and new technologies are reviewed. Chapter 2 thus corresponds to the first and the second goal stated above. Chapter 3 describes aspects of the legal system relevant to the whole paper, but especially goals 3 and 4. Chapter 4 introduces the difficulties inherent to decision-making in water resources management and presents alternative approaches to this problem. It corresponds to goals 3 and 4. Finally, chapter 5 contains the description of the proposed systems design methodology as stated in goal 5.

In the next two chapters, it will be convenient to classify potential technological developments into the following five basic categories, based upon their possible impact on anticipated water supply and demand (National Academy of Science, 1971):

(a) Technological developments which will increase or decrease future water demands,

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(b) Technological developments which should increase the usable supplies of fresh water,

(c) Tecnological developments which extend the usefulness of impure water,

(d) Technical developments which dould have an influnce on future water demands and supplies,

(e) Considerations which could influence technical achievements.

Utilizing this classification scheme, the objective of this paper is to introduce new technological developments in the various categories and to evaluate the role of these developments in current and future water management strategies. Primary emphasis will be upon those technological developments falling into categories (b) and (c); however, technological developments in the remaining categories will also be briefly reviewed. Assessment of the strategic role of each technology discussed will be in terms of social, economic, and technical impact.

2. BACKGROUND

2.1 Evolution of Goals

In this section, the recent change in the goals of water resources development is sketched, then the key problems of water resources are evoked using U. S. examples. The rationale for emphasizing U. S. problems in this review is that many new technologies have been and are being developed in North America. This does not mean to imply that all such technologies can or should be employed in developing countries but simply that U. S. literature provides a fairly complete catalogue of feasible solutions and problems that may appear. Furthermore, the problem-oriented approach suggested at the end of this chapter erases the difference between water resources problems in developed and in developing countries.

In the past, emphasis has been upon increasing the development of water resources with existing technology (National Academy of Sciences, 1971). However, in many developed countries, the objectives of water resources planning and management have drastically changed in recent years. Much of this change can be attributed to an increased awareness of social needs and goals (Biswas, 1973). Historically, water development in the United States has been carried out with the basic objectives of national and regional economic efficiency (Smith, 1972; Biswas, 1973). The authorization of water quality standards in 1965 by establishment of the Federal Water Pllution Control Adminsitration has also had a distinct impact on water utilization in all sectors of the American economy. Quoting from Maughan (1972):

> Projected capital outlays for waste treatment, sanitary sewers, and water cooling requirements are estimated at 30 billion dollars (1968 dollars) for the 5-year period 1969 to 1973. This investment would catch up on the

backlog of needs so that the annual rate to keep up with population and industrial growth could be somewhat less after 1973.

Another major step in recognizing the shift in goals was the 1973 adoption, in the U. S., of a new version of the Principles and Standards for Planning Water and Related Land Resources. This document reflects the increased concern for environmental quality that had developed in recent years, as well as increasing public pressure to include non-efficiency objectives in natural resources development and management. Under these principles and standards, the overall purpose of water and land resource planning is (Howells, 1975): (1) To enhance national economic development by increasing the value of the nation's output of goods and services and improving national efficiency; and (2) to enhance the quality of the environment by management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

A more detailed view on these issues is given by Viessman and Stork (1973), who list twelve water research objectives:

(a) Determination of the impact of present and future water developments on the environment and ecology of localities.

(b) Development of methods for managing and controlling pollution.

(c) Devise and improve procedures for evaluating water resource development to maximize socio-economic benefits.

(d) Understanding of social goals.

(e) Determining how the public can be included in research, planning, and development to assist in the evaluation process.

(f) Determination of the effect of present laws and institutions on water resources allocation and how changes can be affected.

(g) Understanding the nature of people problems.

(h) Understanding the nature of water, its distribution, environmental interactions, and man's effect on natural processes.

(i) Development of new methods and instrumentation for field data collection.

(j) Development of conservation and quality augmenting methods.

(k) Development of techniques for efficient, minimum-cost design, construction and operation of engineering works.

(l) Perfection of techniques for controlling flood damage and erosion.

The emphasis on understanding human factors and institutions should be noted.

The gradual shift in emphasis from economic development and efficiency as the sole objective of resource development and environmental quality has had far-reaching implications for water resources planning. Other than attempts to broaden the scope of economic analysis, evaluation and justification procedures for water development projects had changed very little in the past 30 years (Burke et al., 1973). One result has been that many of the traditional approaches to water management have come under intense public criticism, forcing authorities at all levels to give increasing consideration to development alternatives which in the past had been rejected as too costly by benefit-cost criteria. In several instances, public pressure was great enough to force complete abandonment of the project, such as Bridge Canyon Dam in the Central Arizona Project, in spite of its obvious financial attractiveness (Hall and Dracup, 1970), or the trans-Florida barge canal.

2.2 Key Problems

While much of the current water resources research has shifted in emphasis from water supply to environmental impact and other contemporary issues (Viessman and Stork, 1973), there is still a need for continued research into new technology to solve the classical problems of irrigation, flood control, and supply for human consumption. Most of the basic approaches to these problems have changed very little over the centuries. If structural technology for water development is defined as the technology which is utilized to modify the distribution of water in space and/or time by altering its natural flow, it is observed that the primary difference between the dams, canals, levees, and aqueducts of centuries ago and today is that of scale. The major advances in the development of structural technology for water development and control have come primarily in the field of engineering (White, 1973). Another difference that might be pointed out is that there has been an evolution from single-purpose utilization of many of these structures to multipurpose utilization, indicating that strategic uncertainty is present at the time a system is designed, then implemented. Still, the natural hazard of floods is certainly not the least crucial of the problems examined below.

2.2.1 Flood Control

In spite of man's ability to build larger and more complex flood control systems, it has been estimated that in the United States alone flood damages are expected to increase from $1.7 billion in 1966 to approximately $5 billion in the year 2020 unless additional flood control works are built (Maughan, 1972). In almost every region of the world, annual damage from floods is on the increase (Yevjevich, 1974; Bogardi et al., 1975). The development of flood plain areas in some urban locations has also created distinct changes in the surrounding hydrologic environment. Development of flood plains has had the effect of increasing locally the frequency and magnitude of floods (Rickert et al., 1973).

2.2.2 Irrigation

Water demands for irrigation remain critical in many areas. In many of the developing countries where large increases in population are being experienced, agricultural development is a must. At the same time, irrigation is by far the largest consumptive use of water, with approximately 70 to 80 percent of the withdrawals for irrigation lost to evaporation and transpiration (UN Department of Social and Economic Affairs, 1972). Conveyance losses are also significant when water is transported over long distances for irrigation usage. Irrigation also accounts for a high percentage of the use of groundwater extractions. For the agricultural year 1967-68, groundwater accounted for 33.7% of the net area under irrigation in India; in 1970, 66% of the 94 km^3 of groundwater extracted in the United States was utilized for irrigation (Burdon, 1973). New extractions of groundwater can be expected to increase in almost every region of the globe in the coming years, creating many new problems such as saltwater intrusion and overextraction (Bokhari, 1975). In those areas where groundwater sources are already highly developed, the imbalance between withdrawals and intake have created the necessity for seeking methods to augment the natural recharge of aquifers. Groundwater management is an area of increasing concern to water authorities in many regions, particularly in those regions where extraction laws are practically nonexistent, such as Arizona.

2.2.3 Urban Growth

An urgent need in many countries is that of developing new water sources to meet increasing urban supply needs and to upgrade existing rural supply systems. Quoting from a United Nations report (1972) on forecasting water demand:

> Although irrigation may be of primary concern in a long range perspective, the most urgent tasks of national and local authorities in developing countries in the field of water resources development are related to rural and urban water supply. As stated in the 1972 Progress Report of the World Health Organization to the Twenty-Fifth World Health Assembly, 77 per cent of the 1,627 million population surveyed (including 88 developing countries) is not adequately served by community water supply services.

Urban growth, in addition to creating problems of supply, also stimulates many other problems such as the alteration of the natural distribution of water in developed areas due to land alterations, conflicts among competing users (municipal versus industrial use), waste disposal, and urban drainage.

2.2.4 Water Quality

Urban development, industrialization, and agricultural development, along with the natural hydrologic processes, have generated multiple requirements for water pollution control. For example, it is estimated

that suspended solids transported to United States streams by surface runoff are at least 700 times those imposed by sewage discharge; that erosion caused by surface runoff is by far the dominant form of soil loss; and that approximately three-fourths of the 4 billion ton/yr of sediment carried to various waterways in the continental U. S. as a result of surface runoff comes from agricultural lands (NAS, 1974). The four general sources of urban wastewater pollution are municipal treatment plants, industries, urban runoff, and fringe area agricultural drainage (Rickert et al., 1973). For example, urban surface runoff is normally treated as surplus or waste in the urban environment, as such most urban drainage systems have been designed to remove runoff as rapidly as is feasible. As a result of this policy of quick removal, urban runoff may be a major contributor to water pollution (Howells, 1975).

The North Atlantic and Great Lakes regions of the United States are experiencing severe water quality problems (Maughan, 1972). In other nations, such as Japan and the Philippines, domestic and industrial waste pollution of water resources has reached such a level as to be classified as serious. Another type of water pollution which has come under increasing criticism in developed nations is that of thermal pollution caused by the discharge of heated industrial wastes and cooling waters from the generation of electricity into natural water bodies. Thus, there is a need for research into new technologies for the control and improvement of water quality and for the development of reuse or recycling technologies to reduce the demand of fresh water supplies. Some reuse schemes have been studied by Duckstein and Kisiel (1975), while a recent bibliography has been published by OWRT (1975).

This background has only touched briefly on a few of the major problems facing water development authorities. Creative new approaches are sorely needed for improved water resources management, including structural and non-structural alternatives, new technologies and old ones. A more complete listing of the problems in the context of research needs will be given next.

2.3 Current Research Trends

The concern in this section is with both on-going and necessary research in the domains of water resources planning as well as physical (engineering) studies.

2.3.1 General Trends

The United Nations Committee on Natural Resources (1971) reported six major issues of concern in water resources development and use.

(1) Water resources planning -- to include the collection of adequate data on water resources and water use, the development of groundwater resources, and the development of methods for forecasting water requirements.

(2) Water resources administration, management, and law.

(3) Water pollution and water quality management -- the need for an integrated approach and comprehensive planning in both the quantitative and qualitative aspects of water management were stressed.

(4) Flood and drought damage prevention.

(5) The development of new sources of water supply and new technologies -- to include desalination, water reuse, the development of national water grid systems, cloud-seeding, and hail suppression.

(6) The need for a more co-ordinated approach to the development of international water resources.

2.3.2 Physical and Engineering Research

In parallel with the above broad research needs, the American Society of Civil Engineers (1973) published a list of physical or engineering research needs in two distinct areas: (a) water resources and (b) wastewater treatment. Items that seem of direct interest for developing countries are briefly reviewed below, other items are listed in Appendix A for sake of completeness.

(a) Water Resources

--Field Data Collection: A systematic methodology for design of water quality monitoring systems, guidelines for the establishment of sampling locations and sampling frequency; such measures are part of the "test plan" step of the systems design methodology described in chapter 5 and are most important in developing countries where data are almost always inadequate if at all existent.

--Estuaries: The effects of river diversions and impoundments which reduce the flow of fresh water into estuaries.

--Groundwater: The effects of oxidation ponds, soil disposal systems, and deep well disposal of wastewater on groundwater sources, the effects of land disposal systems on groundwater quality, the development of groundwater simulation models as illustrated by papers presented at the Madras Symposium (1973); the development of improved technologies in groundwater resources is equally important for developed and developing countries.

--Hydrology: Long-range prediction methods, the development of stochastic streamflow models as a function of rainfall, the effects of urbanization on streamflows.

--Storm Water Runoff: Definition of the effects of runoff on water quality, the control of combined sewer and storm sewer overflows: this is an example of problems that is bound to arise in areas of the world which are becoming urbanized.

--Water Quality Standards: The establishment of realistic water quality standards, the formulation of enforceable standards, a continuing review of water quality criteria (which is essential when the economic level of a country is evolving).

--Wastewater as a Water Resource: The use of wastewater for industrial, agricultural, and domestic use, as illustrated for the case of Tucson by Ko and Duckstein (1972).

(b) Water Treatment

--Organics and Trace Elements in Water: Methods of rapid detection of trace elements and determination of danger threshold.

--Inactivation of Viruses in Water-Disinfection

--Development of Suitable Viral Indicators

--Filtration.

These four points are fundamental, since they determine the quality of drinking water, hence, to a great extent, public health. Further elaboration of water treatment technologies is given in section 2.4.

2.3.3 Water for Energy

In recent years, particularly since the implementation of the oil embargo against the United States and other countries in 1973 as a result of the Middle-East Conflict, another area of water related research has received increased attention, that of energy production. The demand for cooling water withdrawal for electrical energy is projected to increase tenfold between 1965 and the year 2000 (Maughan, 1972). If utilities meet their schedule, the generating capability in the United States is expected to increase from a 1971 capacity of 360,000 MW to a 1976 capacity of 556,000 MW, with 51.2 percent of the additional capacity from conventional design fossil-fuel steam plants, 37.2 percent from nuclear-fueled plants, and the balance supplied by gas turbine and diesel engine-driven generators, as well as conventional and pumped storage hydropower installations (Hanke and Boland, 1972). As previously mentioned, the problem of thermal pollution from the discharge of large quantities of heated cooling waters into natural waters is a major concern. Many of the biological effects of the introduction of heated wastewater into lakes and streams are not fully understood and are the subject of much research and great debate. Another aspect of the water-energy issue is that of the use of water for the abstraction of coal and oil. In the United States, with increasing emphasis on the concept of "self-sufficiency", in the future there is little doubt that every available means will be utilized to make maximum usage of existing coal and oil reserves. Viessman and Stork (1973) suggest three related areas for immediate research:

(1) What are the best technologies for water use in the coal gasification process?

(2) What are the effects of strip mining on aquifers?

(3) What are the water requirements for oil shale development and how do they relate to those for coal development?

It should be noted that the problem of water allocation also plays an important role. A 1973 study by the National Research Council of NAS/NAE (NAE, 1974) summarized the problem as follows:

> The shortage of water is a major factor in planning for future development of coal reserves in the American West. Although we conclude that enough water is available for mining and rehabilitation at most sites, not enough water exists for large-scale conversion of coal to other energy forms (e.g., gasification, steam electric power). The potential environment and social aspects of the use of this water for large-scale energy conversion projects would exceed by far the anticipated impact of mining alone. We recommend that alternative locations be considered for energy conversion facilities and that adequate evaluations be made of options (including rehabilitation) for the various local uses of available water.

One possible alternative source of water suggested by the National Academy of Engineering (1974) was the utilization of non-potable subterranean water. The presence of saline water aquifers above the oil shale beds located in Colorado provides the alternative of salt water conversion using current desalination technology to provide fresh water for conversion activities. Semiarid countries of the world may benefit from such ideas and research if they process similar energy sources and wish to develop them.

2.4 New Technologies: A Survey

As stated in the introduction (chapter 1), the classification scheme for technological development related to water resources development and management utilized herein was adopted from a report of the National Academy of Sciences (1971). Of all the reports reviewed, this report provided by far the best attempt to place into perspective water resources development and technological advance, and the reader is referred to the report for details beyond the material given below. A summary of each of the technological developments in each of the five categories listed in the introduction is abstracted from the report for convenience of the reader. Only the most promising developments are listed below for sake of brevity. The other ones are listed in Appendix A. While this division necessarily contains arbitrary choices, it may serve as a basis for discussion. This listing is followed by a discussion of two developments of current interest, namely, desalting and wastewater treatment.

2.4.1 Technical Developments Which Will Increase or Decrease Future Demand for Water

(1) The future demand for water will be increased by

--Electrical power generation by conventional nuclear reactors

--Surface transportation using electrical power

--Transport of solids by water slurry pipeline

--Solution mining

(2) The future demand for water will be decreased if electrical power is generated

--By nuclear fusion

--By use of wind and water power

Also, if the following technologies are utilized:

--Recirculation cooling pond development

--Water as diluent for wastes

--Genetic development of plants to withstand drought and salinity

(3) Future demand for water may be increased or decreased depending on the specific situation and region by

--Conversion of solar energy to heat and power

--Electrical power transmission over long distances

--Geothermal energy

--Vegetation management

2.4.2 Usable Supplies of Fresh Water Should be Increased By

(1) By making new sources available where needed

--Desalting of seawater and brackish water

--Long-term seasonal precipitation forecasting

--Large-scale canal systems to carry water from regions of surplus

--Nuclear explosives for canal, tunnel, and reservoir construction

(2) By conservation of existing sources

--Evaporation reduction from lakes and reservoirs

--Phreatophyte control

--Groundwater storage and management

2.4.3 The Usefulness of Impure Water Will be Extended By

--Advanced treatment, improved processes for purification and reuse

--Increased use of seawater by industry

2.4.4 Water Demands and Supplies Could be Influenced By

--Subsurface and marine waste disposal

2.4.5 Technical Achievements Could be Influenced By

--Populating the desert

--Reservoir role in water management

--Effects of bioconcentration of toxic materials

2.5 Water Treatment Technologies

The purpose of this section is to examine in greater detail two technological areas of great potential importance to either arid or populated regions, respectively, desalination and wastewater treatment.

2.5.1 Desalination

From the standpoint of technology, desalination of saline and brackish waters is a viable means of augmenting fresh water supplies in many regions. Current desalination processes are divided into three categories:

(1) Distillation processes: Multistage flash units, vertical-tube evaporators (VTE) and vapor compression

(2) Membrane processes: Electrodialysis and reverse osmosis

(3) Freezing processes.

The most extensively used process is multistage flash distillation with units commonly on the order of 1 million gallons per day capacity. However, serious consideration has been given to the construction of installations with capacities of up to 150 mgd (UN Department of Economic and Social Affairs, 1970). Many of the multistage flash units are dual purpose plants in that they are integrated with power production plants, resulting in significant economies in water and power production costs. The VTE process is still in the research stage; however, it is believed

that it will have significant economic advantages over the multistage flash process. VTE plants in the 100 mgd capacity range should be available by 1980 (Spiewak, 1971). Vapor compression distillation is mainly utilized in areas with water requirements in the 10,000 to 100,000 gpd range, and in areas where continuous manning of the facility is not desirable or possible. Electrodialysis processing is restricted by economic factors related to the initial salinity of the feed-water and the required level of purity. Electrodialysis has normally been applied to the treatment of brackish waters with salinities of up to 5,000 ppm dissolved solids, and product purities better than 350 ppm total dissolved solids is seldom attempted (UN Department of Economic and Social Affairs, 1970). Most units operate in the 200,000 gpd range.

Reverse osmosis appears to have the greatest potential in terms of economic criteria and simplicity of operation. An additional advantage of this process is that it can be utilized to treat waters contaminated by industrial and municipal wastes.

Desalination technology will be utilized on an increasing basis to augment fresh water supplies as costs associated with supplying the product to potential users are reduced. In most regions, the unit of cost of desalted water is higher than that from conventional sources; however, there has been a steady decrease in unit cost as technological improvements have occurred. For example, the cost of seawater conversion in the United States was reduced from $8/1,000 gallons (1970 dollars) to in-service plant costs of 80¢/1,000 from the period 1952 to 1970. In 1971, the utilization of membrane processes resulted in costs of about 40¢/1,000 gallons (Rothermel et al., 1971). It has been suggested (NAS, 1971) that a reduction in costs to around 25¢ per kilogallon would probably result in a large impact by the technology in areas where saltwater is abundant and freshwater scarce. While costs are normally considered on a unit cost basis, Mobasheri et al. (1971) suggest that desalination plants should be considered as a sub-system of the total water system; the rationale being that the economic objective should be the minimization of the worth of the total system cost for meeting water demands.

Desalting plants have been utilized primarily to supply industrial and municipal water in regions where the demand value is high or desalination offered the only alternative (Spiewak, 1971; Mobasheri et al., 1971). There has been, however, increasing interest in the conjunctive use of desalting plants and conventional water supply systems in areas where salt waters are sufficiently available. Blood et al. (1971) suggests that in areas where further surface development is impractical, the conjunctive operation of desalting plants utilizing new sources of inexpensive energy shows promise as an alternative. The benefits of conjunctive operation are: (1) desalting plants can provide an alternative source to meet water demands in areas where natural supplies are erratic; (2) in surface water systems yielding supplies in excess of long-term reliable yield, the intermittent use of desalination in conjunction with such resources, the surplus, or non-firm yield, can be largely converted to firm yield and committed to firm water supply rather than being lost (Blood et al., 1971; Mawer et al., 1971). Clearly, energy considerations in the desalination process are crucial in determining the feasibility of such a scheme as mentioned in section 2.2.3.

While there has not been a wide-spread application of desalination technology to provide irrigation waters, it is expected that as unit costs decrease there will be a greater incentive to use desalination, particularly in those regions where energy and saline waters exist and high quality waters do not, or are inadequate.

2.5.2 Wastewater Treatment

Unfortunately, dumping raw sewage into rivers, lakes, estuaries, and oceans is still common practice. As a result, the touristic value of a region or its so-called quality of life element may be ruined. It is thus important to know which techniques are available to treat wastewater before disposing of it. The reader interested in technical details on wastewater treatment is referred to Appendix B. There is no doubt that wastewater should be treated as much as is economically feasible in any country. Developing countries can reap the fruit of the technological know-how described in Appendix B whenever they are ready. They must first recognize the problem, then study those available alternatives which are feasible within the various constraints of the country.

2.6 Technologies for Developing Countries

How can the members of a water resources management team find their way through the listing of available technologies presented above and in the appendix (remembering in addition that only a summary was presented)? This section attempts to provide an answer to this practical question.

Although it is customary to designate special technologies for developing countries as if all the developing countries had the same or similar problems in managing their water resource systems, the validity of such an approach has not been established. Rather, if it is necessary or desirable to classify water resources management situations, shouldn't it be done on the basis of the characteristics of the problems rather than on the loosely defined terms "developed" or "developing"? In other words, the classification could be problem oriented rather than based on subjective political and/or economical considerations. For example, as far as capital is concerned, developing countries such as Saudi Arabia and Algeria have almost no capital constraints, while countries such as India and Egypt are very much constrained by this factor. In this sense, a few developing countries may presently be ready to use the technologies listed in Appendix A. Moreover, the nature of the problems that the developing countries face in their water resources managements vary significantly, not only from one country to the other, but also within the countries. The political and social situation in many developing countries restricts the use of certain technologies, and thus it is essential to establish a problem-oriented approach to the problem in which non-engineering considerations such as social structure and ideology are included. As far as "new" technologies are concerned, it should be realized that the term "new" is highly subjective. What may be considered a new technology in Saudi Arabia, for example, may be considered as an old technology in the United States, Europe, or Israel. Thus, when considering the situation in developing countries, a redefinition of the term "new" is required.

While using a problem-oriented approach, it is necessary to define carefully the problem under consideration: a methodology developed for this purpose is presented in chapter 5. The remainder of this section is devoted to further considerations on (1) non-engineering aspects of water resources management and (2) evaluation of long-range consequences of technological and strategic uncertainties. Particular attention will be given to potential situations in "developing" countries.

2.6.1 Non-Engineering Considerations in Water Resources Management

Returning to the overall goals presented at the beginning of the chapter, the "non-engineering" considerations often present in water resources management are:

(a) Self-sufficiency

(b) Capital availability

(c) Technological know-how

(d) Income distribution

(e) Social and ideological structure

Often one or more of the above combinations are used to distinguish between developing and developed countries. Generally speaking, the above characteristics may be used as constraints while designing and operating the water resources systems. Although one or more of the above considerations are limiting factors in developing countries, it will be a fallacy to assume that all developing countries face similar situations as far as the above characteristics are concerned; similarly, in many developed countries one or more of the above considerations is a limiting factor in the design and operation of the water resource system. As mentioned above, by using a problem-oriented approach to the management of water resource systems, no distinction is made between developing and developed countries. However, in order to include all the aspects (including the non-engineering ones), special attention is to be given to the factors listed above. This is especially important when transferring technologies from one country to the other. The decision-maker should be aware of the non-engineering characteristics of the system under consideration; and before transferring technology on the basis of its success in other places, he should make sure that similar conditions and considerations exist in the system for which he is responsible.

2.6.2 Long-Range Consequences of Technological and Strategic Uncertainties

One of the most important characteristics of a water resources management system is its flexibility or adaptability, in other words, the capability of the system to respond to future expected and unexpected developments, whether of engineering type or social type. This is a crucial situation in developing countries where often structural changes in the

economic and social structure and ideology are experienced. It is often very difficult to evaluate the long-term effects of a technology that causes a structural change in the water resources management. At the same time, it is very difficult to predict how a certain technology will respond to changes in the management strategy. This is strategic uncertainty. For example, what happens if the purpose of an already implemented retention reservoir is shifted from water supply to irrigation and recreation? Many dams built by the Bureau of Reclamation for irrigation purposes turned out to be primarily useful as power producers. Similarly, a long-range worsening of the world food crisis may give certain river regulation dams an additional role of water suppliers for food (irrigation and fish ponds).

In order to establish some rationale in the design and operation of water resources management systems, particularly if a problem-oriented approach is used, there is a need to establish a methodology for problem definition. In this context, systems theory and its application to systems analysis may and should be considered as a new technology. The complexity of most water resource problems and the variety of potential problems prevent any methodology from being specific. However, guidelines in the form of a general framework may still represent a most useful technological improvement. In this spirit, after a brief review of legal elements to orient this report along the main avenue of the conference, systems design methodologies are presented both as new technologies and as a tool to study the long-range effect thereof.

3. THE LEGAL SYSTEM

Since the other reports in this conference elaborate in great detail on the various legal aspects of water resource systems, only a sketch of the elements relevant to the theme of this study is presented here.

3.1 Role of Legal System in Overall System

The increased role of government in water supply stems from a combination of factors such as the scarcity of water in some regions, coupled with a surplus in other places (floods), increased demand, rapidly rising costs of water development, and the even larger distances involved in transporting water. Recently, the increased concern for water quality in developed nations has added new dimensions to the role of government in water management, especially from the legal viewpoint. The concept of social or collective utility is also being introduced into some modern legislation.

Comprehensive multi-purpose planning strategies involving riverbasin development and inter-basin transfers of water have served to point out the inadequacies of both national and international law since many riverbasins are contained within the boundaries of several states, provinces, or countries. A list of several areas of concern related to item 6 at the beginning of section 2.2.1 on general research trends, within the realm of international law, is given below (Finkel, 1973); regulations are needed concerning:

(a) The use and protection of boundary lakes and rivers, and streams passing through several countries, respectively,

(b) The pollution of coastlines and international waterways by passing vessels,

(c) Aquifer pumping near international boundaries,

(d) Flood control in valleys forming international boundaries,

(e) Flood, erosion, and pollution control in watersheds whose upper portion lies in one country and whose lower portion lies in another.

Many of these problems are found in Hungary, especially (a), (b), and (e) (Fogel et al., 1974). On the national level, legal problems may be easier to control; however, they are nonetheless just as complex as those on the international level.

Insight into the role of legal factors in water resources development can be enhanced by a brief discussion on the characteristics of various legal systems, their relation to the decision-making process, and the effects of legal decisions on the introduction of new technologies.

3.2 Characteristics of the Legal System From the Decision-Making Viewpoint

Water laws were developed historically to settle disputes over the use of water or water allocation. Fundamental concepts such as "reasonable use", "riparian rights", and "prior appropriation" evolved from attempts to resolve these conflicts. The legal decisions handed down under these concepts usually reflected little concern for optimal use of water resources -- their main purpose is to resolve existing conflicts, perhaps avoid future conflicts of the same type.

At this point, a first question arises to ascertain when legal constraints become important in water resources development relative to factors such as hydrologic, physical, economic, or social factors. Thus, in the case of the Colorado River, a legal decision was made in the twenties about appropriating water before the randomly fluctuating annual quantity of water available had been properly estimated. As a result, the ex ante allocation decision has caused several decades of litigation between the states bordering the Colorado River and has prevented a comprehensive development of utilization of that water until recently. A second question that arises is: which new legal elements are needed as new technologies emerge? Thus, neclear power creates thermal pollution, as described in section 2.1; desalination creates brine disposal problems; urbanization causes bigger floods, and so on. In every case, legislative action must be taken to protect the rights of adversely affected parties.

Tarlock (1969) has presented an interesting although somewhat extreme contrast between legal and engineering approaches to water resources development as characterized by the types of decisions made under each.

Legal Decisions	Public Engineering Decisions
concerned with past events	concern with future events
concern with a few parties	concern about all parties
settle disputes	prevent disputes
incidental and temporary	optimal and semi-permanent
unpredictable results	more predictable results
immediate solutions	deferred solutions
indirect long-range solutions	direct long-range solutions

While these probably represent extremes and could be taken jointly to give a fair description of decision-making in general, the contrast serves to point out why water resource planning must give careful consideration to the legal apsects of decision making. In this respect, two basic questions may be asked.

(1) Is the legal framework adequate for dealing with the complex problems generated by the increasing demands being made on water resources and the technologies utilized to satisfy these demands?

(2) Does the legal framework encourage the efficient use of water resources and the introduction of new technologies?

In answering the first question, the concept of legal feasibility in resource development must be evaluated. Ostrom and Ostrom (1969) write:

> As supply and demand change among the various joint and alternative uses, and as new forms of technology affect the productive potential, substantial legal and political problems are created in rearranging decision-making capabilities. Every new technical solution to a water problem implies such rearrangement to accommodate the communities of affected interests. The wider the ramification of the consequence of a particular technological development, the more complex will be the task of rearranging decision-making capabilities to develop appropriate institutional arrangements.

Thus, any attempt to implemeent large scale water development projects, such as river basin development or the inter-basin transfer of water, may be constrained by a lack of the legal mechanisms necessary to resolve conflicts on other than a short term basis. The answer to the second question is open-ended and deserves a separate treatment, which is given in the next section.

3.3 Legal Elements, Water Use Efficiency, and New Technologies

Legal constraints on technological development and the implementation of certain types of technology (e.g., the use of nuclear reactors for power generation) are becoming increasingly important in all aspects of water resource development and use. The demands for higher quality water in many developed and developing nations is acting and is likely to continue acting

in the future in a direction that limits the range of acceptable technology. Thus, industries requiring high quantities of fresh water for material processing (canneries, paper pulp factories) can expect an increase in waste treatment costs as new standards are introduced and the legal mechanisms for enforcement of these standards become more viable. At the same time, controversies surrounding the validity of new standards, enforcement, and costs associated with alteration or replacement of existing water use and treatment technology may require a complete re-evaluation of the methodologies through which these standards are defined (Duckstein, 1971). This evaluation process usually occurs through the legal system, which then acts in the direction of decreasing efficiency of water use in order to increase welfare.

There are two basic types of law which are normally applied in attempts to resolve these types of conflict: common law and statutory law. According to Green (1972), five basic limitations may be associated with common law and four with statutory law. As these limitations affect the legal decision-making process, they are presented below with a few comments. The limitations with respect to common law are:

(1) Since courts normally act only after damage has been incurred by a party, the system is of little use in protecting society against new technology.

(2) Courts react to information presented by adversaries, and judges and juries may not correctly understand the technical issues involved, for example, measurement errors incurred when testing if standards are met.

(3) There is great difficulty in showing damage in a sufficiently legal way where the risk or damage is of a slow, cumulative nature, as in the case of mercury or lead poisoning.

(4) Conversely, there may be great difficulty in showing a causal relationship between existing damage and some technological source; interaction between wells tapping the same aquifer is a typical example of this difficulty.

(5) Common law is extended to new problems by trial and error, therefore, the formulation of new common law principles which adequately reflect the benefits and risks of new technologies is a long and slow process; in this sense, it is certainly not efficient. (At this point, a parallel may be made with the sluggishness of engineers in adopting new principles, which may be quite high. Traditional procedures encoded in manuals are still used many years after better methods have been developed.)

Next, the limitations of statutory law are:

(1) The inertia characteristic of legislative bodies usually results in the enactment of statutes only after the need is extremely obvious; this was the case for the dumping of waste into the Delaware estuary.

(2) The tendency for political compromise is strong, in particular, when the least chance of unemployment may result from enactment of the law.

(3) The more obvious nature of the benefits of a new technology may overshadow the less obvious nature of the risks.

(4) The general form of legislation is such that it is unable to anticipate the situations to which it will be applied, which may be an efficient way to introduce new technologies. The destruction of wildlife habitat below the Peau River Dam (Peau-Athabaska Delta Study, 1973) provides an example of points (3) and (4).

These legal limitations act as both constraints and facilitators to theintorduction of new technology. The general trend has been (Tarlock, 1969) to broaden the range of objectives to be considered in water development and to reduce the importance of least-cost solutions. This in turn has increased the range of technical alternatives that must be considered.

Legal factors may be intertwined with technological constraints. For example, in Pakistan, the farmer rights are such that water is given to the land and everybody has equal right to a volume of water assigned tentatively at the beginning of the season (or of each month). On the other hand, there is a stringent technical constraint created by the lack of storage. As a result, water is given out in a fixed quantity basis but according to a time allocation. This in turn limits the kind of irrigation technology that may be used. Once such a system is set up, changes are hardly realizable because of the economic investments necessary to obtain an operational system. A complete hindsight evaluation of river basin development in Pakistan has been given by Bokhari (1975).

It is thus seen that legal factors are an integral part of the decision-making process. This leads to the next chapter where a review of the decision-making process in the design and management of water resources systems is presented.

4. DECISION-MAKING IN WATER RESOURCES MANAGEMENT

Generally speaking, the management of water resource systems includes (but is not limited to) the following sequence of stages:

(a) Forecasting

(b) Planning

(c) Decision-making

(d) Action

In this chapter, the third stage is discussed in greater detail than the other three, for reasons explained below. It should be emphasized that each stage affects the other stages, and the overall performance of the water resources management system is only as good as the weakest link between these stages. Past experience, current situation, and projections into the future provide the decision-maker with forcasts of both future needs and potential future supply. This constitutes the first stage, i.e.,

future inputs and desirable outputs of the water resources management systems. The second stage involves the consideration of potential technologies to be used by the water resources management system. The crucial point in any water resources management system is the third stage in which a decision is to be made as to the alternative(s) to be implemented. This is the heart of the management process and it should be carefully examined.

In our discussion, we will introduce some of the basic problems involved in the decision-making process, and we will briefly review potential approaches to water resources management from the decision-making viewpoint. For a more detailed study, we refer the reader to Duckstein and Dupnick (1971), Popovich et al. (1973), and Chaemsaithong et al. (1974).

4.1 Difficulties in Decision-Making in Water Resources Management

The decision-making process in water resources management is rather complex. The basic difficulties involved in the decision-making process stem from:

(a) Various types of uncertainties

(b) The multi-objective nature of the decision process

(c) Numerous constraints that may be difficult to pinpoint.

We will discuss the above factors with emphasis on water resources management systems in developing countries.

4.1.1 Uncertainty

The various uncertainties which are present in a decision-making situation may be classified as follows (Kisiel and Duckstein, 1972, Bogardi, 1975):

(a) Natural uncertainty: The natural processes involved in a water resources system (rainfall, droughts, natural population growth, etc.) always introduce some degree of uncertainty into the decision-making process.

(b) Model uncertainty: The impossibility of construction or choosing a proper model to represent the actual elements of the water resource system introduces uncertainty due to imperfect modeling.

(c) Parameter (sample) uncertainty: Even if we accept a certain model to represent accurately the actual system, say a lognormal probability density function for yearly peak flood, still we have to estimate the parameters of this model. The parameter uncertainty is caused by the finiteness of sample data that are available to estimate the model parameters. This is a typical situation in developing countries where insufficiency in the information concerning the natural processes of the water resource system is experienced frequently.

(d) Economic uncertainty: Due to the inadequate knowledge of economic factors such as construction, energy, and labor costs, as well as flood, drought, or shortage losses, further uncertainty is introduced to the decision-making process. This situation is common to practically all countries -- construction costs are almost always strongly underestimated.

(e) Technological uncertainty: While introducing new technologies, such as the ones listed in chapter 2, it is difficult to forecast the response of the system. It should be noted that "old technologies" already implemented in highly developed countries (say desalination) may turn out to be "new" technologies in developing countries, so that they may cause a structural change in the system and increase both the economic and strategic uncertainties.

(f) Strategic uncertainty: This uncertainty is caused by not knowing (at the decision-making time) what the institutions and priorities will be at the time the system is implemented. For example, it is next to impossible to know what the common law concerning treated sewage recharge into the aquifer will be, statutory law may be almost as difficult to forecast. Structural changes caused by new technologies often increase this uncertainty: thus, a new water production or reuse scheme may offer possibilities of human settlement or industrial implantation that were unthinkable before.

4.1.2 Multi-objectivity

Low costs and high benefits are rarely the only goals to be achieved by a water resources management system. Income distribution, probability of failure, environmental impact, and many other considerations are often involved in water resources management systems. The difficulty is not only in chosing among vectors of measures of system effectiveness but also to define the goal(s) the system is supposed to achieve (Monarchi et al., 1973). Some subjectivity is introduced into this process. It is essential that the decision-maker communicate with the public (consumer) before defining the objectives. This is of particular importance in developing countries where often the decision-maker may not be in a direct contact with the consumer.

4.1.3 Constraints

The feasibility of a system depends on the resources available for its implementation. The word "resources" should be accepted in its widest sense. Raw material (water, for example), capital, manpower, etc. are only a few of the resources to be considered. The availability of these resources determines the range of alternative systems that may be considered as feasible. Another constraint to be considered in decision-making in water resources management is the already existing system. For example, if a given legal system exists and is not subject to change in the design of the new water resources management system, then this legal system should be considered as a constraint. In the next chapter, it is shown that another viewpoint on the legal system may be taken in certain circumstances; namely, the legal element is taken as a decision variable.

The identification and formulation of constraints in the decision-making framework is often a difficult task since human beings and institutions are involved. Moreoever, in many situations, there is a need to analyze and evaluate the "cost" involved in violating certain constraints such as quality standards or the cost-benefit effect of relaxing certain constraints.

4.2 Approaches to Decision-Making in Water Resource Management

A detailed description, critique, and comparison of a variety of approaches to decision-making in natural resources management is presented in Cohon (1973) and Duckstein *et al*. (1974). In this discussion, a partial list of the approaches that are commonly used is established and briefly discussed.

Basically, most approaches are based on some analysis of a benefit-cost relationship. They differ from each other with respect to the definition of the terms "benefit" and "cost", i.e., the trade-off between beneficial and adverse effects, the method of handling uncertainties, and the approach used to deal with the multi-objectivity of the problem.

Benefit-cost analysis (BC). Benefit-cost analysis is a method of evaluating the worth of a project by computing and examining the ratio of the monetary benefits derived from the project to the monetary costs associated with the project, or the difference between these two quantities. One of the major problems with benefit-cost analysis, as noted by Prest and Turvey (1965), is the complete absence of an *a priori* structure with which to handle a given problem. Since the necessary mathematical structure must be formulated in advance, subjective biases are often placed (perhaps unknowingly) in the framework. Consequently, a certain amount of arbitrariness is inherent in answering the questions:

(a) Which cost and which benefits are to be included?

(b) How are they to be valued?

Collective utility (CU). Collective utility is a systematic approach to economic analysis and is primarily concerned with small changes or marginal transformations with not too many qualitative factors (Lesourne, 1972). The phrase "collective utility" is appealing to the senses. First of all, "utility" denotes the capacity or the quality of the article or service to satisfy a want. "Collective" means from an aggregate standpoint, whether it be the aggregate society or society as modified by a centralized decision-making agency. The specific purpose of CU theory is to provide a basis for comparing two alternative uses of resources. An example of application of this approach for comparing water pricing schemes is found in Duckstein and Kisiel (1975).

Bayesian Decision Theory (BDT). Bayesian decision theory is primarily used to evaluate the worth of additional information concerning uncertainty in the decision model. Although BDT is often used to "optimize" decisions (using expected value as a criterion), the single

objective characteristic restricts its use to relatively simple and well-defined situations (Davis et al., 1972).

Multi-criteria or multi-objective models. Roy (1973), McCrimmon (1973) have presented general reviews of such models. Specific techniques applied to water resources have been given by Monarchi et al. (1973) and Haimes and Hall (1974).

Cost Effectiveness (CE). Cost effectiveness seeks to find significant differences in the costs or resource requirements among the available alternatives for approaching one or more goals while also examining the beneficial effects. Thus, CE compares alternative systems with each having a chance to meet a goal set. Carpenter (1970, p. 7) defines CE as the trade-off between effectiveness and cost of one program compared to the same trade-off of some other program or of various variants of the same program. Simply speaking, the scope of the economic evaluation has been broadened from that of cost-benefit analysis. A standardized CE approach was put forward by Zazanowski (1968, 1972). The CE approach is one of the most general approaches available and therefore may be considered as a framework for water resources system design (Duckstein, 1975). Since we are dealing with a most important problem, involving first the definition of a problem, then the design of a new system or the improvement of an already existing one, another methodology that minimizes the chance of errors or omissions will be discussed. This is the methodology for system design developed by Wymore (1974, 1975), which is akin to the CE approach but treats the steps of the design in a more rigorous manner and is especially structured for large-scale systems. Wymore distinguishes two phases in the process: the problem definition phase, followed by the design phase. The next section includes a presentation of the problem definition phase of the system design methodology.

5. A SYSTEM METHODOLOGY FOR PROBLEM DEFINITION

On the basis of the available alternative improvements of the existing water resources management system, the decision maker has to choose one alternative--the most satisfactory one. By system design methodology is meant a two phase process consisting first of problem definition and second, of problem solution. Wymore (1974, 1975) has developed a systems design methodology which can be adapted to fulfill almost perfectly the purposes of this paper, including the examination of long-range consequences of alternative technologies. Only the first phase of the process is considered here, namely, the problem definition phase. Before going into the presentation of the methodology, it should be emphasized that the word "system" is to be taken in its widest meaning to include geographical, physical, economic, social, political, and legal elements.

5.1 The Basic Steps for Problem Definition

Five steps to be iterated upon are necessary for the problem definition phase before any alternative system can or should be considered (Wymore, 1975):

(1) The input elements (considered to be given) and output elements (considered to be controllable) are classified and listed.

(2) The sets of input and output variables which will be observed for the purpose of evaluating a system are defined. Let those variables be called performance indices (PI). The PI's will be used to measure the goodness of a model of a system in terms of the decision-maker's or client's desires. Systems will thus be ranked or ordered according to the set of PI's that characterizes each of them. This is the performance ordering α.

(3) With due consideration to available technologies (as in chapter 2) a set of indices, called resource indices (RI), is defined to evaluate the type and quantity of resources (natural, capital, manpower, etc.) that are necessary for a given system. There, indices are used to examine the feasibility of the systems under consideration; they also lead to an ordering based on the level of allocation of these resources. This is called resource ordering β.

(4) A set of trade-off functions (TOF) is defined for the case when conflicts arise between the ordering α (over performance indices) and β (over resources indices), and leads to a trade-off ordering γ. For example, if systems Z(1) is α-ranked before system Z(2) on the basis of desirable features, but system Z(1) requires more resources than Z(2), hence it is β-ranked after Z(2), the ordering γ decides whether a less satisfactory system Z(2) can be accepted or more resources should be provided so that Z(1) can be chosen.

(5) Finally, a test plan describing how the implemented system will be evaluated in space and time is drafted.

Often, an additional step implied by the first sentence is (3) is considered explicitly after the second step. Here the possible systems concepts available to develop the solution are listed, that is, the methods and technologies available for solving the problem are defined in detail. Including this additional step insures that the solution of the problem will be technically feasible.

Phase II of the process--the design phase--would use the results of Phase I to define and optimize alternative systems. A first selection of systems is made on the basis of α and β. In this stage, non-feasible systems and dominated systems may be eliminated. Then the final selection can be made using the trade-off ordering γ.

The above approach will now be explained step-by-step by means of examples.

Step 1: Input-Output Definition

Consider the problem of designing an irrigation system in a given developing country. The input set consists of elements which are taken to be given for the purpose of the analysis: this may include rainfall, floods, water demand, price of imported water, natural growth of population, educational level of farmers, legal constraints, etc. In a way, input elements are constraining (or spurring) factors of an external

origin in the development of the system.

Data on the output involves elements that can be controlled, such as distribution of water quantity and quality, flood phenomena, groundwater levels, population distribution, land use, etc. It should be emphasized that the introduction of new technologies affects the elements of the output. For example, by means of cloud seeding, the rainfall may be controlled so to speak, so that if cloud seeding technology is a potential element of the new system, rainfall (or subsequent runoff) will be an element of the output. Adequate historical and forecast data on both input and output is of utmost importance (Duckstein, 1974).

Step 2: Performance Indices, Figures of Merit, and Ordering

Performance variables or variables observed to evaluate the performance of a system are combined as merit indices to answer the question: "What does the decision-maker (or the client) want?" and thus, to arrive at an ordering of systems according to their performance. The procedure to define the above characteristics might be as follows:

(a) Decide which system variables will be observed, that is, choose those input and output variables that will constitute the basic information for evaluating system performance. These variables, called performance indices (PI), may be water quantity and quality, number of shortage events, useful storage of a reservoir. Notice that these indices may be elements of either or both the input and the output.

(b) Assign, with the help of the client, a subjective weight or probability p(i) to any possible realization of the states of the system considered. For example, since rainfall is a random variable, rainfall events during the life time of the system are viewed as time series whose probabilistic characteristic should be estimated. Performance indices such as probability of failure of a system (shortage of water supply, for example) are commonly used when random variables are considered.

(c) Define, again with interaction with the client, combination of PI's which yield numbers measuring the performance of effectiveness of a system; for example, a water quality characteristic may be based on both the yearly average and the maximum two-hour concentration of a pollutant, which are two different PI. These characteristic numbers are called figures of merit (FM).

(d) Define an ordering scheme over the set of all possible FM. This ordering problem constitutes a multi-criterion or multi-objective decision-making problem, which as mentioned in section 4.2, can be solved by various procedures presented or reviewed in Roy (1973), McCrimmon (1973), Cohon (1973), and Duckstein et al. (1974). The decision-making algorithm leads to the performance ordering α of the systems considered.

As noted above, the performance (or merit) ordering α should be defined in the absence of any specific system in mind with the objective of being able to compare any two systems with respect to input-output performance. It also performed without regard to economic or technological feasibility: such considerations are reserved for the next step

which leads to an ordering of designs with respect to resource utilization, which is made to include technological feasibility.

Step 3: Resource Indices and Ordering

Resource indices are designed to answer the question: How much resources are needed to implement a design? As pointed out earlier, it may be appropriate at this point to take an inventory of available technologigies, including new ones. For example, for the design of irrigation systems, potential technologies may include pressure systems, sprinklers, dead-flat land irrigation, wastewater reuse schemes, drainage systems, etc. For each technological or social element, the amount of natural or human resource used is measured by a set of resource (utilization) indices (RI) such as: capital, operation and maintenance costs; management, technical, manual, and clerical labor; natural resources utilized (area for the lake behind a dam); energy requirement (sprinkle versus flatland irrigation systems). Since a system is composed of building blocks, every design may be labeled by a set of RI's. Let system j be characterized by a set of resource indices {RI(j,1)}, {R(j,2)}, ...: a multiobjective scheme may be used as in the previous step to order a set of systems from the viewpoint of resources utilized. A resource ordering β is thus defined on the set of systems that are feasible from the technological and human viewpoint.

Because of numerous uncertainties present in the determination of the RI's, the concept of risk (de Neufville and Stafford, 1971) is inherent to this step. In particular, Bayes Risk, which weighs present construction costs versus expected future benefits (or losses) in the presence of both natural and sample uncertainty may be considered as a β-ordering; see section 4.2 and Davis et al., (1972).

So far, two orderings have been defined on the set of systems Z(1), Z(2),... (which is to be designed later): a performance ordering α and a resource ordering β. Thus, at this stage, certain systems may be eliminated. If system Z* is ranked first under both α and β-orderings, then Z* will be the system selected. Unfortunately, such a system Z* does not usually exist, because the system that performs most satisfactorily is bound to consume the most resources. "Maximum effectiveness at minimum cost" is a well-documented fallacy of systems analysis (Kazanowski, 1968), since the minimum cost is always zero at zero effectiveness, while maximum effectiveness is attained at an infinite (or very high) cost. Then how can conflicts between good performance and acceptable resource utilization be resolved? A third ordering is defined for this purpose.

Step 4: Trade-off Ordering

This step tells us how to order systems when a decision cannot be made on the basis of orderings α and β (the usual case). The conflict between these orderings is resolved by trading off FM (quality of water, quantity of water, reliability) and RI's (cost, manpower, capital). Formally, trade-off functions (TOF) are defined and constitute a trade-off ordering γ. In certain cases, elements of γ can be derived from elements of α and β (Wymore, 1975).

As pointed out by Sewell (1974), conflict resolution of this type requires data at the policy level; it also requires economic, physical, and hydrologic data, in quantities proportional to their relative importance in the planning process (James et al., 1969). For example, in a wastewater reuse scheme, a TOF resolves the conflict between a high FM representing a quality of effluent discharge and a high tertiary treatment cost RI (Duckstein and Kisiel, 1975).

Choosing a system on the basis of ordering is not sufficient. How will the system be tested? For this purpose, there is another step of problem definition, namely, the establishment of a test plan.

Step 5: Test Plan

Once a system is selected to develop our irrigation system, how will we verify that it accomplishes the set tasks, namely, how will hindsight studies be performed (Bokhari, 1975)? What kind of data will be set up for control and surveillance of system operation? Obviously, a legal system setting regional water quality standards would be useless without proper surveillance and enforcement schemes. The test plan includes not only legal factors, such as those described in chapter 3, but also the specification of instruments and statistical methods that will be used to observe the performance variables and compute the FM of Step 2 above. Institutions should be provided to follow up on the performance of the system.

The definition of a test plan, which leads to a clear set of acceptance criteria for the system, should include provisions to observe unexpected beneficial and adverse effects, such as environmental impacts of the project; these effects may be long-range ones, such as accumulation of minute quantities of a harmful substance (asbestos, DDT). Unfortunately, the test plan step is notoriously absent in many water resource planning studies. The absence of a test plan may result in a wrong decision--for example, one that cannot be enforced, so that the situation which the decision was supposed to remedy not only remains but may become worse. Also, the presence of a test plan sets the stage for a study of the long-range consequences of the technological choices made in the systems design. Simulation may be used for that purpose; for example, the use of a closed system for irrigation may lead to water logging and salinity problems that can be ascertained by a simulation model. Remedying such a situation once it occurs is much more costly than providing proper drainage to begin with, as it can be observed in many countries (Bokhari, 1975).

5.2 The Role of the Legal System

Generally speaking, the legal system is an integral component of the entire system, hence legal considerations are introduced in all the steps mentioned above. As demonstrated in section 3.3, the legal system may be one of the constraints imposed on the decision-making procedure. On the other hand, in certain situations, the legal system may be considered as a decision variable to be chosen from a set of feasible legal systems. From the entire systems viewpoint, one desirable charac-

teristic of a legal system is its adaptability. In other words, a "good" legal system shouldbe designed and operated so as to handle possible changes in the requirements of the client. Changes in standard of living, for example, cause changes in the value of non-economic characteristics of the system and often the client would like to change standards, such as the quality of the environment. The legal system should be flexible enough to adapt itself to possible new situations. Another suggestion is to set up a trial period for laws and thus introduce a feedback in the legislative process. Again, simulation may be used for such evaluations if the risk of creating too many inequities when applied "in vivo" is too large. As was mentioned in the previous section, the performance of the legal system is an important element of a test plan.

5.3 Special Considerations for Problem Definition in Developing Countries

Although the methodology presented in this paper is general enough to consider a variety of design situations, a few additional remarks are in order for the case of developing countries. The application of analyses methods depends on the specific structure of the problem under consideration. The methodology presented in this chapter is based on two fundamental assumptions:

(a) Information is available for the determination of such system characteristics as PI, FM, TOF, α, β, and γ-orderings.

(b) These characteristics are time invariant.

When considering the design of engineering systems in developing countries, these assumptions may be far from being satisfied. Inadequate data on water and soil classification and on the socioeconomic pattern of rural life is bound to lead to an utterly disappointing performance of an irrigation system. One of the difficulties in evaluating the TOF, for example, is due to the fact that the development of the system may cause structural change from the viewpoint of involved individuals. Under structural changes, the individual usually changes his preference (FM versus RI). Thus, possible changes in α-ordering over time should, for example, be considered if structural changes are expected.

Another aspect of importance relevant to developing as well as other countries is the human factors aspect. First, the orderings may reflect the actual public needs only if a dialog is established between the decision-maker and the public. Second, the decision-maker is often isolated from the public because of the lack of proper institutions and educational level to establish public participation in planning; then, the orderings do not reflect the public needs. This is true even in developed countries; thus, training of the Rhone River (France), which was decided in the capital, has not gained the acceptance of the valley residents, although the project is almost completed and has proven to be quite beneficial (Monier, 1975). The problem of public input in water resources project planning is far from being solved, especially for large-scale projects.

6. RECOMMENDATIONS AND CONCLUSIONS

The recommendations emerging from the report may be stated as follows:

(1) It is generally beneficial to introduce systems analysis methodologies into water resources management problems.

(2) The development of problem-oriented approaches avoids becoming lost in long lists of available technologies, possible criteria, and detailed consequential effects of the project, such as any environmental impact statements that have been produced to date in the U.S.A.

(3) The communication and interaction between different disciplines, such as engineering and legal ones, needs to be improved. In particular, the waste consisting in designing projects without regard to test plans or institutions or legal factors and the waste consisting in establishing laws without regard to technical feasibility, such as unrealistic quality standards, should be avoided.

(4) Know-how and experience acquired in water resources management could be shared through an information bank which could include available legal systems.

(5) The possibility of making the elaboration of new laws an adaptive process, namely, testing new laws before deciding to implement them permanently, should be considered.

Other points broached in this study lead to concluding remarks as follows:

(a) A problem-oriented approach coupled with a rigorous problem definition methodology gives a proper framework for the study of new technologies and the consequences. A problem-oriented approach has the enormous advantage of avoiding the lumping of all developing nations into the same category.

(b) Systems analysis techniques themselves may be considered as new technologies in water resources management: a proper use of systems approaches may have more beneficial effect than the use of a new physical technique.

(c) An old technology for one country could be a new one for the other countries and is susceptible of introducing structural changes in a developing nation. The perception of a structural change is easier if a problem-oriented approach as suggested in point (a) is used.

(d) A trade-off is necessary between measures of the performance of a system and resources available. The cost effectiveness methodology is a possible approach to aiding this trade-off, while the systems design methodology approaches the problem-definition phase in a rigorous manner. In either case, a common language is provided between the various disciplines which is a necessary condition for the implementation of recommendations (3) and (4) above.

(e) A positive approach should be taken to the problem of designing a legal system, namely, the legal system can be treated as a decision variable in the design process rather than a constraint.

(f) Both technological feasibility and long-range consequences should be considered when setting up institutions to follow up development plans.

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APPENDIX A

Further Research Areas and New Technologies

The appendix lists those topics whose application in most developing countries seems remote or exceptional for the time being. For example, most advanced water treatment technologies are reserved for countries with cheap and abundant energy reserves. This list may be considered as supplementary ideas for possible future use.

2.3 Current Research Trends

2.3.2 Physical and Engineering Research

(a) Water Resources

--Impoundment Quality: understanding of algal blooms and eutrophication

--Impoundment Flow: instrumentation for velocity flow measurements in the low range.

--Rivers: the establishment of water quality baselines, river pollution, reduction of nonpoint source pollutants.

--Automatic Data Collection Systems: automatic monitoring of water quality, effective methods for surveillance of wastes disposal.

(b) Water Treatment

--Dialysis and reverse osmosis

--Coagulation and color removal

--Sludge Disposal from water treatment plants

--On-line quality control for water supply

2.4 New Technologies: A Survey

2.4.1 Technical Developments Which Will Increase or Decrease Future Demand for Water

(1) The future demand for water will be increased by

--Gas production from coal

--Fire hazard area irrigation

--Forest and rangeland irrigation

(2) The future demand for water will be decreased if electrical power is generated

--By gas-cooled nuclear reactors

--By fuel cells

--By magneto-hydrohynamics

--In open-cycle engines

Also, if the following technologies are utilized:

--Cooling tower design and utilization in industry

--Industrial cooling systems using air

--No rinse washing/laundry technology

--Bioprocessing to provide food

--Artificial anti-transpirants

--Subirrigation and unsaturated leaching strategy

--Landscaping with artificial materials

(3) Future demand for water may be <u>increased</u> or <u>decreased</u> depending on the specific situation and region by

--Power generating units for meeting peak demands

--Oil shale conversion to liquid fuels

--Advanced communications systems

--Central electric versus on-site total energy systems

--Regional environmental management of bays and estuaries

2.4.2. <u>Usable Supplies of Fresh Water Should be Increased By</u>:

(1) By making new sources available where needed

--Compact water desalting units for residential use

--Precipitation increase through cloud seeding

--Augmenting fog drip

--Artificial ice fields

--Deliberate snow/ice avalanching

--Melting of ice caps to create lakes

--Iceberg towing

--Collapsible bladders for transport of liquids

--Undersea aqueducts

--Offshore reservoirs

--Service tunnel use in urban areas for electric power distribution, sewage, water services, and storm drainage

(2) By conservation of existing sources

--Runoff water control using rock tunnels and galleries

--Groundwater recharge using craters created by nuclear devices

--Soil and rock reservoir modification

--Watershed management: surface water harvesting

2.4.3 The Usefulness of Impure Water Will be Extended By:

--Instream aeration for water quality improvement

--Wastewater renovation by surface spreading

--Water recycling in manufacturing industry

2.4.4 Water Demands and Supplies Could be Influenced By:

--Reservoir bottom water use

--Crop production by use of residual heat and other by-products

--Reducing contaminants from watershed areas

2.4.5 Technical Achievements Could be Influenced By:

--Rationalizing the market for water services

--Residential water demand modification

--Water-based recreation needs

APPENDIX B

This appendix is devoted to a brief technical presentation of both traditional and new methods of wastewater treatment; it pertains to section 2.5.2 of the main text.

Water pollutants can be grouped into two basic categories (Huang and Smith, 1974):

(1) Suspended solids: coarse, medium, fine, colloidal, bacterial, viral

(2) Dissolved matter: organic (biodegradable, refractory) inorganic (gross, plant nutrients)

Current methods of treatment include three primary technologies: (a) conventional treatment, (b) advanced treatment, and (c) land treatment. Both conventional and advanced treatment processes have been widely applied to industrial and municipal wastewaters while land treatment has not been widely applied outside of industrial treatment (Roper, 1973).

Conventional treatment of suspended solids includes the following techniques:

--Coarse: screening or comminution to reduce size

--Medium: sedimentation or flocculation

--Fine: biological flocculation and/or hydrolysis

--Colloidal: biological flocculation and/or hydrolysis

--Bacterial: disinfection with chlorine or ozone

--Viral: inactivation with chlorine or ozone

Advanced treatment of suspended solids includes:

--Fine: coagulation and filtration

--Colloidal: Coagulation and filtration

--Bacterial: alkaline pH($\geq$ 11.0), reverse osmosis or electrodialysis

--Viral: alkaline pH($\geq$ 11.0), reverse osmosis or electrodialysis

Conventional treatment of dissolved matter is normally limited to the treatment of biodegradable organics by the method of biological oxidation.

Advanced treatments of dissolved matter includes:

--Organics (biodegradable): carbon absorption or reserve osmosis

(refractory): carbon absorption, reverse osmosis, or chemical oxidation

--Inorganics (gross): electrodialysis or reverse osmosis

(plant nutrients): chemical precipitation of phosphate, air stripping of ammonia, biological nitrification and denitrification for nitrogen removal, and breakpoint chlorination for ammonia removal.

Utilizing advanced wastewater treatment, it is possible to produce a treated effluent of a very high quality. Renovated wastewater is used in Windhoek, South Africa, to provide 14% of the normal water for drinking purposes and up to 40% during winter months (Huang and Smith, 1974). However, in the United States, treated effluent is used only for non-domestic purposes. Huang and Smith (1974) suggest that there are both psychological and scientific reasons for this aversion to a closed-system of water supply. The scientific reason includes the difficulty in getting rid of viruses (Duckstein and Kisial, 1975). Huang and Smith compared the treatment efficiencies of two advanced treatment plants (South Tahoe Plant, California; Ahuimanu Plant, Hawaii). Concentrations of the five-day biochemical oxygen demand and suspended solids were reduced to between zero and three, total coliforms reduced to less than 43 counts per 100 ml, and the effluent from both plants exhibited no color, turbidity, taste, or odor.

The introduction of excessive levels of nutrients into some natural waters, resulting in eutrophication, has been another pollution problem of concern in recent years. Eutrophication results in the excessive growth of algae and other aquatic vegetations. Since the removal of nutrients was not an objective of wastewater treatment until fairly recently, conventional treatment processes were not suitable for the removal of phosphorous and nitrogen from wastewaters. New technologies for the removal of nutrients have been developed which are capable of providing effective removal at reasonable costs.

There are several land treatment methods which represent relatively new approaches to wastewater treatment. These are: (1) spray-irrigation, (2) rapid-infiltration, (3) spray-disposal, and (4) spray-runoff.

Spray-irrigation is the application of treated effluents to crops. The typical system consists of six basic components (Krivak, 1972; Roper, 1973): (1) a collection and transport network, (2) treatment cells, (3) storage lagoons, (4) irrigation and land facilities, (5) the soil or "living filter", and (6) a drainage network. The basic objective of the system is to transfer the nutrients from the treated effluent to the soil where they are stored for uptake by crops. The water without its undesirable chemical constituents is then allowed to percolate through the soil into the underlying aquifer or is removed for addition to surface sources. The technological uncertainty inherent to such a scheme may cause lawsuits by residents accusing the municipality

of polluting their water supply, as in the case of Tucson (see Ko and Duckstein, 1972).

Rapid infiltration, whereby treated wastewater is allowed to filter through a porous soil for the purpose of recharging underlying aquifers, is still being researched. However, studies indicate (Krivak, 1972) that the limiting factor in this process is the concentration of nitrates in the recharge water, which may be the cause of lawsuits as in the preceding case.

The utilization of spray-disposal and runoff has been the subject of considerable research by the paper and pulp industry, the dairy industry, and the food processing industry in the United States: this is because spray-disposal seems fitted for the treatment of wastewaters containing high concentrations of biodegradable organics.

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NEW WATER LEGISLATION
Drafting for Development, Efficient Allocation and Environmental Protection

by

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1. INTRODUCTION

1.1 The Need for New Laws

In today's rapidly changing world many water lawyers find themselves faced with a task that puts them to a challenging test. Each an expert in the application and administration of an existing system of water law, some are called upon to write new laws that will replace that system while others are asked to transplant their systems to new and unfamiliar ground. Once practitioners of an obscure specialty, water lawyers have been pushed to prominence by an immense surge of interest in their subject. Nations all over the world, in developed and developing stages, in tropical and temperate zones, with arid and humid climates, are re-examining their laws regulating water allocation and use and are calling on local experts and consultants from afar to recommend needed changes.

The overshadowing cause of this interest is, of course, the increase in world population, which everywhere adds to needs for urban supplies, rural domestic use, and food production. A contributing factor is industrial growth, including the processing of minerals, food and textiles for all the world's peoples. With industrialization comes a higher standard of living and a concomitant increase in the per capita consumption of water that compounds the problem. Arid countries seek to make their land more productive or to produce higher valued crops, those subject to rainy and dry seasons to stretch the growing season and add a new annual crop. In humid zones once plentiful water supplies are now subject to local and intermittent shortages, caused not only by increased urban and industrial uses but by new demands for supplemental irrigation to smooth out the vagaries of seasonal rainfall and eliminate losses from periodic droughts. Investors in multimillion dollar enterprises and international agencies underwriting large projects now seek from the law the security once supplied by a seemingly inexhaustible stock of water. Where supplies are scant and almost wholly put to use, pressures of new demands require greater efficiency in use and legal mechanisms to shift water from less productive uses to new and more desirable applications. All these demands on a finite quantity of wa ter are met with a counterpressure that arises from our new-found concern for preservation of environmental and ecological values and that operates to diminish the available supply.

The laws at hand to manage and meet these demands and conserve the supply are in many cases left over from simpler days. Time has overtaken laws which give developers or property owners a free hand, and advances in knowledge and technology have outdated many early types of control. The search for new sources leads to groundwater, to trans-divide importation, to storage and distribution schemes of undreamed size, and existing laws may have no provisions for regulating these sources or enabling such projects.

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To meet these needs new water laws must be drafted. They must be designed not only to facilitate and achieve efficient allocation of resources and environmental protection, but in many cases they must also help to achieve social and national goals. Each law must fit a particular set of physical and climatological conditions and be compatible with local historical and cultural backgrounds. This is a difficult task and a challenging assignment for the draftsmen.

1.2 The Function of a Water Law System

The comprehensive planning, development and management of water resources must rest on a basis of water law doctrine, and that doctrine must be implemented with legal mechanism and procedures that authorize and facilitate these processes. In earlier days a "water law system" referred primarily to rules of law that fixed the relations of one water use vis-a-vis another, such as the riparian doctrine or the law of prior appropriation. Today the interests and objectives of government add a new dimension to the system, and it must as well regulate the relations of the water-user with the state and delineate the powers of the state over private uses of water.

Water law is, of course, a broader concept, one that includes many more topics. This paper is directed only at that part of water law which governs the activities of persons and firms who withdraw and use water for beneficial purposes, in other words, the law of water rights. The subjects of government structure and organization, construction and operation of projects, pollution and quality control, land use and servitudes, flood control and drainage have, of course, a bearing on the allocation and use of water resources, but these matters are here put aside. This paper does not even treat all rights of water users, since it excludes those of the consumer who receives his supply from a government project, irrigation district, municipal water works, public utility or a mutual or communal organization. Such wholesalers of water, even those which are government instrumentalities, will have water rights and will be governed by the water use laws to the extent that those rights and laws delineate their powers over the source and fix their external relations with other water users, but the internal relations between the distributor and the consumer are governed by institutional laws of a quite different nature. This is not to say that the system of water rights is an independent and isolated logic. The other items may be component parts of a comprehensive water code that also includes a chapter on water rights, or each subject may be an independent statute. Each will have a bearing on water rights and the form of water rights will influence and affect all of them. All must be correlated and fitted into the total picture, but initially at least each part must be separately constructed.

A government seeking to regulate water use for development, efficient allocation of resources and environmental protection may have to make a major change in its water law system. Rights and privileges based on riparian rights, "private waters," landowner's rights to groundwater, wild west style prior appropriation -- all rights arising ministerio legis -- must go, or must be subjected to such a heavy overlay of regulatory controls as to become almost unrecognizable. If private water rights are to be fitted into government policies, if development by individuals and corporations is to be compatible with government objectives, proprietors and entrepreneurs cannot act as their own will. Systems based on sporadic grants or concessions from the executive and laws controlling or grant privileges to specific types of water users must be replaced with continuing and unified administrative action.

Systems based on sporadic grants or concessions from the executive and laws controlling or grant privileges to specific types of water users must be replaced with continuing and unified administrative action. The state must superimpose control upon the initiation of uses, the exercise of water rights, the division of water among users, and the reallocation of water rights to new uses as needs change. A modern water law system must not only promote the welfare of water users, it must accomplish the state's social and economic objectives, coordinate private activities with state projects, protect the interests of the public in common uses and environmental values, and integrate the activities of individual and corporate users into comprehensive state plans for water development and management.

2. METHODOLOGY

2.1 Philosophical Approach

The task of writing a law for water allocation and use is subject to some pitfalls that lie in the mind of the person who undertakes that task. His initial bias, his frame of mind as he approaches the assignment, may lead him into fallacies that can hinder the ultimate accomplishments or effectiveness of his law. He may be led into error if those who employ him have a particular attitude toward water law. Even if he has the right approach, he must be prepared to perform a difficult feat if he must persuade others to abandon their bias and accept his views.

A quite common fallacy of this type is that a water law should be focused on the resource, that the object of regulation is the water. But the statute, or its administrator, will not regulate water, develop water resources or provide maximum welfare from water use. The statute will regulate people, people will develop the water and hopefully people will maximize the output from their uses of water. Officials, lawyers, and judges have been known to personify and almost apotheosize water, and in protecting water from what they see as undesirable consequences have done great disservice to people who seek to use the water or to protect environmental values created by man. Artificial standards of "efficient use" and absolute values ascribed to some one use or environmental element can do much harm by preventing the achievement of truly maximum welfare or by requiring departures from optimum allocation. A statute can encourage or deter, require or prohibit, the activities of people, but realistically it must take human nature and economic facts into account or it will inevitably fail.

A second attitude that can so color a water law as to detract from its efficiency is the bureaucratic notion that the statute is primarily for the protection of the government or the public from the illegal or undesirable activities of private or corporate water users. People, including corporate managers, have been known to waste water, to act for personal gain to the detriment of others, to use water in ways thought undesirable by those who represent the state. All this must be controlled or prevented, but this is a secondary concern. The face of the state should not be set against the water user, and private interests should not be regarded as inimical to the public interest. It must be recognized that under a good water law the private water user accomplishes the government's purpose and achieves the government's objectives. The state wishes full and comprehensive development of its water resources in the public interest. To the extent that irrigation and industrial production are a part of that

development, landowners and proprietary firms who profit from water use further the state's ends as well as their own.

2.2 Analyzing the Problem

The person setting out to draft a water law must be steeped in the historical, governmental, legal, physical, climatological, hydrological, economic and social conditions of the country he is to serve. If he is a native all this may already be part of his mental equipment, although he may have some gaps to fill. If he is a consultant called in from afar, all this he must learn, and quickly. A good encyclopedia and a good atlas will be starting places for obtaining a preliminary understanding. In the library he will find books and magazine and journal articles on the country. Detailed information can often be obtained from studies or surveys made by local or international agencies or consultants, from reports on or plans for projects supported by international development and financial agencies and from national and economic development plans.

A reconnaissance of the country, especially one taken in the company of an informed person, can be of enormous help in understanding the physical conditions in which the law is to operate. A tour of existing waterworks, dams, damsites, projects, future project areas, mining districts and cities will enable the draftsman to visualize the consequences of what he is doing. A view from the air may be especially valuable.

The consultant must talk to, and above all listen to, many, many people. They should include ministers and administrators in many posts, water users representing farmers, miners, manufacturers, power plants, cities, sportsmen and conservationists, representatives of international service and development organizations, professional people including engineers, lawyers, scientists, economists, and university professors. Engineers are placed first among the professionals for emphasis, for they will generally be among his best contacts. Most engineers are instinctively good water lawyers. Because they understand what is to be done with water, they understand what the water law must provide.

The purpose of these investigations and interviews will be to discover the problems the draftsman must solve, the constraints he must face, and the policies and the objectives he is to meet. Countries will be at different stages of development. In the writer's experience, the state of Alaska was almost virgin territory, with very little water in use, while in contrast, some Philippine rivers are overappropriated and claimants with conflicting rights scramble for water. In Swaziland low flows can accommodate few more year-round users but many new uses for agriculture and industry are just around the corner, and must be made from high flows or storage. Countries will present different physical problems. Jamaica's groundwater is found primarily in karstified limestone that does not act like most sandstone and alluvial aquifers, and groundwater and streams are much more closely connected than is usual. In the Philippines artesian pressure must be preserved to keep water levels within reasonable reach of pumps. On the other hand, Swaziland has no known aquifers capable of sustaining large irrigation or industrial uses.

Countries will have different social conditions and problems that must concern the water law draftsman. Land reform may accompany water law reform. The subdivision of land may call for a redistribution of water rights appurtenant to that land to insure equality of opportunity among the new owners. Settlement schemes to open up new land to irrigation or to turn nomadic or pastoral people to farming may require special provisions in water laws or special organizations to manage or distribute water. Programs for the betterment of indigenous people may need special provisions to enable them to compete with proposals for industrial development or large commercial irrigation projects. The future holders of water rights may have various degrees of sophistication that require different treatment. Much free choice might be given to landowners and industrialists in a developed country, or to a Filipino rice farmer who can read, write, figure, and drive a hard bargain, who is in short a shrewd small businessman. On the other hand, a more paternalistic system may be required for those whose introduction to what we call civilization is quite recent, whose transition to modern commercial life is incomplete, who may be recent graduates from nomadic or pastoral life or who may have been raised in a tribal or communal system to which some of our notions of law and property are foreign.

Countries will present different legal problems. In some the need is the abolition of riparian rights to unused water and the substitution of state control; in others, the modernization of existing controls. Constitutional questions may attend the termination of private rights and powers or the state takeover of private waters. Governmental structures and existing agencies may need to be altered, and political as well as legal problems can arise where powerful agencies seek to retain their grasp on the reins or where internal struggles for control must be resolved.

2.3 Choosing Solutions

The government may have well defined objectives and clear-cut policies to be followed, or it may merely have problems it does not know how to solve, and it may look to the expert to suggest solutions. In identifying problems, in finding solutions, in selecting mechanisms to reach objectives and implement policies, the water lawyer is put to his mettle. He must use all the skills and techniques of his profession.

Lawyers are used to handling precedents. Knowledge of what has happened elsewhere may enable the expert to see problems in the instant locale, and to foresee problems that have not yet arisen. Knowledge of the water laws of other countries will show him how similar problems have been solved elsewhere. The study of comparative water law has received a big assist from the United Nations and its Food and Agriculture Organization, which have published analyses of a number of water laws written and edited by Caponera,[1] and the useful compilation of Teclaff.[2] There are even "how-to-do-it" books, the Economic Commission for Asia and the Far East has published a set of guidelines for the drafting of water codes,[3] and since in the United States there are, or could be, 50 water law systems, three manuals or models have been written for the drafter of new water laws.[4] Not all the recommendations are the same, and choosing among them,

like choosing among foreign precedents, is excellent exercise for the consultant.

The lawyer is also skilled in getting the facts and applying the law to them. He must test whether a law that has worked well elsewhere will fit the local situation, he must apply the provision under consideration to existing and foreseen problems to see whether the desired outcome will result. Where physical solutions or particular schemes are suggested, the lawyer must provide authority and support to make them possible.

The lawyer is also a negotiator. There may be dominant or competing pressure groups seeking special treatment -- powerful landowners, influential industries, strong environmental groups. Sometimes their positions must be reconciled, sometimes one or another must be overruled. Compromises must often be suggested that will placate such a group without sacrificing major objectives of the legislation.

The consultant will also find himself playing the role of diplomat, salesman and teacher. Persuading a group of landowners, or their representatives on a government body, that abolition of riparian rights to future uses of water is a necessity and that government control of future uses would be of greater benefit to them is not an easy task. Showing those who may administer the law how it works, how its parts fit together, how it will be applied in various cases and how it will be used to solve particular problems may call up every skill of the pedagogue. If his students fail his law may fail.

2.4 Drafting

Laws cannot be imported in a pre-packaged container. The expert may have preconceived notions of the major features of water allocation law and of the best ways to solve general problems of encouraging efficient use, handling shortages, and accommodating progress, but he cannot simply prepare a model water code that will fit every country and can be enacted without change by any country. Even if all of the core ideas of the expert are accepted, they must be applied to the particular facts, the water rights law must be coordinated with other aspects of water law, and particular economic and social conditions or objectives may call for modifications.

At the drafting stage a consultant must have local legal assistance. He may call upon agency attorneys, the attorney general's staff, or local legislative drafting services for information and advice on many collateral matters. He must learn the legislative style. He cannot become an expert in the local legal system and learn all at once the structure of government, the powers and procedures of government agencies, administrative law doctrines, appeal procedures, the form and availability of remedies, traditional criminal sanctions, and the workings of the court system. Local counsel should provide information on the existence and effect of statutes relating to other matters, such as mining laws, irrigation laws and civil codes, and must point out the necessity of amendments and repeals and the existence of constitutional problems.

When the consultant has learned enough so that he feels able to make a start, he must prepare a preliminary draft, at least of a portion of the law, or of salient points with indications of the form of the remainder. These should be widely distributed and checked with practically everybody originally consulted, and a second round of talks and interviews should be held. At this point pride of authorship has no place. The draft should be clearly identified as something to be shot at and criticized, as a request for suggestions and additional information. Many new facts will be forthcoming, not intentionally withheld, but the relevancy of which was not seen until concrete language brought them to mind. At this point explanations can be made, language clarified and compromises reached. A second and perhaps a third draft will follow, with much the same procedures.

The draft, and the final report, should contain much explanatory material. It may consist of a formal exposition des motifs, a simplified summary of the law, a statement of the problems and solutions, a statement of policies and their application or accomplishment, an explanation of operations under the law, an annotation to each section explaining its purpose, effect and force, or any combination of these.

3. MAJOR FEATURES

Despite the emphasis placed on the differences between countries and the need to tailor each law to fit the requirements of each country, some central principles will be found applicable to every water law and some widespread problems will present opportunities for common solutions. Any new water law must define its scope, the waters, the uses and the users it will cover. Every modern water law will require state authorization for most new uses, and must provide some process for registering existing rights and uses and some method of incorporating them into the new system. By postulate the law is needed because the water supply is insufficient for all and must be allocated, reallocated and distributed among the holders of water rights. It is, therefore, possible to indicate preferred principles and solutions that may have application almost anywhere, although specific local problems and conditions may require variations in form, procedures, application and administration.

3.1 Scope

A modern water law should be comprehensive. All water available to man in usable form should be subjected to the same fundamental rules. Water law should be consistent with hydrologic science, and no "private waters" should be placed beyond the law's reach, no artificial classification should require different rules to be applied to the same water as it moves from one phase to another of the hydrologic cycle.

The old concepts of private property in some forms of water once had a rational basis, but their function can be better performed by more flexible controls. If it is desired to permit free use of pluvial water, or to encourage soil conservation measures that retain rainwater in the soil, exemptions can be granted from some of the regulatory features of

a law without surrendering the power to prevent the accumulation of such water and its sale, as has sometimes been attempted. Rural people can be given a free hand to use small springs and rivulets for domestic and stock use without permitting them to disrupt important sources of streams. The widespread notion that the landowner owned the groundwater discovered within his boundaries was originally adopted because ignorance of hydrogeological principles made a rational system of control impossible, and because harm done to neighbors was generally small and rare. The landowner's "property" in groundwater was really a system of anarchy, under which each landowner could seize what he might without regard to his neighbor, who was powerless to protect his property. Science now has supplied the factual lack and technology has so magnified the possibilities of harm that the rule is made intolerable.

Just how these private waters are to be subjected to the law is a matter of technique, and seemingly a matter of semantics and careful choice of words. One method is to declare all water to be the property of the state. It has been said that in civil law countries a change in the code that places unused things in the public domain is permissible, that a civil code does not create intrenched rights beyond the power of the legislature to change.[5] It is also argued that in common law countries this should be avoided, that the theory should be that the law simply regulates property rights for certain public purposes. Be that as it may, a number of American states use the state ownership concept,[6] and the Canadians have never had any trouble with vesting water in the crown, or in the province.[7] But whether the state takes over the property or regulates it, it can reach the same result. In the United States statutes which "regulate" property to the extent of preventing the "owner" from using it have been held not to deprive him of that property without due process of law.[8]

The purpose is not to here settle the matter, but merely to point out the problem. It appears that under neither civil nor common law does the so-called ownership of bits of water in some portion of the hydrological cycle present an insuperable obstacle to a system of state control and regulation of all water, and that the method of accomplishing the desired result is a matter of form. Nevertheless, to the extent that form can influence substance, some care should be taken to use a formula of words which will be locally acceptable and will not unnecessarily raise constitutional questions.

Sometimes it may be tempting to disregard the advice to embrace all water. If the major purpose of the law is to fulfill a pressing need for regulation of streams, while groundwater use poses no presently acute problems, it could seem expedient to follow old patterns and apply the law only to surface water. Yet history has demonstrated that sooner or later groundwater problems will surface and that their arrival may be accelerated by a law that strictly controls streams but leaves landowners a free hand with groundwater. Sooner or later the use of one will disrupt the other. While many, perhaps most, laws are needed because an emergency has arisen and a bad situation needs to be patched up or a stop must be put to undesirable practices and activities, many wise laws are enacted to prevent emergencies from happening and to protect the people from even the beginnings of harm. It would seem desirable in such cases to strike

while the iron is hot and zeal for water law reform is running high, and to establish a rational system from thebeginning. At least the power over groundwater should be established and present users should be required to register and to furnish data on their withdrawals. Rather than setting up an elaborate regulatory system, however, the law might give the administration standby powers to assert control in areas or basins when conflicts arise.

On the other hand, the law need not chase water completely around the hydrologic cycle. Some day atmospheric science may advance to the point where we can license people to milk the clouds and we can apportion rights to vaporous water among users. Until that day comes it is better to emulate our ancestors by keeping our hands off such water and to leave weather modification to other types of regulation.

As for water users, all should be covered and should have the same types of rights. Occasionally it may be argued that the government itself, or an intrenched public agency, should be exempted from the law and should not have to apply to the water administration for rights or be subject to the same restrictions as are private users. Yet a government project needs rights that define its relation to other water users, including other government users, as much for its protection as theirs. A state should not deliberately create the unfortunate situation that has arisen by historical accident in the United States. There the states control the water uses of their citizens, but they cannot control the activities of the federal government. Some withdrawals and uses are therefore made pursuant to state-created water rights, while others are made pursuant to powers of the national government. Unified or coordinated planning and management is subjected to extraordinary difficulties.

3.2 Initiation of Rights

A system of concessions, licenses or permits that allow new uses to be made and new water control structures to be built only with the approval of the state is the sine qua non of state control. Privileges that arise from land ownership and location and self-created rights acquired by appropriation of the public domain can exist only in areas of water plenty and in early stages of development, when any use is seen as a desirable advance, or only for personal or domestic uses that take miniscule quantities. Rights to take water from a source at any time, unlimited rights to share in a common pool resource, become intolerable when water is taken by personal privilege from those who have put it to beneficial use or when so many shares are claimed that all are diminished to unworkable quantities. All such rights are incompatible with the major objectives of a modern water code. Government planning, government choice of and control over uses in the interest of advancing government policies, government restrictions to efficient use, all are impossible.

The procedural details of applying for and granting of authorizations need not concern us, beyond noting that this is the preferable point in time for deciding conflicts, before investments are made and before harm is done. Every attempt should be made to bring up and settle objections at this stage, to give notice to the public and to opposing interests, and to iron out any intragovernmental differences.

A word might be said about preferences. Many water laws list the order in which various uses are to be preferred when competing applications are filed for different uses of the same water. Such laws should be avoided. In the first place, they are seldom effective, since the coincidence of incompatible applications is rare. Secondly, they too often reflect the economic and social thought of the moment of their enactment and are soon outmoded by time and change. Lastly, they prevent the intelligent weighing of alternative and relative values. Almost everyone has the automatic reaction that the domestic needs of urban population should have the first preference. Yet take the case of a groundwater source underlying a potential agricultural area, one that presents the only available source of irrigation of the land and is also one of several possible sources for a nearby city. If municipal use is given a statutory preference and the city and the irrigators file simultaneous applications, the city will get the water. Yet the lost benefits of food production may be far greater than the cost to the city of going to the next cheaper source. The water authority should have power to choose flexibly between the competitors and award the water right so as to accomplish the greatest good.

The permit system is also the primary tool for the protection of the environment from unwanted effects of water withdrawal and use. The sleeping beauty of environmental law has been the power of water officials to deny an application if the proposed use would not be in the public interest. This phrase has been construed to incorporate the concept of economic efficiency, to allow the officials to choose the project that provides the greater net benefits, to deny a permit that would do harm or preclude better uses.[9] The main thrust of the environmental movement has been to change our attitudes and values. Amenities we once threw away because of their abundance are now scarce and there are more people to enjoy them and treasure them. Actions we once took without a thought to consequences now are known to do great harm or to present grave risks. Today an application should be denied to protect the public interest if the private benefits sought would be outweighed by a greater loss of common rights to fishing, desirable wildlife habit, or more sophisticated scenic, recreational and wilderness values. Permits can be denied if the proposed uses would destroy needed minimum flows, or they may be conditioned to require the maintenance of such a flow. Minimum flows and lake levels can be maintained for consideration of public health, recreational uses and preservation of ecological and environmental values, as well as for economic factors such as maintaining property values added by lakes and streams, or protecting uses for domestic and stock water.

Water pollution presents the greatest threat to the environment, of course, and although the mechanics of water quality control are beyond the scope of this paper a word must be said about the interrelationship between water abstraction and the use of water to carry away and treat wastes. At the same time that permission is sought for a withdrawal of water, consideration should be given to the means for disposing of it, to the effect of effluents or saline return flow on the stream and on other uses, present and future, and to the need for disposal, treatment or drainage of the water. Sometimes the water use and water quality laws will be a part of a single package, and both will be the responsibility of the draftsman of the code. The preferable arrangement is to

place both under the control of a single agency. However, often a good pollution control law will exist before a water use code comes into being, and quality regulation may already be firmly in the hands of an existing agency not suited to regulating the quantitative aspects of water. Then, of course, it is the task of the draftsman of the water law to take the other law and the other agency into consideration and adjust his work and product so that all efforts are correlated. Dual permits may work very well, but there may be need for mechanisms for coordination of effort and settlement of differences between agencies.

3.3 Preservation of Existing Uses

All new water laws must have some sort of "savings clause" to confirm existing rights and permit the continuation of current beneficial uses. It is preferable, however, not to save old rights as such. This may carry forward into the new law all the old legal baggage of the former riparian rights, private waters, concessions or whatever, and complicate administration, set the old rights apart from the new, and require the holders of old rights to be treated differently than the holders of new permits. It is preferable to confirm existing uses and to issue to the user permits identical to those issued for new uses. The same standards of beneficial use and efficiency should apply, the same conditions and regulatory controls should be imposed.

Matters of convenience can influence the choice of procedures for issuing confirmatory permits. When most western American states imposed control systems on previously unregulated prior appropriation, they used elaborate court or administrative "adjudications" initiated by officials, in which all water users were notified to file claims and each claim was subject to contest by other water users and by the officials. Simpler procedures are available, such as registration followed by an investigatory rather than an adversary process, although persons wishing to contest the treatment of their own claims or the awards to others should be allowed to do so. Some of the eastern American states with new permit systems have simply required existing users to file for a permit as if they were initiating new uses, but this would not seem to be a desirable practice unless there are very few claimants, since the agency might be faced from the moment of its creation with an almost impossible task.

Fixing the relative rights of existing users requires a knowledge of preexisting law. The basic conditions under which the user has received water in the past should not be materially altered. In the State of Alaska, where administrative controls were superimposed upon an existing system of customary appropriation, the temporal priorities established by the date of beginning each use were confirmed.[10] In Swaziland, where the borrowed South African law had previously dictated riparian sharing, all confirmed rights were expressed as a percentage of river flow subject to a top limit based on the quantity needed to efficiently accomplish the beneficial use.[11] But this ideal cannot always be reached. In Jamaica, water rights stem from a hodgepodge of riparian law, permits issued under several statutes, and statutory authorizations given in special and general acts. Actual shortages have been rare, and since there are no precedents it is impossible to say what rule the courts would apply in

distributing water in case it became so short as to require rationing. In the suggested act for that country, all rights were made equal and officials, in the infrequent case of such a shortage, will distribute the water on the basis of principles of value, national interest, equity and avoidance of hardship.[12] On some streams of the Philippines a combination of appropriations, prescriptive rights, uses of private water and out-of-priority uses of appropriations that far exceed the supply has created other situations that seem almost incapable of being sorted out. The recommendation there[13] was to follow the example of Chile, where a somewhat similar proliferation of rights had led to chaos in some valleys when conflicting demands exceeded supplies. The records were so obscure and disputes so prevalent that a complete new start had to be made. "Areas of rationalization of water use" were declared, in which all rights were extinguished and new concessions were granted on the basis of the physical supply, the existing distribution system and economic and social criteria. In the few cases in which a holder of an extinguished right could prove harm to a prior legal use, he received compensation.[14]

3.4 The Nature of the Water Right

The major objective of any water law must be to achieve, or at least promote, the efficient allocation of water resources. Economic efficiency is the reference: that combination of labor, capital and resources which will produce the greatest net benefits. Social and environmental factors will be worked into the adjustment of costs and benefits, state plans, programs and policies may determine the optima to be sought and state projects and agencies may play a large part in reaching them. Yet it is clear that in most countries a very large contribution toward optimum use of water for irrigation and industry will come from private sources. The water law system must foster and encourage water use and provide a climate conducive to investment in water using enterprises. A person will put his capital and labor into such an enterprise if he has sufficient assurance that he can eventually recoup the cost of wells, pumps, dams, distribution systems and treatment works and his investment in the associated lands, buildings and machinery, and if he has sufficient assurance that he will receive a fair return for a period long enough to make the venture worthwhile. This is the minimum the state must offer, if it is to enlist the efforts of the private sector. The use of water by people and firms can be guided and controlled but it cannot be forced. The state may screen the uses and weed out the undesirable ones in such a way as to insure that state policies and plans are furthered, and it may impose conditions and limits to prevent undesirable practices and side effects, but it must give security to investments and opportunities for profit. With these assurances long-term ventures and stable endeavors will be undertaken. Without them much will be lost, for if risks are great only those requiring little capital and promising quick returns will be taken, and cheap construction and short cuts can be expected.

In a dynamic society efficiency also requires change, if maximum benefits are to be continually obtained. New and better uses will arise that promise more than is being produced by existing, perhaps outmoded, uses. Demands will increase as population and industrialization expand,

and if they cannot be economically satisfied from unused supplies, changes in use must take place. The resulting shifts from present uses to new ones must meet the same test applied to an original use. Each must be another step toward maximization of the benefits from the resource. The economist, using the "Pareto criterion," tells us that a change will reach or approach a new optimum if it will make at least one person better off and if it makes no person worse off. A change that merely shifts wealth from one person to another does not increase economic welfare, and even if a new use will create greater wealth, the criterion requires the gainer to pay the loser. The person who is better off should receive the net gain from the change, not someone else's wealth as well.

The problem for the lawyer, then, is to draft a law, a system of water rights, that will promote this goal of efficiency by providing both security and flexibility of water rights. Some people see these two desiderata as opposites, and it too much of one is given the other is thought to suffer. Yet they can be reconciled, and water rights can be made both secure and flexible.

A prime element of security is the tenure of the right. Some water rights are held "in perpetuity," although in view of the possibilities of loss through forfeiture or expropriation they might better be described as "of indefinite duration." The ideal water right should last as long as it is contemplated that the water use will last. Rights for cities, irrigation and other purposes of a continuing nature should last indefinitely. There is no substantial reason to think that a need will arise in ten or fifty years to take water from the inhabitants of a city and give it over to another use. If irrigation water furnishes a major component of the value of land, the titles to the land and the water should run concurrently. On the other hand, there is little utility in leaving a mining company with a water right after the mine has been exhausted.

Rights that last as long as the enterprise will give security of tenure to the water user, but how are flexibility and change to be accommodated if rights are perpetual or for long terms? As an analogy, consider the laws applied to another valuable resource. That resource is land. The state has exactly the same interests in seeing that the highest and best use of land is made and that those uses can change when needs change. Almost universally rights to land are as secure a form of property as there is, and land titles run forever. Yet land use is flexible, and a shift from a low productive use to a higher productive use is accomplished by the simple process of a sale of the land. A farm on the outskirts of a city may have a higher productive use as an industrial site or as a residential area. In either case the industrialist or the developer can afford to pay the farmer more than the land is worth as a farm, and the one with the best use can afford the most. Both buyer and seller profit. In this respect, water resources are not too different from land resources. This is not to say that full property rights and unrestricted powers of sale are recommended for water rights. Legal mechanisms can be found that will permit economic forces to operate within a framework of government control. The government will generally favor a change in use that moves water to higher productivity. The government may disapprove of a change, however, and should be able to

block a transfer of the water right that would interfere with the rights of third persons, result in a disfavored water use, or harm the public interest. Procedures that permit affected private persons to raise objections and the government to approve or disapprove can take the form of government confirmation of a sale or of cancelling the old right and issuing a new permit for the new use. On the other hand, the government may wish to force transfers that advance the public interest when private action does not produce the desired change. Again consider the case of land. If the government needs the land, it takes it by expropriation or condemnation; if a favored enterprise needs it, the government gives those powers to it. Fair compensation is paid if the total value is taken, and should similarly be paid if the value given by water is taken.

The desirability of this mechanism for change is not seen by all water lawyers. In fact, it seems quite popular nowadays to recommend that water rights should last only for fixed, fairly short periods.[15] The advantage is thought to be the attainment of flexibility, since at the end of the term the state has power to reassign the water to new and better uses. There are disadvantages, however, to such a system, some of which accrue to the state in departures from optimum use, and some of which impose unnecessary harm upon the water user. Most investments take many years to amortize, and the term must be a long one if capital is to be attracted. Repairs and replacements may be foregone by the water user towards the end of a fixed period. Flexibility is surrendered during the life of the right, and if an application for a new use does not coincide with the expiration of an old permit, the new user may have to wait a fairly long time before water becomes available. If to meet this the right is subject to condemnation or expropriation during its life, the usual compensation offered is the unamortized portion of the investment. But the holder of the right will, in many cases, lose an asset more valuable than his sunk costs, that is, the going concern value of his enterprise, the continuing opportunity to make a profit, which is presumably a contribution to the economy.

At this point it may be wise to return to some of our methodological precepts and remember that we are speaking of laws that affect people and that laws should be tested by thinking through their application to practical facts. The theoretical proposition is that water use should be flexible and that water should move from less productive to higher and better uses. The fact is that almost everywhere in the world irrigation of agricultural crops produce less wealth per unit of water than does almost any other use -- hydroelectric power, food processing, raw material processing, mining, manufacturing and domestic and commercial consumption within municipalities. So in practical operation a change to greater beneficial use will mean that water now used by farmers will be shifted to large enterprises or cities. There is nothing bad about this per se; in fact it is almost inevitable. It may need to be controlled. For example, in a country where food production has a high government priority the natural economic production has a high government priority the natural economic processes may have to be interrupted and such changes forbidden. This would force cities and industries to seek higher cost water not presently in use and they might have to construct reservoirs or bring water long distances from places where use

has not yet equalled supply. But if these considerations do not apply and the change is desired, a change made by fiat, without payment or compensation, will impoverish the farmer and unnecessarily enrich the industrialist or city dweller. Inevitably the farmer is poorer than he was before, he can produce less on his dry land. The water he formerly used is now being used by a manufacturing or mining company, for which the water cost would be a small part of total operating costs and could be recouped in the price for the product. If the water has moved to municipal uses, it is now benefiting householders and owners of commercial establishments within the city, and the principle of requiring those who receive the benefits to pay for them can be accomplished by a simple adjustment of water rates. A very small addition to the water bill of everyone in the city would crea e a fund from which the payment could be made.

Legal security given by tenure is only one-half the picture. So far it has been assumed that water was available to fulfill the right. Yet what if there is not enough to satisfy all rights? What physical security does the law provide, what guarantees that the holder of a right will get water? When there is a shortage of water, which water uses get it? These questions go to the heart of the law, indeed, shortages are what the law of water rights is all about. There is little need for water rights if there is plenty of water for all.

The word "shortage" needs to be defined. It is meaningless unless demand is considered as well as supply. On a variable stream there may be an annual shortage if the normal or average low flows cannot support existing uses, although much high water flows to the sea. There may be shortages induced by drought if a usually sufficient supply fails in some years. There may be a shortage although the stream is running full, if the full flow is needed for fisheries, navigation, or environmental concerns. There may be no shortage even though every drop is used if the stream is so controlled that annual and perennial flows are equated by storage and the smoothed-out supply is fully but not overallocated. Such a firm right to a firm supply puts the water user in the best of all worlds.

But, for the most part, the real world is not so ideal. Some aquifers with steady recharge may present an opportunity to limit water rights and match demand to supply, but most streams are subject to very large annual fluctuations and to marked variation in yearly total flows. Some are sufficiently predictable to allow a dependable flow to be determined and split among a fixed group of water users, but this either wastes the excess high water if no rights are given to it or casts most of the burden of shortage on the users of high water.

In all cases, however, the physically available supply limits the water that can be withdrawn and the state, if it is to avoid chaos, must limit the claims to it. Inevitably, this limit will have an element of temporal priority to it. When claims equal supply, no more can be granted. New demands for better uses must then be accommodated by some mechanism for flexibility, as discussed above. Such a limit can be easily fixed if the supply is fixed. When the source fluctuates and sometimes

can fill all needs but sometimes cannot, some method of allocating or distributing the immediately available water must be devised.

There are at least five ways of doing this. One is to enforce strict temporal priority, as exemplified by American prior appropriation. Another is to apply equal sharing enforced by proportionate reduction, as among some riparian irrigators. A third is to follow a statutory list of preferences, giving priority according to a fixed ranking of the values of different uses. A fourth is to distribute the water as determined by administrative discretion based on various economic and social factors. A fifth is to put up the water for sale or auction, as practiced in some Moslem communities.

Since the criterion for the law is efficiency in obtaining maximum net benefits from water use, each of these must be evaluated against that standard before an intelligent choice can be made. Prima facie, each seems to have advantages and disadvantages. Temporal priority gives security, but it may sometimes seem to discriminate rather arbitrarily among people who are essentially similarly situated, and the earliest uses may not be the best ones. Sharing may be equitable among many farmers, but not if some have orchards or vineyards and others grow annual field crops, and a variable supply may be completely unsatisfactory for a factory or a mine. Statutory lists may reflect prevailing notions of relative values, but they may embody obvious diseconomies or prevent the comparison of the relative merits of individual uses. Even if they do prefer the most efficient uses, they operate so that the rich get richer and the poor get poorer. Bidding on the water market would seem to insure that the water goes to those who can produce the most from it, but it can lead to speculation and gouging, and to enrichment of those who hold a monopoly on water rather than those who work with it.

This leaves administrative control, and a number of water lawyers have thought this to be the ideal. Their theory is to place all the water in the hands of a wise administrator, let him put it where it will do the most good, let him prorate, let him reduce the supply or suspend the rights of some so that others may receive the water.[16] I have serious reservations about this. We seldom give to a government official so much power over the lives and livelihoods of people. This procedure may deter investment and development, since entrepreneurs hesitate to engage in enterprises when success or failure depends upon factors beyond their control. A rather ugly thought occurs, that the human factor could be subjected to enormous temptations and tremendous pressures to play political favorites, yield to political coercion, offer and receive bribes and graft. Even the most scrupulously honest administrators have complained of the personal strain such decisions cause, and have disclaimed the wisdom to make them with any assurance. And even if wisdom can be found, it must not only exist in higher echelons where policy is decided, it must be spread through all the regional subordinates and fieldmen who must make the actual on-the-spot decisions in individual cases.

Those who advocate administrative distribution in case of shortage may urge that with this method the public interest, or the environment, can be protected. But it must be remembered that all of this has been taken care of in the initial allocation of rights. To understand the

workings of administrative distribution, it must be very clearly kept in mind that all we are talking about is water already allocated to private use, that the state and its administrators have issued permits for its use, that every use is beneficial, and that all the uses can be made in times of water plenty. It must be remembered that all minimum flow requirements are met, that all other environmental factors are protected, and that the state water plan is observed or even furthered. The public interest stands neutral, and the only question is, which people get to use the water.

If each system has its good and bad features, must we then choose the least of evils? I think not, I think it possible to combine the best features of all of these and to eliminate the bad effects of each.

In my preferred solution, temporal priority is the starting point, but only that. It does give security, it does mean that the state, having granted water to A, will not later grant that same water to B. Temporal priority is not the grant of a special privilege, it is simply a necessary element of the description of the water right that marks its boundaries and distinguishes it from other rights. On a fluctuating source, it is the only way that new rights can be limited to water that is available in nature and is not already committed to existing uses. These virtues can be combined with those of sharing, if that is desirable. This is frequently done all over the world, even in western America, where a project or distribution scheme serves a number of irrigators who have in a sense a share of the distributor's water right. If that right cannot be supplied in full, the consumers take a proportionate reduction. Much the same thing can be done even though no works are needed and it is contemplated that individuals will provide their own means of diversion. If a reasonably dependable supply is available and total withdrawals are held to that limit, all of the permits, although requested at different times, could be given the same priority date or number. The plan would replace the project, the plan would receive the priority. This would avoid overcrowding by too many seeking shares, and would settle the relationships between the irrigators as a group and other irrigators, industrial users and municipalities.

Next is the problem of seeing that the water goes to the best uses. If the more productive and valuable users have junior water rights, economic efficiency can still be served by using the market, under the supervision of the administrator. We have spoken of transfers of water rights, but there is also need for sales of water as a commodity. The State of New Mexico gives a good example of how this can work. A statute permits the "leasing of the use of water" by an appropriator to any other person, with the approval of the state authorities.[17] In a water-short year, growers of beans who anticipate a high price may hold junior water rights that give them no supply, while potato growers who face a glutted market can draw water under their senior rights. The bean growers buy water from the potato farmers. Maximum efficiency is reached, since the high-value crop is produced, and both water users share the profits. An administrator could not do as well. If he were charged with distributing the water on the basis of economic efficiency, he would allocate the water to the bean grower, but that lucky farmer would get all his profit while the unfortunate potato grower would suffer a total loss. If the

administrator attempted to avoid this by a criterion of equity and gave half the water to each, the highest and best would not be served and maximum production would not be reached.

Another example of how temporary transfers of rights or sales of water could be of great utility is that of the city which gambled on a junior water right and is faced with an unusual drought. If farmers hold the priority, I would assume that an administrator would say that the city has the better use and would cut off the farmer's supply. The city would get the water but the farmer would be bankrupted. This is a social cost which must be reckoned, and the best way to account for it is to have the city pay for the farmer's lost crop. A country enacting a new law could improve on the New Mexico system by allowing only owners of permits to make purchases and by limiting quantities to enough to make up the shortage in the permitted supply. This would avoid the use of water by unauthorized persons or in unauthorized quantities. The administrator could also be given the power to force such temporary transfers and empower preferred users who are unable to make private arrangements to take temporary control of water rights at a fair compensation.

Up to now we have been dealing with shortages as if they were inevitable and uncontrollable. Both annual low flows and cyclic drought produce periods of plenty and periods of shortage, but in many areas storage of water can be used to equate the flow, to save high water for use in the low water period. Where storage is physically and economically available, the rule for dividing shortage is in practical fact a rule for determining who pays for the dam and reservoir. If an open-ended system of riparian sharing of a variable stream for irrigation eventually were to lead to too many and too small shares, all holders of rights might band together in some joint or communal organization to raise the dam. I think, however, that the costs of dislocation and the difficulties of organization would be great. If economic productivity is the criterion for determining who gets low flows, the burden of providing storage would be cast on those least able to afford it. But if temporal priority is the rule, the juniors who enter the field after the low water is all spoken for must pay. Is this fair? I think so, for reasons to be developed later. It certainly is desirable from the standpoint of securing the main goal, the efficient use of water. The persons who will get the direct benefit of the storage must consider whether it is worth the price. A large estate, a communal group of farmers, an industry, a city, a government multipurpose agency -- whichever wants the water must calculate whether the benefits it will receive will exceed the costs.

From the standpoint of equity and justice, it should be remembered that development takes place over time. The first users take cheap, easily available, always available water. There is no shortage. When more and more uses are made, shortages are created as demands increase to meet or exceed low flow supply. Additional risks are created and additional costs must be met. It seems not unfair for the government to place those risks and those costs on those who create them.[18]

Justice is difficult to identify. One American writer has said that injustice is easier to spot, that human beings hold in common many

notions of when they are being abused or teeated unfairly.[19] I think one of those notions is that when a person has taken, used, become accustomed to, and made a livelihood from water, it becomes "his water," and that one who takes it from him has "stolen his water." I used to think that prior appropriation was an American invention, but now I am convinced it was simply the verbal identification of a very widespread human trait.

Teclaff, in his survey of 57 countries, tells us that seniority in use is the most common of all bases for distributing water among users.[20] In its most explicit form, prior appropriation exists not only in 19 American states, but also in the four western provinces of Canada, in Taiwan (China), Iran, Rhodesia, Zambia and the Philippines. There are strong elements of it in several South American countries.[21] The 1963 British Water Resources Act creates a "protected right" indistinguishable from an appropriation, though enforced in an unusual roundabout manner.[22]

Protection based on temporal priority is to some degree implicit in many other laws. Before state controls came into being, customary water rights, held from time immemorial or for prescriptive periods, were everywhere protected. When state authority to use water was instituted, the notion that a state should not make successive grants of the same water to different people appeared in most such laws. Permits, licenses or concessions, whatever they may be called, are not to be issued to the detriment of existing uses in most of the Spanish American countries, in several of the eastern United States, in Tanzania, and in Italy. Practically every new water code has given some sort of group preference to uses in existence when the code was adopted.

Some evidence indicates a subliminal recognition of priority even where the law is specifically to the contrary. The natural flow theory of 19th Century English riparianism has been said to have been a protection of mill owners, a law designed to keep the wheels of the Industrial Revolution turning.[23] The reasonable use theory of American riparian law is applied to require several types of adjustments which enable several riparian uses to coexist, but a recent study of the cases shows that when two uses are truly incompatible the American courts almost invariably hold that a new use is unreasonable if it takes the water supply of an existing user.[24] Empirical studies show the existence of a sort of "practical priority" in some American states, where riparians with theoretical rights to share in a stream voluntarily refrain from taking water after their neighbors have first captured the available supply. Even under modern statutes that subject the allocation and distribution of water to administrative discretion, the administrators in Great Britain, Kenya and Mexico have eased their burden by issuing permits that authorize the withdrawal of water only when there is a surplus over the needs of existing users.

4. CONCLUSION

4.1 Examples

Most of the first part of this paper is based on common knowledge, generally accepted legal principles and widely adopted statutory

provisions, or simply states my personal predilections and homespun advice. Little of it is controversial. When I move to my precepts for a desirable form of water rights, however, I take issue with a number of my colleagues. In many personal conversations and exchanges of correspondence we have debated the merits of long term versus short term water rights, voluntary transfers versus governments shifts of water use, priority versus administrative distribution of shortages. I seldom lose these debates, of course, but I seldom seem to win them either. Too often our arguments do not meet head on because my propositions seem hard to state or difficult to understand, and my opponents assume that I advocate some form of Wild West scramble to rip off the public domain or a kind of robber baron speculation in the national patrimony. It is not difficult to show that administrative control offers advantages over such systems. It seems very difficult to explain how a system of controlled rights, secure but flexible, limited to quantities available in the source and not previously committed to other uses, can incorporate each advantage claimed for discretionary administration.

Perhaps the propositions here set forth can be clarified by illustration. Two very new examples may be compared. One represents the ultimate in discretionary control of water use by officials, the other is based on the principles I have recommended.

Last year the President of the Philippines created a new National Water Resources Council and empowered it to issue rules and regulations for the exploitation and optimum utilization of water resources.[25] The superseded Irrigation Law of 1912 was modeled on an early form of American prior appropriation, implemented by a permit system. A number of contributing factors had made administration of the law ineffective, and permit procedures were overwhelmed by a flood of applications resulting from a new government program. The Council quickly adopted interim rules designed to expedite the processing of applications for water rights, and those rules make a fundamental departure from the nature of existing rights. The permits under the rules will not definitely fix the quantity of water allowed, the priority of the right, or the duration of the right. Each will be subject to these conditions:

> The Council may, after due notice and hearing, reduce at any time the quantity of water or adopt a system of apportionment, distribution or rotation thereof when the facts and circumstances in any situation would warrant the same in the interests of legal appropriators.
>
> The Council may, after due notice and hearing, revoke the permit in favor of projects for greater beneficial use or for a multipurpose use.[26]

As explained by the Council's staff, these conditions were written into the permit for five reasons:

(1) Wasteful uses -- some water users are wasteful, some can get along with less water, and as water demand increases and technology progresses,

all water users may be required to initiate more economical methods or facilities.

(2) Reduction of use -- irrigated lands are frequently subjected to changes in land use. If a water right exists to serve an area of land and part of the land is sold for residential use, or if the water is concentrated on one part while another is more or less permanently devoted to a purpose such as storage or a barnyard, the right should be reduced in quantity or terminated in part.

(3) Sharing during drought -- in time of drought, it is inequitable that the entire burden of shortage fall on some farmers, while others, essentially similarly situated, get a full supply. "We wish to abolish priority," was the statement made.

(4) Incorporation into projects -- it is expected that many small irrigated plots will later be served by large multipurpose projects.

(5) Flexibility of use -- to "keep up with progress" under developing conditions and to permit "greater beneficial use," it will be necessary to shift water from one enterprise to new and different ones that will contribute more to the Philippine economy and development, and to permit multipurpose uses of greater public benefit.

Each of these reasons has a sound basis in fact and each problem or need described exists. Each condition described can be corrected and each aim accomplished by administrative action under the terms of the permit. These conditions will protect the paramount interests of the state, preserve every right of the state, and subordinate private uses of water to state control at every stage.

Contrast the new water law recommended for Swaziland. The Swaziland permit is a "protected right," following British terminology, and each permit bears the date on which the application therefor was filed. The law provides:

> Every water right shall be protected from derogation by the exercise of any permit bearing a later date and shall entitle the holder to abstract the whole amount of water specified in the permit before any water is distributed to the holder of a permit bearing a later date.[27]

The permit lasts as long as water is needed:

> Every permit shall state the period of its duration, as determined by the Board in accordance with the following provisions: (a) any permit for [domestic] use, for urban and public water supply, for the irrigation of land and for other purposes of a continuing nature shall be of indefinite duration, and valid until revoked, varied or cancelled in accordance with § 23 [with compensation except in cases of three year nonuse or violation of law]; (b) any permit for industrial purposes shall lapse with

> the termination of the use of the water for such purposes or with the abandonment of the mine, plant or other facility for which it was used.[28]

These provisions give the Swaziland water user the security denied to his Philippine counterpart. Yet every objective of the Philippine government can be accomplished under the Swazi law. In Swaziland as in the Philippines, physical waste can be found. Irrigators use large quantities of water, inefficient means of diversion and wasteful practices. Cheap water is used instead of expensive equipment or labor. But a Swazi permit will be issued subject to:

> Such terms, conditions, restrictions and limitations as [the Board] deems necessary for the protection of others and the public interest including (a) any limitation whereby the quantity of water permitted to be extracted is restricted to that amount which may be beneficially and economically used and efficiently applied.[29]

If future conditions require the state to impose an increase in efficiency, the permit is also subject to:

> Any requirement for the abstraction and use of the quantity allowed by the permit to be made pursuant to the regulations or orders of the Board governing efficient water management.[30]

These same conditions in the permit could be used to take care of the second case that bothers the Philippine Council, in which the amount of irrigated land is decreased and less water is therefore needed. Since the beneficial use is decreased the amount of water needed for the remainder of the land would decrease. Further, the Swazi law states that:

> The Board may cancel or vary any permit if the holder thereof voluntarily fails or neglects, without sufficient cause, to apply all or any part of the water to the use for which the permit was issued for a period of three successive years.[31]

Thus, if the decrease in use were temporary, the decrease in water delivery would be temporary, but if the decrease were permanent, a part of the water right would cease to exist.

In the third situation, the Philippine council reserves the right to apportion and rotate a short supply among irrigators. The practical problem arises from the fact that the government, seeking to improve rice yields by prolonging the growing season with irrigation, has distributed a large number of pumps to individual farmers in order to enable them to use whatever water is available. Each farmer will have to apply for a permit, and it is felt that minor differences in the time of filing should not be the deciding factor in determining who gets the water. In Swaziland as well, projects are being studied that call for irrigation of small plots of new land by the Swazi people. On some of them the water is quite accessible and may be taken by individual works

that may be initiated at different times, on others the government will construct large works and deliver the water to the farmers. In either type of settlement, equality and sharing among the irrigators is thought desirable. The law therefore states:

> If a government irrigation project or scheme or an irrigation project or scheme initiated by an organization or group of water users is to be effectuated by permits issued to individual water users, the government, industry, department or agency, or the organization or group, may apply to the Board for an order setting aside or reserving a specified quantity of water for the irrigation of all irrigable lands to be served by the project or scheme, and the Board may issue such order and thereafter all permits issued for the irrigation of such land shall bear the date of the application for such order.[32]
>
> All permits bearing the same date shall entitle the holders thereof to a prorata share of the source of water insufficient to supply all such rights in full.[33]

The fourth concern of the Philippine Council is that of the small farm which is swallowed up by a large project. It is contemplated that the land will continue to be irrigated, and what is actually involved is the substitution of the project's right for the old individual right. This would be done without compensation. The farmer's facilities would be rendered useless, however, and he would bear a double burden if he must pay for his own works and a full share of project costs as well. Contrast the Swazi solution:

> If as a result of variation or revocation the holder of the varied or revoked permit can be supplied with water by a government or private scheme or project, or a local authority, in favor of which the permit was revoked or varied, damages shall be limited to the unamortized portion of the investment in water works rendered useless or unnecessary.[34]

Lastly, the Philippine permit was made revocable at the will of the Council so that it might keep up with progress and shift water to new enterprises that will contribute more to the country's development, or to government multipurpose projects. Such opportunities for water to move to higher and better uses will occur in Swaziland as well. If a new government scheme is planned, and it is found that an incompatible existing use must be ended or the water must be acquired for the project, then:

> If the [King], a local authority, the Electricity Board, or any ministry, department or agency of the government constructing or operating a government scheme, project or water work, desires to acquire for its purposes any existing water right, servitude or land, it may . . . acquire such water rights, servitude or land, or such portion thereof as may be necessary, by expropriation

> and the Acquisition of Property Act shall . . . apply to such expropriation and the compensation . . . to be paid therefor.[35]

Swaziland has large reserves of coal and is highly mineralized, and if a mining enterprise should in the future need a firm supply of water, it could approach any one of a number of farmers who have high priority water rights, and work out a transfer:

> The Board may authorize the use of all or part of the water to be abstracted pursuant to permit to be changed or transferred to a different use or place of use by the same or another person if a change or transfer is effected by a surrender of the permit and the issuance of a new permit or permits bearing the same date.[36]

> In proceedings for obtaining approval of the Board for any change or transfer, . . . the Board shall approve and allow changes and transfers . . . only if it is satisfied that no injury will occur to the water rights of other persons, that the new use or place of use will be in the public interest and in conformity to or compatible with a water resources plan relating to the source or area, provided, that in appropriate cases the Board may inquire into the adequacy of the consideration paid to the person making the transfer and as to whether permitting the transfer will be to the best interests of such person.[37]

The transaction would be the same as if the mining company needed the farmer's land. Since the company will in fact produce greater wealth than does the farmer, it will be able to afford to buy out the farmer's interest to give him a substitute in money that will replace the foregone income from farming. The state will control the transaction, protect its interest, and must agree that its goals and plans are furthered by the shift. The last proviso illustrates state retention of control over a social factor. If the transferor is a Swazi farmer, the transaction can be scrutinized to see that he was not overreached in the bargaining process, and that he has other opportunities he can grasp and has not merely sold his birthright for a mess of pottage.

To summarize: in both countries, under either form of law, waste can be prevented, forfeiture imposed for nonuse, shortages prorated among similarly situated irrigators, large projects substituted for individual works, and water can move to higher and better uses. Under the interim rules of the Philippines, this is accomplished by telling the water user that the initial quantity of water allotted to him may be reduced at any time for someone else's benefit and, indeed, that his entire water right may be taken from him at any time the government or someone else needs it. This is overkill, more than is necessary for the purpose. Though these same objectives are reached in Swaziland, there the water user, whether African farmer or mining executive, knows he will be allowed the quantity needed for efficient accomplishment of his use. He knows whether or not he must share, and if he must, with how many. He knows that

if he needs a firm supply and the source is variable, he must arrange for storage. He knows that if the government takes back its grant of water it will compensate him for it.

The Philippine Water Council, and its staff, are men of good will, public servants seeking to advance the best interests of the government and to wring the last benefit from water use. But since the intent is to accomplish much of the development of the Philippines through the private sector, by individuals, cooperatives, and businesses engaged in food production and processing, raw material extraction and processing, manufacturing and mining, the question may be asked whether such tenuous rights may not frighten away such water users and actually prove counterproductive in achieving the government's objective. When the present crisis is over the interim regulations are to be replaced with a permanent water code. At that point, the Philippine government might well consider whether its interests may be better served and more benefits may be obtained by giving more assurance to those whose energies must be enlisted in the effort to develop the nation's water resources.

4.2 Applicability

Any claim to universality is subject to challenge. Nevertheless, it is believed that state control over all waters, state authority to control new uses, and state confirmation of beneficial existing uses will be elements of any new water law, and that the reconciliation of stable enterprises with mechanisms for progress is everywhere desirable. If this paper has sounded too much like the talk of an American lawyer, the challenge to one trained in another system is to translate it into his terms. For the general concepts here outlined are not based on any one legal or economic system.

Let us not become confused with formal and semantic differences. The secure and transferable water rights I have described would be called "property" by an American, while a lawyer familiar with a civil code would probably not use that word. The American speaks in a constitutional sense, with reference to the guarantee that, "no person shall be deprived of property without due process of law." His appropriation creates an entitlement that gives him the firm expectation that he can secure water under stated conditions for a stated time, unless he chooses or is forced to accept an equivalent in money. The American's property right may be subject to loss by forfeiture for nonuse, liable to reduction in the interest of efficiency, accountable for taxes and charges, cancellable for certain causes, and he cares not. He thinks of property as a "bundle of sticks," and you may strip away some sticks and still leave the bundle. Although his expectations must be qualified and his actions adjusted accordingly, he can enforce his qualified right against other claimants to the water and the government cannot change the rules of the game, terminate his right on bureaucratic whim, give his right to another, or seize it for itself unless his loss is replaced by compensation. These limited and qualified rights are hig property, what he owns.

On the other hand, a civilian with much the same expectations would not call his water right property. To him ownership or dominium is an absolute, a single staff rather than a bundle of rights. A government lawyer trained in civil law will not understand an American who tells him that water users should be given property rights. He knows that the water is the property of the state, inalienable and imprescriptable. The most he will think the government should give is a concession, hedged with contractual limitations, or better yet a permit giving usufructuary privileges, subject to reduction in the interest of efficiency, subject to termination if not used, liable for taxes and charges, and cancellable for certain causes. Yet these are exactly the same powers, privileges and restrictions created under the common law.

The same problems of terminology may apply to the theme of obtaining flexibility. The common law right to sell real property may be hedged about by zoning restrictions, land use planning requirements and even planning permission by the authorities, but the common law owner will still think of a voluntary transfer of land under these conditions as a sale, and he will call his water right salable although it is subject to similar restrictions. In civil law countries the transaction may be termed a transfer by the authorities at the request of the parties, but the upshot is much the same. Expropriation by favored users declared to be of public utility may be more widespread under civil law than condemnation is in common law countries, and to the extent that the expropriators are those users most likely and best able to seek and pay for water in use by others the practical operation is much the same as if voluntary transfers were allowed. For example, in Peru transfers of water rights are forbidden, but the authority may terminate water rights in order that the resource may serve a favored user such as an industry, on condition that the beneficiary pay fair compensation to the aggrieved user.[38] In practice, this has meant that negotiations take place between old and new users as if a sale were about to take place, then the transaction is consummated by having the authority cancel the old right and issue the new, fixing the proper compensation to the "aggrieved" user as the price he previously agreed to accept.

Nor does a water law system of secure rights depend upon an economic foundation of pure laissez-faire capitalism. It is equally necessary or desirable under various degrees of socialism. Mixed companies depend upon private investors for security as do proprietary firms. Social schemes may be needed to give an unsophisticated rural population with little access to capital an opportunity to participate in irrigation development. If a nearsubsistence level of farm income is expected, security of the water supply from encroachment is especially important. Again, an interesting variation on the themes of security and flexibility is found in the Peruvian Water Law of 1969, a very socialistic regulation keyed to the nation's program of land reform. Planning priorities go to crops of the greatest and most direct benefit to the community, the most efficient irrigation systems and the most suitable land.[39] But if in time of shortage the preference for certain types of agricultural use and specific crops leaves some farmers unable to grow any crops, money is substituted for water and a social compensation scheme will be established in which all users within a given district may participate in order to

insure them an income sufficient for subsistence and to compensate them for costs incurred in preparing their land.[40]

Even in Marxist countries, where all resources and means of production are owned by the state and the economy is run almost entirely by plan, these principles for a water law system can be translated into socialist terms. The USSR provides an example. Until uses grew so large that all could not be accommodated, there was no Soviet system of water law. Plans were made for production of steel, energy and food which, of course, included plans to use water, but no allocation of water as such was assigned to the production enterprise.[41] In 1960 the Council of Ministers issued the first Water Resources Decree, which required planning for "complex use" of water (multiple use by multiple means) and a registration and certification of principal water uses and installations,[42] but not until the 1970 Principles of Water Law did the Soviet Union provide for authorization from state agencies of all special uses of water, those carried out by facilities or technical devices.[43] Under these Principles a grant creates a form of socialist civil property: every water user is obliged to respect the rights granted to other water users,[44] and if loss to a water user is caused by violation of water law the offending water user must compensate the injured user.[45] If loss is caused to enterprises, organizations, institutions and citizens by carrying out water management measures, or by the termination or change of conditions of water use, compensation must be paid.[46] Of course, since all water rights stem from the state property in water[47] the rights of water users may be limited in the interests of this state,[48] which may terminate the grant if the enterprise or organization is liquidated, if the installations are transferred to other water users or if it becomes necessary to end all individual use of a body of water.[49] But if, for instance, the state planning committee were to decide that irrigation on a state farm in the arid regions of the Soviet Union must be discontinued so that the water supply might go to a new steel mill, the Soviet government would not simply abandon the workers on the farm. They might be reassigned to new employment, possibly retrained, but some socialist opportunity for their continued well-being would be found, equivalent to the opportunities that payment or compensation gives in other societies.

I might close with an anecdote. My charge in the assignment to Jamaica was to draft a law which would give aid and encouragement to the developing Jamaican economy, based largely on irrigated sugar cane with a more recent overlay of tourism, mining and manufacturing, and to protect the island's cities and tropical environment. In submitting various drafts I encountered some resistance to American language and quietly shifted from "prior appropriation" to the British "protected right," with which the Jamaicans felt more comfortable. During the process a counter proposal was made from another source for an "administrative system" of permits for the "expected constant yield" and for rationing water in times of shortage on the basis of "the value of the particular uses" and "the national interest." The supposed simplicity of this, compared to my allegedly complicated recommendations, had a certain appeal, but eventually my proposal won out. It has since received cabinet approval although it has not yet been adopted by the Parliament.

During the discussion the Jamaican co-director of the project, probably the future Commissioner for Water Resources, probed into how operations would actually be conducted under it. He was quick to see the type of pressures that could be brought and the difficult decisions that would have to be made in determining the size of the "expected constant yield" and whether one more permit could be squeezed into it. He also saw the ease with which he could issue permits that prohibited interference with previously issued protected rights. And he was enchanted with the notion of handling shortages by priority coupled with temporary transfers of water, as in New Mexico. "I see -- under the other system I might have to choose between shutting down a new hotel or starving some cane farmers. But one or two farmers' quota would supply the same hotel, and under your law I could just notify the hotel manager to start negotiations. Why, I might even act as a broker and help them get together."

I believe that man caught a glimpse of what water law is all about, and grasped the fundamental idea I have advocated. A water law must be designed to promote "comprehensive development" and achieve "efficient use of resources." But why? To increase the nation's welfare. For whom? The people who form that nation. How? By offering them opportunities and incentives to participate in that development and enjoy the fruits of that use. The water laws we draft must give people tools to work with and assurance that if conditions change they will not have worked in vain. So encouraged, farmer and entrepreneur will use the water to the fullest extent when there is enough for both, and when there is not, the water will move to its best use but they still share its fruits.

FOOTNOTES

[1]Groundwater Legislation in Europe (Legislative Series No. 5, 1964); Water Legislation in Asia and the Far East, Parts I and II (Water Resources Series Nos. 31 and 35, 1967); Water Laws in Moslem Countries, Part I (FAO Irrigation and Drainage Paper No. 20, 1973).

[2]Abstraction and Use of Water: A Comparison of Legal Regimes (ST/ECA/154, 1972).

[3]Guidelines for the Drafting of Water Codes (U.N. Water Resources Series No. 43, 1973).

[4]National Conference of Commissioners on Uniform State Laws, Model Water Use Act (1958); Maloney, Ausness and Morris, A Model Water Code (1972); National Water Commission, Water Policies for the Future, pp. 280-298 (1973).

[5]Guidelines, supra n. 3, p. 19.

[6]See Trelease, Government Ownership and Trusteeship of Water, 45 Cal. L. R. 638 (1957).

[7]E.g., Water Resources Act, Rev. Stat. Alberta c. 362, §§ 2(2), 5(1).

[8]Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 291 P.2d 764 (1955); Knight v. Grimes, 80 S.D. 517, 127 N.W.2d 708 (1964).

[9]Young & Norton v. Hinderlider, 15 N.M. 666, 110 P. 1045 (1910); Tanner v. Bacon, 103 Utah 494, 136 P.2d 957 (1943).

[10]Alaska Stat. § 46.15.135.

[11]National Water Resources Order, 1975, King's Order in Council No. of 1975 (Swaziland), § 17(1).

[12]Trelease, A Proposed Water Resources Act for Jamaica (FAO, AGL: SF/JAM 12, 1973) § 17(c).

[13]Trelease, Current Developments in Philippine Water Law -- Suggested Interim Groundwater Regulations (MIA-UNDP/FAP Groundwater Development Project, 1975).

[14]Chile, Agrarian Reform Law, Art. III, Law No. 16, 640 28 July 1967.

[15]See Guidelines, supra n. 3, Maloney, supra n. 4.

[16]Ibid.

[17]N.M. Comp. L. 1953, §§ 75-40-1 to 75-40-7.

[18]Again, local problems may call for variation. In Swaziland, European landowners have prior rights to most low flow water, and future projects for the Swazi people will require storage. Justice in this case was thought to require a water charge on the early users to provide a fund to pay for the dams. See Swazi Order (supra n. 11) at §§ 29, 36.

[19]Cahn, A Sense of Injustice (1949).

[20]Supra n. 2, at p. 81.

[21]Id. at pp. 82, 83.

[22]Water Resources Act, 1963 Stat. Ch. 38, §§ 26(1)(a), 51.

[23]Beuscher, Appropriation Water Law Elements in Riparian Doctrine States, 10 Buffalo L. Rev. 448 (1961).

[24]American Law Institute, Restatement of the Law, Second, Torts, Tentative Draft No. 17, § 850B(h)(i), Reporter's Notes pp. 115-118. (1971).

[25]Presidential Decree No. 424, 28 March 1974.

[26]Philippine National Water Resources Council, Interim Rules Governing Application for Water Permit, 17 December 1974.

[27]National Water Resources Order, supra n. 11, § 25(1)(b).

[28]Ibid., § 20(2).

[29]Ibid., § 20(1)(a).

[30]Ibid., § 20(1)(c).

[31]Ibid., § 23(4).

[32]Ibid., § 24(5).

[33]Ibid., § 25(1)(c).

[34]Ibid., § 23(1).

[35]Ibid., § 22.

[36]Ibid., § 21(4).

[37]Ibid., § 21(5).

[38]General Water Law, No. 17, 752, 24 July 1969, Art. 35.

[39]Ibid., Art. 45.

[40]Ibid., Art. 46.

[41]Kolbasov, Legislation on Water Use in the USSR (1965).

[42]USSR Decrees, 1960, No. 9, Item 67.

[43]10 Dec. 1970, USSR Laws 1970 No. 50, Item 566, Art. 15.

[44]Ibid., Art. 17.

[45]Ibid., Art. 46.

[46]Ibid., Art. 20.

[47]Const. USSR, 5 Dec. 1936, Art. 6.

[48]Supra n. 42, Art. 17.

[49]Ibid., Art. 18.

WATER LAW AND ADMINISTRATION, THE CONTRIBUTION OF THE UNITED NATIONS SYSTEM

INTRODUCTION

The United Nations is making a major contribution to the consolidation of water law and water administration. This action is an important part of the activities the United Nations has undertaken in the broader field of natural resources development.

There is no need to demonstrate the importance of the legal and administrative aspects of a harmonious development and management of water resources. This symposium is an expression of its importance, which will be further reinforced by the International Association for Water Law during its second conference, to be held in Caracas in February 1976; the latter will prepare the legal segment of the United Nations Water Conference (scheduled for 1977 in Mar del Plata). What explains law's importance is the role of law itself. Law is a formal expression of the beliefs and values of a community. Thus law can never transcend the political and economic levels of the community to which it applies, and the measure of its quality is partly a function of its capacity to respond to the social, political and economic trends of its environment. However, law also has its own dynamic which sometimes makes it an inelastic response to the socio-economic conditions of society. Law demands precision and stability, and these qualities may tend to undermine the adaptive capacity which the discipline must possess. Stability can generate facile excesses which lead to sclerosis; law then appears as the main obstacle to the change and innovation necessary for a better-founded management of water resources. The critical importance of water law stems from the fact that law can be a powerful factor for development when it follows or reasonably forecasts the social and economic evolution of a country, as well as the fact that it can also be a powerful barrier to needed change.

Reflecting the law which created them, the administrative agencies responsible for applying legal texts, judicial cases and established customs are a crucial factor in deciding the success of the management of water resources. There are innumerable interactions between law and administration; the qualities of administration benefit law, its defects discredit it. The effectiveness of water law depends on administration and conversely the strength of an administration may depend on water law.

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For instance, regulations to prevent water pollution become meaningless if inertia or weakness renders an administration incapable of enforcing its regulatory measures, similarly water management fails if the law puts the responsibility for this resource in the hands of agencies that are divided, fragmented or competitive.

The necessity for well-developed water administration and law reflects every society's constant concern for the regulation of the abstraction, use and allocation of water. More or less defined, customs have been elaborated (and have been transcribed in legislative texts in the most advanced instances) according to the level of development in each country.

Water management has been transformed recently by three salient factors: a very aggressive approach in the technological orientation toward water; a rise in the standard of living, and thus in water consumption (either directly or by agricultural and industrial products whose production requires large quantities of water) and, to a lesser extent, population growth. These three factors have dramatically multiplied both the qualitative and quantitative problems of water management. Meanwhile water law and administration has often lagged behind, with the result that many countries now face the need for an urgent modernization of their legal and institutional facilities. To achieve this, the co-operation of international bodies is desirable if not indispensable. The United Nations is prepared to offer the necessary support.

The United Nations has long been concerned with the development of water resources. As early as 1949, a scientific conference on the conservation and utilization of resources was organized at Lake Success. The United Nations Secretariat function in this field is entrusted to the Centre for Natural Resources, Energy and Transport. In the various regions, this role is delegated to the Economic Commission for Africa, the Economic Commission for Europe, the Economic Commission for Latin America, the Economic and Social Commission for Asia and the Pacific, and the Economic Commission for Western Asia.

In 1952 the Secretary General was requested by a resolution of the Economic and Social Council to "assume responsibility for the promotion and co-ordination of international activities concerning water resources development" (2 June 1952, ECOSOC (XIV) 417). In defining the tasks of the water resources centre, the United Nations' Economic and Social Council decided in 1964 to pay special attention to legislative and administrative problems related to the development of water resources in developing countries.

I. The Contribution of the United Nations in Water Law and Administration

The United Nations' contribution in water law and administration is effectual through various modalities, is provided by various members of the United Nations family and is addressed to a variety of agencies: regional, national and local.

A. Relevant Agencies and Procedure

1. Donor and Recipient Agencies

In the United Nations family, several organizations are responsible for water administration and law. The water resources branch of the Centre for Natural Resources, Energy and Transport of the United Nations Secretariat is of course concerned with these questions because it has the function of providing assistance in multi-disciplinary questions of the whole range of water management. The legislation branch of FAO has a section for water law. Other specialized agencies, such as the World Health Organization, are also active in this domain.

The contribution is always directed to Governments but it involves a variety of bodies. These bodies may be central or local Governments, including executive and advisory bodies; they may be public or semi-public or autonomous agencies (such as the Centro de Economía, Legislación y Administración del Agua in Argentina).

2. Procedure

The procedure that is followed is intended to implement the fundamental principle of adapting the assistance to conditions in the country to which the assistance is directed. For instance, the assistance must be expressly requested by the country involved. Once the project is accepted, the expert sent by the agency providing the assistance must undertake a preliminary mission to draft a state of the act report concerning water law and administration in the country concerned. The recipient country must provide the

main contribution at this survey stage. The survey mission is completed with the selection of a counterpart in the assisted country who will later have the essential task of processing the assistance received. Then the expert must then ensure that he has a good understanding of the situation in this field and propose broad outlines for the proposed reforms. After the counterpart has agreed, the assisting agency drafts a first version of the reforms' proposals and submits them to the counterpart for study. On the latter's request, a joint draft of a water code or of a fundamental act is prepared. This short description of the procedure for carrying out assistance is intended to emphasis the essential interchange of knowledge and of information which is organized between the recipient and assisting agencies; one-way assistance is doomed to failure.

In dealing with administration, the same exchange of knowledge and information is necessary although the procedure may be different; the establishment, reinforcement and development of a central water administration generally requires more experts and a larger counterpart contribution than the drafting of a water code.

B. Methods and means

A United Nations contribution in this field is provided for in the regular programme, but it is mainly effected through projects executed by various organizations in the requesting countries where it is referred to as "assistance". The contribution may be channelled either through meetings which are exclusively or partly devoted to this theme, through official publications, or through operational activities such as the drafting of legislative or regulatory texts for water management and development.

1. Meetings (symposiums, seminars, conferences)

The Water Resources Branch, Centre for Natural Resources, Energy and Transport, United Nations Secretariat, has on many occasions organized or participated in the organization of seminars on water law or administration within the framework of projects financed by UNDP. A recent example was the seminar held in

Mendoza (Argentina) from 7 to 13 July last on "multijurisdictional rivers' administration (federal countries)", is part of the assistance project at the "Centro de Economía, Législación y Administración del Agua". In some cases the seminar is a project in itself, intended to serve as a forum for the training of the participants; a good example is the interregional seminar on the water resources management (New Delhi, 1973). Another is the "interregional seminar on river basin and inter-basin development" to be held in Budapest from 16 to 26 September 1975 which will deal with certain directly relevant legal aspects. Meetings may also be an occasion for experts to explore the subject in depth; the results of these experts' groups later provide a basis for the better orientation of assistance. The Buenos Aires (1970) and Delft (1971) meetings on the politics of water development and administration policies are examples.

The meetings may also be wider in scope and may be organized by non-governmental agencies with which the United Nations offers its co-operation when meetings are directly related to its objectives. One may mention the second Conference of the International Association for Water Law, which will take place in Caracas in February 1976, with United Nations' co-operation. This conference will be a preparatory meeting for the UN Water Conference to be held at Mar del Plata in 1977, whose principal goal is of course to stimulate governmental action in all aspects of water resources development, including the legal and institutional aspects.

2. Publications

The experience of the United Nations is made available world-wide through its publications. In the legal, institutional and national fields, two recent publications of the Water Resources Branch are of major importance: "Abstraction and Use of Water: A Comparison of Legal Regimes", published in 1972, and "National Systems of Water Administration", published at the end of 1974. As early as

1967 ECAFE (now ESCAP) published a work on "Water Legislation in Asia and the Far East" and in 1974 made a major contribution with the publication of "Guidelines for the Drafting of Water Codes".

The Food and Agriculture Organization of the United Nations (FAO) also contributes largely to the dissemination of information in the legal field. The two volumes of "Water Laws in Moslem Countries" are an essential reference text for all students of water law. Over many years FAO has made a substantial contribution to the United Nations effort in the matter of water law, notably through its "Legislative Series" which includes a volume on "Ground-Water Legislation in Europe". Reference should also be made to FAO's important contribution through its semi-annual review "Food and Agriculture Legislation" which deals in part with water legislation. As early as 1956 FAO published a major study on "Las Leyes de Aguas in Sudamerica". The World Health Organization (WHO) published in 1967 an "Aperçu de législation sanitaire comparé "Lutte contre la Pollution de l'Eau".

3. Assistance in the field

Many assistance projects financed by UNDP relate to water law and administration. In Ethiopia, the Water Resources Branch is carrying out an assistance project for the strengthening of the national water commission. The programme of this large-scale project includes the drafting of a water code for the country, the training of the specialists needed for efficient water administration and the organization of a planning service. A somewhat similar project has recently been concluded in Afghanistan and a project of similar scope has been started in the Philippines. Some projects are more oriented toward research and education; this is true of the assistance given to the Centro de Economía, Legislación y Administración del Agua in Mendoza (Argentina). Finally, the Water Resources Branch participates in the drafting or modernization of legislative and customary texts on water, as presently in the cases of Nicaragua, Chile, Bolivia and Swaziland.

The FAO legislation service has also assisted many countries in matters of water law and administration, the most recent projects being in Jamaica, Libya, the Philippines and Indonesia.

C. Characteristics and nature of this contribution

Because the contribution is made by international organizations of the United Nations system, it seeks to be neutral, wide-ranging, advisory and effective. The United Nations contribution is neutral, that is to say that it does not try a priori to impose the legal system of one type of society rather than another. The main principle is to respond to the interests of the country being helped, to provide assistance that is fully adapted to the national conditions and reality of the country concerned. This implies for instance that many legislative models from developed countries involving sophisticated administrative systems and of costly centralization must be substantially amended.

This contribution is directed to all Member States of the United Nations which need and request it. It is limited neither to a particular geographical area, nor to a particular social or political category.

The assistance is advisory, that is to say not executive. As it is addressed to individual countries or groups of countries, it is offered to independent authorities that are free to accept or reject the advice provided by the assisting agency.

Lastly, the contribution seeks to be effective; it seeks to propose solutions that are not only beneficial but also applicable to the country and acceptable in the legal, human and physical environment.

From a functional point of view, the United Nations in the field of water law and administration is a supplier of information, a teacher, a technician, a moderator and a catalyst. The United Nations disseminates legal data, knowledge of new technical, legal and administrative texts, through publications, seminars and information provided by the headquarters of the various organizations. The

transmission of knowledge may be more direct when water law and administration are taught in the field as in the case of the CELA project at Mendoza (Argentina).

The assisting agency functions as a legal technician when it helps in the drafting of a water code, specific laws, decrees or regulations.

Recourse to the United Nations is not always necessary from a technical point of view, but the backing of an international authority may help in the re-organization of water administration by encouraging governmental authorities to entrust a single body with responsibility for water resources development (as in the case of the transfer of authority from a technical department to a national water board). In this sense, the United Nations functions as a moderator. Finally, the United Nations acts as a catalyst and often attracts bilateral assistance from governments. This catalytic role is particularly evident in the case of projects for the development and the administration of international river basins.

II. Principles and implementation

A. Principles

Since the fundamental principle in water law and administration is that recommendations must be adapted to the physical, economic, social and cultural conditions of the country or region concerned, it is difficult, if not impossible, to lay down pre-established criteria that should be met by an ideal form of water law or management. An enumeration of such criteria may nonetheless serve, if used with great caution, as a useful reference to elucidate the questions that may theoretically be raised in every case. It should always be borne in mind that foreign experience does not constitute a rigid model, and that in preparing or improving water law or administration for a particular country, a pragmatic approach must always be adopted, respecting the existing legal framework and the requirements of a pre-established development policy. All that follows should be understood in the light of this important proviso, which will be treated at greater length at the end of this section.

As far as water law is concerned, it is generally preferable to work towards a basic law which gives the government extensive powers to control the resource and its uses. The basic legislative provisions on water should be assembled in a water code or in a broader framework of which they form a section or chapter (natural resources code, environment code...). What is important is that they should be together in a single body of legislation so as to form a convenient, complete and stable reference work for administrators, planners and the public. Only by limiting the basic law to major questions, while leaving the details to regulations, will it be possible to ensure that the law is easy to consult, complete as regards principles, and stable. The inclusion of provisions liable to frequent amendment should be avoided; it is essential to restrict the fundamental law to provisions which confer or define the powers of the administration (the implementation of these powers will be governed by administrative regulations).

The contents of a fundamental water law are clearly not constant; it is impossible to speak of an ideal content. However, in the context of assistance to a country, it may be appropriate at best to consider the desirability of a water code embracing nine basic questions.

The first section, on the "Legal regime of water and water rights", would define the regime of ownership of the resource and the various rights to use water (mode of acquisition, granting of rights, cancellation, order of priorities...). The second section, on institutions, would deal with the creation of bodies at the national and local level, which is an essential element of a fundamental water law. These include not only administrative but also judiciary bodies; some have an executive function, others are merely advisory or deliberative (bodies to act as a framework for public participation). This chapter may also define the role to be expected of public, semi-private and private research, educational and civic institutions. A third section may be devoted to the prevention of the harmful effects of water. At this point one must consider whether to include provisions covering flood control, the prevention of soil erosion and salinization, and the organization of emergency measures in the legislation of the country concerned. A fourth section on uses of water would include provisions on the legal regime and the various modes of the water use. A fifth section deals with the relationship to be established between water management and the human environment (distribution of human settlements, public health) as well as the physical environment (protection of water and other natural resources, protection of the aquatic environment). Section six may be devoted to the control of water demand and supply and to measures to increase the latter and restrict the former. In view of their importance, it may be desirable to devote a section to underground waters. Section eight covers water works and their management, and the final section deals with economic and financial questions.

This last section is far from being the least important. It covers water pricing, as well as all economic incentives (grants, loans) to

finance water policy. It also deals with monetary penalties (fines, payments).

If it is decided that it is appropriate to include these questions in the code of the country concerned, it would then be sensible to consider the following basic principles: the registration of all water uses and their subjection to administrative authorization; the creation of a central administration which may be autonomous or attached to the environmental protection administration, so as to encourage an approach embracing the resource as a whole, and not simply water uses; conferment upon the administration of the necessary powers to carry out an over-all policy with regard to the resource (data collection, planning, research); creation of an emergency programme ready to enter into operation in case of need; recognition of every citizen's right to pure water in sufficient quantity to meet his basic needs; conferment upon the administration of the power to establish the order of priorities, since the fundamental law only established the order of priorities among primary uses; harmonization of the legal texts on water, land and the atmosphere; obligation to carry out a preliminary study of the possible environmental impact of any project to develop the resource; creation of an education and information programme; need for prior consent by the water authorities to any act liable to affect the resource and its uses; establishment of a long-term plan; strict administrative supervision of prospecting for abstraction and use of underground waters; creation of protected areas for scientific research, recreation and renewal of the resource; attribution of a real economic value to all waters; periodic re-appraisal of penalties.

With regard more specifically to administration, the guiding criteria might be: its capacity to manage water resources, striking the best possible balance between economic and ecological needs; its ability to plan the development of the resource and take decisions; its organizational efficiency; and the ease with which it communicates, delegates its powers and conveys its decisions to the organs of public participation, advisory bodies and decentralized administrative bodies to which powers have been delegated.

B. Application and results

1. The role and importance of water·law and administration

In seeking to improve water law and administration, the goal is fully to develop the role of law in this domain. This role is to anticipate and resolve disputes between individuals and disputes between political and administrative bodies. It is also desirable to avoid conflicts between various legal texts concerning water, and to make the law clearer in this field, by ensuring the repeal of texts which are useless, obsolete or inconsistent with new provisions.

The object is also to harmonize water law and the law and administration in other sectors of the country's social and economic life concerned. Finally, the resolution of all these conflicts must be found in a framework of legality that eliminates arbitrariness and uncertainty.

In addition to the basic requirements of certainty and justice, the value of a body of water law depends on the capacity of the system to anticipate and resolve conflicts while protecting water as a resource and adapting itself to the country's political, economic and social priorities and conditions. This may obviously be a source of contradictions. A law may for example be technically sound as far as the resource itself is concerned, but may be incapable of application, and therefore useless, because it does not respond to the country's political concerns. Similarly a law that takes into account a population's unsatisfactory water practices cannot be considered sound. The lawyer must therefore try to achieve a compromise and in some cases go beyond what is immediately feasible. There is no reason why laws should not include provisions that are inapplicable or that are not applied because of the prevailing situation in the country. The inclusion of bold advanced provisions in a law may be useful and desirable, even if the provisions are not applied; once political conditions permit their application, there will be no need to spend time on the long parliamentary process.

2. The application and effects of the principles

The benefits of effective water law and administration are recognized. It should however be stressed that sound water regulations and management may also set an example in other fields. They may provide a model for the satisfactory management of land and air resources or become the embryo of a comprehensive system for the management of the environment and natural resources.

A chain reaction may be set in motion with water law and administration acting as the detonator that leads to a general improvement of the legal system and of the over-all administration of the country as a whole.

Assisting a country to improve its water law and administration is a heavy responsibility.

Determining the limits within which one can seek to improve an existing system poses a serious moral problem. Law and administration must respond to a country's social, economic and political needs. If one accelerates development in this field, there is a serious danger of artificially creating needs that did not previously exist. The improvement of law and administration is not an end in itself. The ideal models of economic feasibility and productivity defined strictly in terms of economic efficiency or purely material data are modified by the inescapable necessity of taking into account more qualitative criteria relating to both the human environment (respect for customs, beliefs and national history) and the physical environment.

As each country is a special case, there are no absolute principles. There are cases in which the establishment of a central water authority would not only be useless but would probably be contra-productive. Some countries have a long tradition of decentralization which would be futile to break. In others, the installation of a central authority would waste trained staff and money, as the funds and personnel required could be used for

other priorities. In some cases it is simply impossible to implement a single policy throughout the country or to apply a water law in all parts of the territory. Water rights cannot readily be defined in the same way for nomads and for farmers, in a single country.

The objective of improving the development of water resources is to increase the well-being of the people concerned. Optimum management is therefore defined by reference to the needs of the people and not to the maximum output that could be obtained from the resource in economic or financial terms. It is worth considering, as a very simple example, a country which has chosen a federal structure because it believes that federation alone can satisfy the desire for autonomy of the inhabitants of its various provinces. In this case, the federal arrangements are, so far as the people are concerned, a pre-requisite of their well-being. There would be no point in proposing unitary and central management of water resources, even if centralization was considered desirable from the point of view of improved management of the resource. In such circumstances, one must devise an administrative structure that provides an acceptable compromise having regard to the political and social choices of the people. Another example is provided by the principle of the multi-purpose use of water. Multi-purpose use is not always desirable and the total benefits of the development of certain waters or rivers may not be automatically increased by multi-purpose use. Multi-purpose use is only appropriate when the uses are complementary or, when they are conflicting, the resulting benefits are greater than those that would accrue from single purpose use. There is no absolute rule that can be applied universally.

Conclusion

The United Nations and the specialized agencies are making a highly important contribution to the improvement of water law and administration. This contribution takes the form of operational activities, such as the drafting of water legislation and regulations, the reinforcement or establishment of centralized or decentralized administration for the development and management of water resources, as well as activities that are not directly operational such as the organization of meetings and application of material on the subject.

workshops

Friday
& Saturday

SHARING WATER ACROSS AN INTERNATIONAL BOUNDARY

by J. W. Clark*

The Upper Rio Grande watershed is one of the oldest inhabited, longest irrigated, and fastest growing sections of the United States. El Paso, Texas, and Las Cruces, New Mexico, in the United States of America, and Juarez, Chihuahua, in the Republic of Mexico represent the population center for the southern portion of this watershed. Because this area is primarily an arid region, the Rio Grande has considerably more influence upon the lives and livelihood for the region's inhabitants than any other element of the physical environment.

History records chronic surface water shortages in this region and controversy over division of the river water between areas of Colorado, New Mexico, Texas, and the Republic of Mexico goes back nearly a hundred years. These controversies have resulted in an international dispute between Mexico and the United States and three separate instances of litigation between Colorado, New Mexico, and Texas. The last instance of litigation is current and has been continued by the U.S. Supreme Court contingent upon compliance by Colorado with terms of the Rio Grande Compact.

The economic futures of the El Paso-Juarez-Las Cruces areas are interrelated and the limiting natural resource is water and it is unreasonable to expect that one state or county will knowingly forego economic growth in order to conserve water except as part of a cooperative regional plan.

The Rio Grande has its headwaters in southcentral Colorado and flows 1900 miles to the Gulf of Mexico (Fig. 1). From Colorado it flows south through the length of New Mexico, and then turns southeast at El Paso, Texas, on its way to the Gulf. The river forms the boundary between the Republic of Mexico and the United States from El Paso to the Gulf.

The river is generally considered to have three regimes as far as water use is considered in the United States: These are the river from its head in Colorado to Fort Quitman, Texas, the Pecos River and the main stem from Fort Quitman to the Gulf. The reach of the river above Fort Quitman is known as the Upper Basin and below Fort Quitman as the Lower Basin.

The Upper Basin drains an area of about 32,000 square miles above Fort Quitman (Fig. 2). Fort Quitman, Texas, is approximately 80 miles downstream from the city of El Paso, Texas. The Upper Basin includes parts of Colorado and New Mexico, and very small parts of Texas and the Republic of Mexico. More than 99 percent of the water comes in about equal amounts from Colorado and New Mexico.

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The Upper Basin comprises three sub-areas designated as the San Luis section in Colorado, the Middle section in New Mexico, and the Elephant Butte section of Southern New Mexico, including extreme West Texas and the adjacent river valley in the Republic of Mexico.

The San Luis Valley is a large north-tending structural depression surrounded on the West, North and East by mountains. It is a high flat mountain valley with an average altitude of about 7,700 feet. The valley is semi-arid, and a successful agricultural economy would not be possible without irrigation. The main crops produced are alfalfa, potatoes, barley, oats, hay, and pasture. Irrigation development began in the San Luis Valley after 1850 and the oldest water right in the valley is dated 1852. Rapid and extensive settlement occurred which utilized waters from the Rio Grande after construction started on the Denver and Rio Grande Railroad through the valley in 1879.

The Middle Rio Grande section is one of the earliest areas in the Western Hemisphere to be occupied by man. Agriculture was first practiced here by the Anasazi Indians who evolved into the people of the Pueblo eras.

It is not known for certain whether or not river irrigation (physical diversion of the river) was part of the cultural development of the Rio Grande Pueblos prior to the arrival of the Spanish. Some students of Southwestern prehistory believe that the use of river irrigation was widespread and flourishing before the entrance of the Spanish - (Dozier, 1970; Eggar, 1950; Wittfogel and Goldfrank, 1943). They base their beliefs primarily on scattered references to irrigation practices in the narratives of some of the early Spanish explorers and in Pueblo mythology. However, other archeologists more familiar with evidence of agricultural practices are not convinced about the extent and use of river irrigation, (Bryan, 1929; Carter, 1945; Stewart, 1940; Woodbury, 1961). There is little evidence concerning the presence of river irrigation systems in the pueblos that were later abandoned (of the 70-80 pueblos in 1540 only 19 remain). It is difficult to determine the age of irrigation works in the existing pueblos because so many changes have been made and because the Rio Grande Pueblos have been reluctant to allow archaeological research in their communities.

Spanish colonization began with the founding of San Gabriel near the present day San Juan Pueblo in 1598. By 1750 it is estimated that about 4,000 colonists had settled in the Middle Rio Grande section. In 1848 the New Mexico territory was taken over by the United States as part of the spoils of the Mexican-American War. The introduction of Anglo settlers was slow until after the Civil War at which time there was a great influx. This coupled with the growing Spanish population placed heavy demands on the water resources of the area.

Irrigation in the Elephant Butte section dates to the establishment of a Spanish Mission in 1659 in what is now downtown Juarez, Mexico. There is no evidence that the Pueblo Indians, or others, utilized the water resources of the Rio Grande for agriculture in this section prior to Spanish colonization.

Spanish supply trains for northern New Mexico traveled from Mexico City and Cuidad Chihuahua to the Rio Bravo (Rio Grande) and crossed at Paso del Norte, the natural pass through the mountains that is now the site of El Paso and Juarez. Colonists and supplies moved steadily north and south through the territory. Communities grew up on both sides of the river in the El Paso area. The area south of the river contained the dwellings and markets of the wealthy Spanish. Americans began arriving in the area in the early 1800s and Franklin, a small trading post was established just north of the river in 1827. El Paso became a major terminal on the Butterfield trail route between Missouri and California. With the discovery of gold in California in 1848, the predominance of travel through the area was shifted from the north-south to east-west. Various Army posts were established in the region before and after the American Civil War to control the Apache Indians. Las Cruces became the county seat of Dona Ana in 1852 and El Paso was officially named in 1858. In 1888, Juarez was named in honor of President Benito Juarez who had defeated the French and had established his capitol in that city.

Irrigation development in the El Paso Valley under the Spanish reached about 40,000 acres (Follett). However, because of lack of proper drainage and other reasons, the area under irrigation in the El Paso Valley had been reduced to a fraction of its ultimate development by the mid-1800s. In 1881, the first Southern Pacific Train arrived in El Paso and other lines arrived shortly thereafter. Work on the railroads and the opening of new markets induced rapid development of irrigated agriculture

During this period a number of private irrigation companies sprang up in the Rincon, Mesilla, and El Paso valleys. These were mostly ditch companies and were generally ill-conceived and crude attempts to direct the flow of the river into a main ditch which would water a few hundred acres. However, one of the largest proposals involved the international sale of stock. The Rio Grande Irrigation and Land Company, Limited, an English Corporation, was formed for the purposes of irrigating, colonizing, and improving the lands in the Rio Grande Valley between Engle, New Mexico, and Fort Quitman, Texas. The forerunner of this company was incorporated in 1893 and received the consent of the Department of the Interior for a reservoir site at the present Elephant Butte Dam for the right-of-way for canals. The prospectus for this company published as part of President McKinley's message to the Senate on the Equitable Distribution of the Waters of the Rio Grande contained the following statements:

"In the Rio Grande Valley the inexhaustible fertility of the soil, the capabilities for irrigating with the fertilizing waters of the Rio Grande - The Nile of America - combined with the exceptionally fine climate- - - - - -.

"The completion of the company's system of canals will bring 230,000 acres of valley land under ditch, and by the construction of the high level canal about 300,000 acres of magnificent mesa (low-lying table lands) can be irrigated.

"The amount of fertile alluvial lands capable of being irrigated by the company's canals, when completed, is only limited by the flow of the Rio Grande, which is one of the largest of the American rivers - - - -.

"Many of the owners of irrigable lands in the valley have already contracted to convey to the vender company one-half of their lands in return for water rights to the other half - - - - - - - - - -.

"Obviously the remaining land owners must, in order to render their properties of value, concede a large portion of their lands for water rights - - - - - - - - - - - - - -."

In the early 1890s, water shortages began to occur in the Mesilla and El Paso Valleys. People across the river from El Paso complained to the Mexican Government about these shortages. The matter was taken up through diplomatic channels and Mexico filed a claim for damages of 35 million dollars against the United States. It was alleged in the claim that these shortages were due to increased diversions from the Rio Grande by Colorado and Northern New Mexico.

As a result of the Mexican claim for damages, the International Boundary Commission was directed to study and make a report of the use of water from the Rio Grande above Fort Quitman. Under appointment from the Commission, W. W. Follett, a civil engineer made a comprehensive investigation.

Follett's summary of findings were as follows:

1. The fact of a decrease in the flow of the river at El Paso exists, as claimed, and dates back to 1888 or 1889. Before those years, the river went dry at intervals of about ten years. Since 1888, it has been dry every year but two.
2. The use of water for irrigation has not materially increased in New Mexico since 1880, and hence is not a cause of this decreased flow.
3. The use of water in the San Luis Valley of Colorado has very largely increased since 1880, and at the present stage of development, it takes from the river, in excess of what was taken in 1880, an amount of water equivalent to a flow of 1,000 second-feet, running for one hundred days; at least this amount is taken, and probably more.
4. It is impossible to state specifically how much water was in the river prior to this increased use of water and since, as the records do not antedate this increased use, and as the flow since records began varies within very wide limit
5. This flow of 1,000 second-feet, if allowed to remain in the river would do much towards preventing a dry river at El Paso.
6. The Mexican and American citizens of the El Paso Valley have suffered in common with their neighbors of the Mesilla Valley and those still further up the river by this Colorado increased use of water. The suffering has been greater in the El Paso Valley than elsewhere.
7. All of the summer flow of the streams in the San Luis Valley, except their floodwaters, are now appropriated, and, therefore,

the use of water therein for direct irrigation is not likely to materially increase in the future.

The Mexican Government vigorously protested the building of a private dam at Engle in favor of an international dam to be built above El Paso in the Mesilla Valley. It is interesting to note that the Secretary of the Interior did not have power to revoke the permit for building the private dam but that the Department of State, with the support of the Secretary of War, intervened on the basis that the Rio Grande was navigable and that to build a dam, it was necessary to obtain the permission of the Secretary of War. There were several private interests involved in support of both the Elephant Butte Dam site and the International Dam site above El Paso due to the possible sale of private land and other advantages. The net result was the authorization for the construction of Elephant Butte Dam in 1905 under the Reclamation Act of 1902.

A treaty between the United States and Mexico was signed in 1906 that provided for the delivery in perpetuity of 60,000 acre-feet of water to Mexico and in turn Mexico relinquished all claims for damages. The Elephant Butte Dam and canal system was completed in 1916.

The International problem was relieved but the distribution of Rio Grande waters between the states of Colorado, New Mexico, and Texas intensified. A Commission was formed composed of a representative from each of the three states and representative of the United States. The first meeting of the Rio Grande Compact Commission was held October 24, 1924 at Colorado Springs, Colorado, with Herbert Hoover, Secretary of Commerce, representing the Federal Government and elected Chairman. In 1929 a temporary compact was agreed upon. A formal compact was finally agreed upon in 1938 where the quantative obligations for Rio Grande flow were set up.

In 1951, Texas instituted legal proceedings against New Mexico in the U.S. Supreme Court and after several years of legal maneuvering, the suit was finally dropped because the United States was not a party to the suit.

During 1966, Texas and New Mexico instituted legal proceedings against Colorado for non-delivery of water. The Supreme Court granted a continuance of this suit subject to subsequent compliance with the terms of the Compact by Colorado. That continuance is still in effect.

I have outlined some of the problems of arriving at an equitable distribution of the surface waters between three states in the United States and between Mexico and the United States for the purpose of giving some degree of magnitude to the more difficult problems of reaching an agreement on the use of shared ground waters and the physical environment. These objectives are set forth in the Water Resources Research Institute Proposal number 008, titled "Rio Grande Regional Environmental Project," John W. Hernandez principal author.

The regional problem is not merely one of drafting an apparently workable management plan; it is the considerably more complex problem of developing the background information and theory on which the plan is to be based. The principal problems are the lack of adequate basic understanding of what should and can be done to protect the quality of the environment

in the region and the lack of appropriate procedures within existing agencies through which a management plan would be put into action. The development of a comprehensive research program is proposed that will provide the basic data and information on which to base a regional environmental management plan that will include appropriate implementation procedures within the existing governmental structure. This plan must be founded on basic research and updated socio-economic theories that include consideration of public rights to environmental quality while enhancing and expediting sound economic development. Only after such studies have been completed can a coordinated management program, to be implemented through existing agencies within their areas of jurisdiction, be designed.

An appropriate research design would include the following elements:

1. an evaluation fo the attitudes, goals, and priorities of the residents of the various geographic, cultural, and economic sectors of the region;
2. an evaluation of the present utilization of the environment and the potential for renewal and enhancement of the regional environmental resources;
3. an evaluation of the complex interrelationships between various elements that constitute the region's environmental resources and the relative effects of various levels and types of growth on these elements;
4. a study of the institutional structure of the region, both intra- and extra-governmental, with respect to the legal status of each of the various parts of the structure, the inter-unit relationships, and the decision-making potential of each;
5. the development and application of new technology, when appropriate, to evaluate, code, store, and synthesize the vast amounts of data available for the region;
6. the development of socio-political and economic resources management models designed to test and evaluate various management alternatives; and
7. the development of a regional environmental management plan and a plan for its implementation.

Due to the interstate and international character of the area, a suitable environmental management system for the region will be difficult to develop and implement, but in this context of mixed interests, conflicts over environmental rights and priorities are bound to arise in the years ahead; consequently, it is in the interest of both nations to support the development of such a plan.

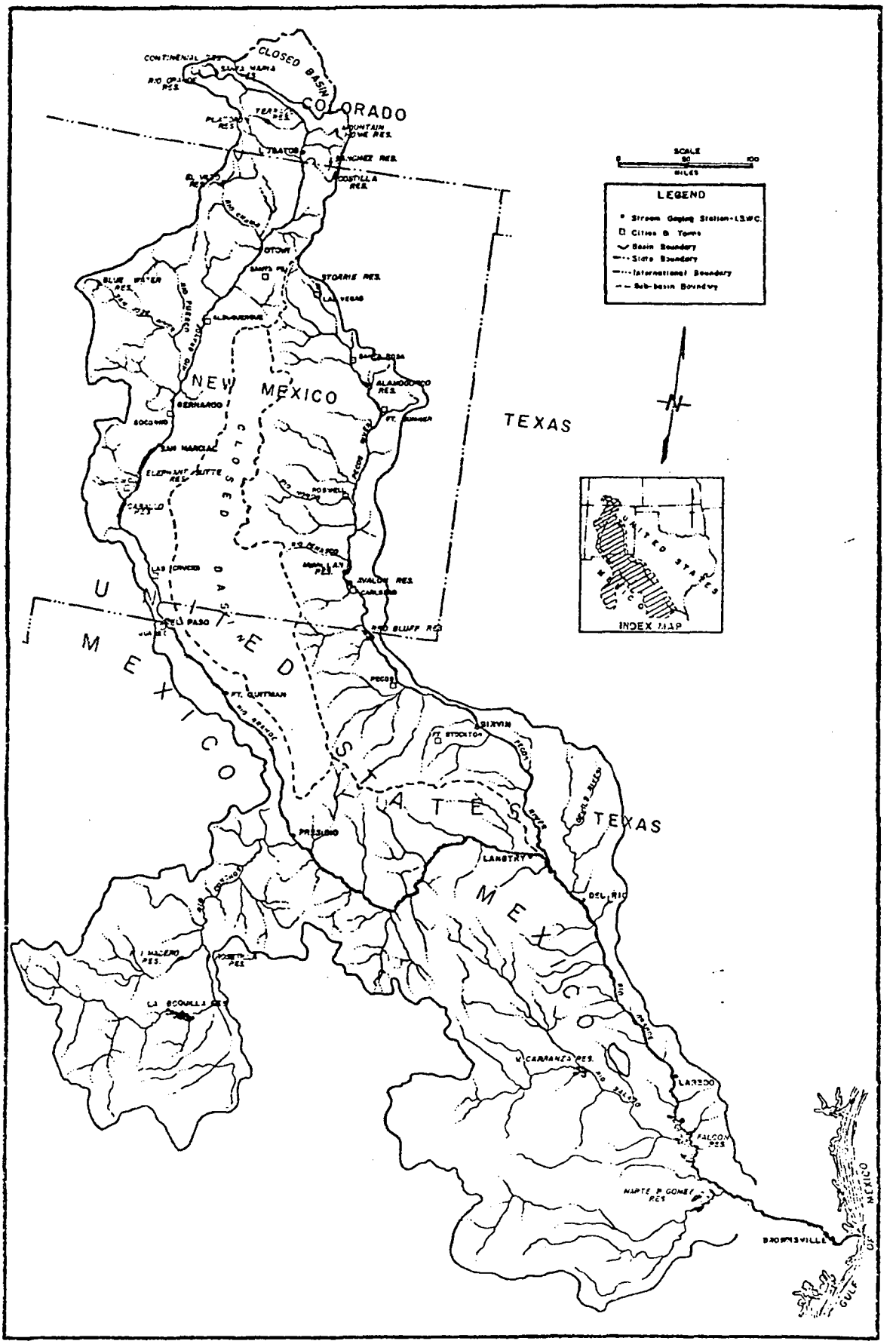

Figure 1. Rio Grande drainage basin.

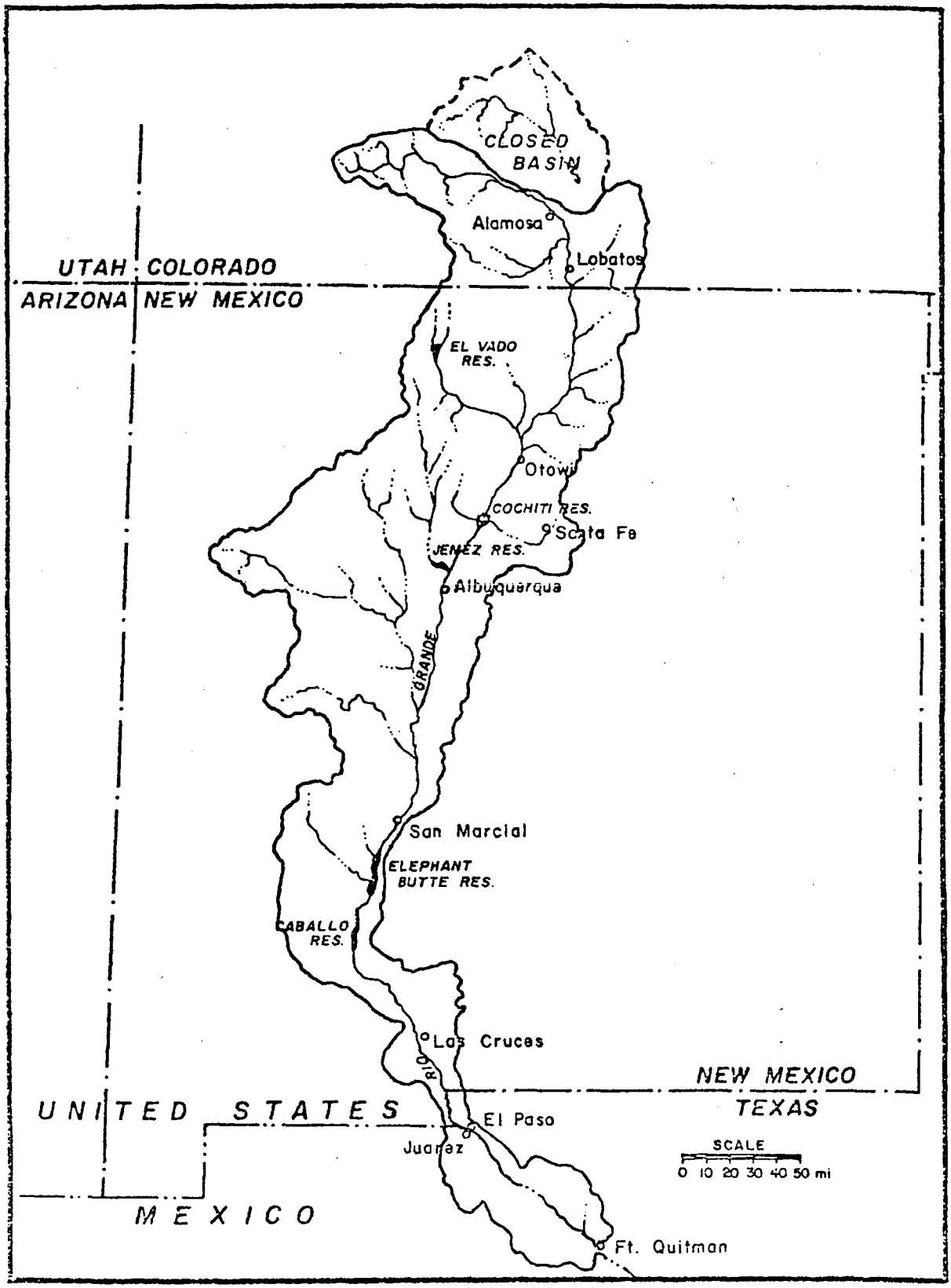

Figure 2. Upper Rio Grande.

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WATER ADMINISTRATION AND MANAGEMENT FOR IRRIGATION SCHEMES

by Juan A. Sagardoy*

1. INTRODUCTION TO THE PROBLEMS OF WATER ADMINISTRATION

In recent years the subject of water administration has awoken great interest among bodies dedicated to the development, management and use of water resources. Perhaps this is only a natural consequence of the world preoccupation for the preservation of the environment, combined with the fact that of all natural resources water is the one most important for man to control. Another possible reason may originate from the recent campaign launched by the "doomsday writers"[1] pointing out the danger of the end of the human race through lack of vital water or food; these campaigns have, at least, had the positive result of arousing public interest in water resources.

In any case, it is a fact that themes related to water administration are the subject of unprecedented interest in national and international circles. Publications, conferences and other related activities multiply. In spite of this, water administration is such a complex subject that solutions of a universal character have not been, and probably never will be, reached. Thus this brief document does not assume to dogmatize on various water administration systems, but attempts to offer a rapid perspective of the general problems, the most common solutions and some observations to keep in mind when creating organizations and institutions for water administration at the national or project level.

To such an end the present document analyses in its first sections water administration at the national level to determine the framework to which management at project level should conform and where major emphasis should be placed.

The complexity of water administration results from the following three fundamental characteristics of the resource: (1) its renewable character but limited availability; (2) its character as a natural resource; and (3) its multiplicity of uses. Each of these characteristics is an area of conflict in water administration which we shall examine briefly in the following three sections.

2. THE RACE FOR WATER

In our day and age there is a certain tendency to present the growth of population, ecology and the use of resources under mythical aspects whose final result is the self-destruction of the human race. Without denying the problems caused by population growth, we believe that this Malthusian vision of the future of mankind is unrealistic. Projections

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based on available facts cannot be extrapolated beyond reasonable time limits because people's attitude to a problem changes considerably as the latter becomes more acute.

Therefore we do not want to fall into the easy temptation of presenting projections of future water demand based upon the present exponential growth of demand, thus offering the picture of humanity succumbing to thirst by the year 2500.

Nevertheless, it is undeniable that every day demographic growth throws greater pressure on water resources and that countries need to review their water policies to permit rational utilization. The days in which water could be used according to the user's whim have passed. On the contrary, the tendency increases day by day to consider it as a common asset which, due to its scarcity and limited renewal capacity, needs a centralized administration permitting adequate planning and distribution to users.

The necessity to augment agricultural production through irrigation has already led some countries to construct formidable engineering works, such as the California Aqueduct (USA), the Tajo-Segura Aqueduct in Spain, the planned interconnection of the river basins of north-east Mexico, the Rajasthan Canal in India, etc. These works impose significant costs upon a country's economy and make adequate and rational utilization absolutely essential.

Growing industrialization requires considerable quantities of water which, in many cases, returns to its source without the possibility of reutilization because of deterioration.

The supplying of cities such as Los Angeles, New York, Liverpool, Manchester, Madrid, etc. requires the transporting of water from considerable distances and frequently occurs in the face of open conflict with other groups of potential users.

This competition for water is and has been the cause of numerous problems which, having developed under the existing socio-economic structures, bring to light the need to revise basic conceptions such as: the validity of the existing legal standards, whether laws should encourage the efficient use of water or by contrast discourage development, whether organizational structures are adequate, the desirability of maintaining old institutions or breaking with old traditions in a drastic manner.

3. ACQUISITION OF THE RIGHT TO USE WATER

3.1 Surface Water

There are three systems for the acquisition of water rights:

(i) riparian;
(ii) prior appropriation;
(iii) administration control.

The concept of riparian rights is born of the idea that surface waters are tied in some way to the land that surrounds them and that the land owners have a right to use the water with or without an administrative authorization. This riparian right is perhaps one of the oldest in existence, and references to it can be found in the ancient laws of the Roman and Arab emprires. Without entering into the precise details of the law, which still prevails in many countries, there is a certain tendency in many of these to abandon this right, corresponding as it does to times when there was not today's pressure on water resources. Furthermore, the concept is only valid in a state of nature where water courses were unaltered; but in our times when enormous volumes of water are carried through canals to zones hundreds of kilometres distant, it is obvious that this doctrine loses validity.

The right of prior appropriation concedes the right of use to the first person who makes a valid appropriation of the water; his right supersedes all previous claims. This right appears for the first time in official form in 1872 in the State of California and was soon extended to seventeen other western states of the United States of America. It is obvious that the establishment of such a right was intended to encourage colonization of the western states and the exploitation of water resources. Examining the actual state of development of these states it is evident that the objective pursued by this water administration policy has been fully realized. Nevertheless, in our times the right created by such administrative measures is an obstacle to the more rational planning of water use.

The right of administrative control originated from the necessity for governments to exercise greater control on the use of water resources; this right is used when the demand for water is greater than its availability. So gradually countries or states in which riparian or prior appropriation rights prevailed have changed to this third system by introducing elements such as the permit, authorization and concession which, while recognizing the right of the use, oblige him to pass an administrative check where the request is confirmed or denied on the basis of certain criteria.

Other countries adopt a more radical course of action and declare water in its entirety as an asset for the use of the country's people and to be exploited and used only by the government in accordance with established criteria; such is the case in the Soviet Union and other centrally planned economies, although this system is also found in countries which have attempted to modernize their water law, for example Israel, Iran and Mexico.

Spanish water laws which had so much influence on the American continent always recognized the fundamentally public character of water; the code of "Las Siete Partidas" of Alfonso X (1256) considered water as res communis, not subject to individual ownership. The water code of Spain in 1866, still in force, and considered one of the best of its time, establishes the public character of water and the necessity of authorization for its use. These same characteristics are met in the majority of Latin American countries, which thus have an appropriate base for a centralized water policy.

3.2 Groundwater

Until the beginning of this century it was believed that groundwater was relatively independent of surface water; hence the general tendency to consider it an integral part of the soil below which it was found. Groundwater was considered by most laws to be an object of private ownership related to that of the land.

The advance of technology has shown that groundwater is closely related to surface and rain water and that it is an integral part of the water cycle. The uncontrolled and excessive exploitation of wells has shown in many cases the necessity for recourse to artificial recharging with surface water to maintain the water level; thus the necessity to undertake the exploitation of groundwater in coordination with that of surface water was made evident. To sum up, the tendency to consider ground and surface water as a unity, susceptible to the same treatment under the same water law, is becoming more widespread. Countries such as Spain, Mexico, South Africa and Australia, which have traditionally recognized groundwater as an object of private appropriation, are modifying or have already modified their water laws so that administrative control over the exploitation and use of groundwater is subject to appropriate authorization.

4. PRIORITIES OF WATER USE

Since water is a resource involved in the majority of human activities, its uses are multiple: agriculture, urban, industry, recreation, fish and fauna, navigation, hydro-electricity, flood control, and other more minor ways. When all these cannot be satisfied, the problem is to decide which should receive priority over the others and which criteria to use to determine such priority.

This problem, today a subject of controversy in almost all countries, is not new; indeed, references to priority in water use are found in ancient Talmudic and Arab law.[2] In general, when a human being must decide between two alternative possibilities, he assigns priority to that from which he hopes to derive the greatest benefits. The decision is made more difficult if those benefits cannot be valued in economic terms and it is necessary to give a value - always subjective - to each one of the alternatives. Unfortunately, this is the case when trying to assign priorities to water use. What is the value of water to the peoples of the Sahel who are at present suffering a period of extreme drought? What is the value of water to a city like New York which depends upon this resource for its growth? What is the value of water to a farmer in an arid zone, where water means production or no production? Or to a farmer in a tropical zone with 2,000 mm of rain per year? Or to a comfortable citizen whose greatest interest is the recreation which water can offer? Each one of these persons or groups if asked would give a very different answer.

There is an important fact to recall when speaking of priorities in water use: the value of the various uses of water is different for each group of individuals and in relation to the circumstances and furthermore is changeable in time with the evolution of society. The

majority of countries are in accordance in assigning the greatest priority of water use to domestic consumption. As far as other uses are concerned, the priorities allotted vary considerably from country to country and among the different states of some countries; this is natural and due to the different values that various social groups put on different uses of water.

In highly developed countries, recreational uses are now receiving a high priority. This is giving rise to a series of new problems related to the evaluation of such uses, because aesthetic appreciation or recreational satisfaction cannot easily be translated into monetary terms. It is important to point out that the priority given to these recreational uses at the present time results from the fact that a certain level of development has been attained. I doubt very much that the average citizen of 100 years ago in the United States, for example, would have preferred a programme for the development of the national parks rather than an irrigation programme, as would very likely occur today.

To sum up, water use priorities must be established to accord with the necessities of the national situation and the level of development reached in each sector.

5. THE ORIENTATION OF WATER ADMINISTRATION AT THE NATIONAL LEVEL

Until recently it was said that the trends or tendencies in water administration were twofold: resources-oriented and uses-oriented. According to the first, water is seen as a unity in its cycle and each use has to be controlled by one organization.[3] In the second, on the other hand, every use is given a priority and an independent organization. A new tendency is now appearing in some highly developed countries: environment-oriented, by which water is seen as one of the basic elements of the environment whose deterioration must be prevented.

The majority of countries, especially developing ones, have employed the uses-oriented system for the development of water resources and we feel that this was correct since of the three systems mentioned it encourages the most rapid development. However, when the resource is scarce, this method presents problems for the coordination and control of the various uses. The most commonly adopted solution to overcome this obstacle is the establishment of an interministerial organization generally called "Water Council" or "Water Committee". Two elements absolutely essential for this body to function well are the availability of reliable information on existing uses and a water master plan upon which to base future decisions.

As already mentioned, water is an absolutely essential resource for some countries (with arid or semi-arid climates) but not so necessary where the ratio of supply and demand is more favorable. It would seem logical that in those countries where water is a basic necessity there should be resource-oriented management, since the control of all water uses by one institution obviously enables more rational planning to take

place. Countries such as Mexico, Israel and Iran quite recently adopted this type of administration. The major criticisms of this system are (a) since water is so important, the body that controls it becomes the most powerful in the country, and (b) there is the obligation to put such disparate uses for water, for example irrigation and fishing, under the same organization. However, this last objection can be solved by putting only the most important and closely related uses under the organization's control; this is the case in Mexico.

A common characteristic of almost all types of existing organization is that their structure is directed towards developing water resources, losing interest in the use made of the resource once it has been handed over to the user. In times such as ours, when development of water resources is more expensive every day and when the use of these resources is often inappropriate, it would be advisable to put greater emphasis on institutions aimed at guaranteeing a better use and control of the resources. An increase in the efficiency of use of the resource could result in greater availability and consequently lower expenditure than the development of new resources would require.

6. GENERAL CONSIDERATIONS FOR THE ESTABLISHMENT OF WATER INSTITUTIONS

The previous sections have briefly summed up the different factors related to the organization of water administration and noted some of the most commonly used solutions. Assuming that no universal solution exists and that each country must seek its own answers in the light of existing circumstances, we shall continue to offer general suggestions for the establishment of such institutions. These suggestions do not of course lead to the defining of a single solution, but can help the planner decide which type of solution would be most suitable.

6.1 Review of the Existing Situation

(a) Existing Institutions: In the field of water management one never has to start from zero. There are always some institutions, often more or less rudimentary or unorganized, which deal with the subject. The modification, abolition, or integration of such bodies to raise the standard is generally one of the most difficult problems facing the planner. This revision should cover aspects such as the effectiveness of carrying out intended functions, the social attitude of the beneficiaries, financing, personnel, etc.

(b) The Legal Standard: Traditional laws are sometimes one of the greatest obstacles to the introduction of desired changes. The abolition of existing rights requires great authority on the part of the government or heavy expenditure in the form of indemnities.

(c) Predominant Areas of Conflict in Current Uses of Water: This information can be very useful in determining the orientation to be given to the future organization.

(d) Social and Political Standards: The introduction of any change always provokes a greater or lesser resistance in the group subject to the change. It is necessary to analyse the position of society towards the changes presented to it.

(e) Geographical Characteristics and the Magnitude of Resources and Their Uses: This can put into perspective information pertinent to the orientation of structures in the future organization in relation to geographical centralization or decentralization.

6.2 Definition of the New Institution

(a) Objectives: Establishing the objectives of the new institution does not generally represent a great problem, since in principle they should be the answer or solution to the problem because of which the new organization is to be established. Before proceeding to the creation of a new organization, it is necessary to analyse thoroughly whether it is possible to attain the same goals through modification of existing institutional mechanisms.

(b) Programs: The definition of the objectives in actual terms of time, money and personnel sets the basis for the programs of the organization. The definition in realistic form of the tasks to be carried out is perhpas one of the bottlenecks of institutional development. There is always a tendency to establish plans too ambitious to justify the importance of the proposed organization; failure to succeed within the planned time only brings discredit upon the new organization.

(c) Necessary Personnel and Equipment: It is difficult to establish staffing standards between tasks to be performed and number of persons required. Nevertheless, despite the errors that this may imply, these standards are the only rational way to estimate personnel requirements. If these standards exist in a country, the available information should be used; if not, examples from foreign experience can be modified conveniently to fit local circumstances.

When considering personnel needs it is very important to take into account the capacity of the country to provide adequate personnel. Overlooking this point is usually one of the most common causes of deficient water administration in developing countries.

(d) Finance: The assurance of an adequate annual budget for the organization's needs is an indispensable requirement for its success and the attainment of its objectives.

(e) Legal Aspects: Only an organization with an adequate legal basis can carry on its functions effectively. Nevertheless, laws are only a means to complement the functions of the organization and unless the government is willing to enforce them they become inoperative.

6.3 The Implementation of Changes

When the chosen institutional structure differs considerably from existing ones, the forms in which changes can be implemented must be considered carefully. The forms are basically:

(a) Radical means: new national laws, decrees, etc.

(b) Gradual change, or transfer of power from old to new institutions.

(c) By-passing obsolete institutions by measures which put problems into the hands of the new institution. One assumes that gradually the new institution will absorb the old.

A water administration organized to take into account the above considerations should have a reasonable likelihood of success, but it does not alter the fact that in organizational matters, the human factor has enormous weight and that success or failure depends largely upon the people who are involved in it and who manage it.

7. THE MANAGEMENT OF IRRIGATION PROJECTS

The proper organization of a body to carry out the various complex functions that integrate agricultural production into irrigation projects is one of the most difficult tasks faced by those responsible for their operation and management. Thus adequate provision for elements what will enter into play at a given moment is an essential requirement for future success.

The importance of this simple fact was not fully understood until recently, when systematic analyses were undertaken upon those projects that failed to attain the planned level of production, or that had to operate for an excessively long time to reach them. In the majority of cases experience has shown that failure was basically due to the lack of organizational support or to grave administrative defects.

The realization of these facts has resulted in the current tendency of international credit institutions and technical assistance organizations to recommend that greater attention be paid to these factors, which are seen as keys for the success of the development of future agricultural systems. It is clearly reflected in the "Guideline for the Preparation of

Feasibility Studies for Irrigation and Drainage Projects," issued by the FAO/IBRD Cooperative Programme, in which organizational and institutional aspects of the project receive unbiased attention. The present document is but a further contribution on these lines.

8. THE ORGANIZATION'S FUNCTIONS

The most complex element of an irrigation project is the irrigation network. However, this element which is absolutely basic to the project's existence is per se incapable of performing any function. Irrigation networks are created to be operated in a manner that will permit the distribution of sufficient quantities of water to satisfy the plants' needs at a given time. Thus, the first and fundamental function of project organization is: the efficient operation of the irrigation network, with all the necessary corollary tasks: preparation of an irrigation schedule, control, personnel, organization, etc.

It is obvious that any element destined to last cannot carry out its functions if the necessary repairs are not made in time. Thus the organization's second important function is the maintenance of structures for which it is responsible.

Efficient water distribution alone is not sufficient to improve the living standards of the farmers. The majority of new users of irrigation systems are neither familiar with irrigation methods nor know how to use water efficiently. New farming and irrigation methods require a practical knowledge that the farmer does not generally possess. The work of irrigation extension and the preparation of the farmer is a basic element in accelerating the establishment and acceptance of irrigation systems.

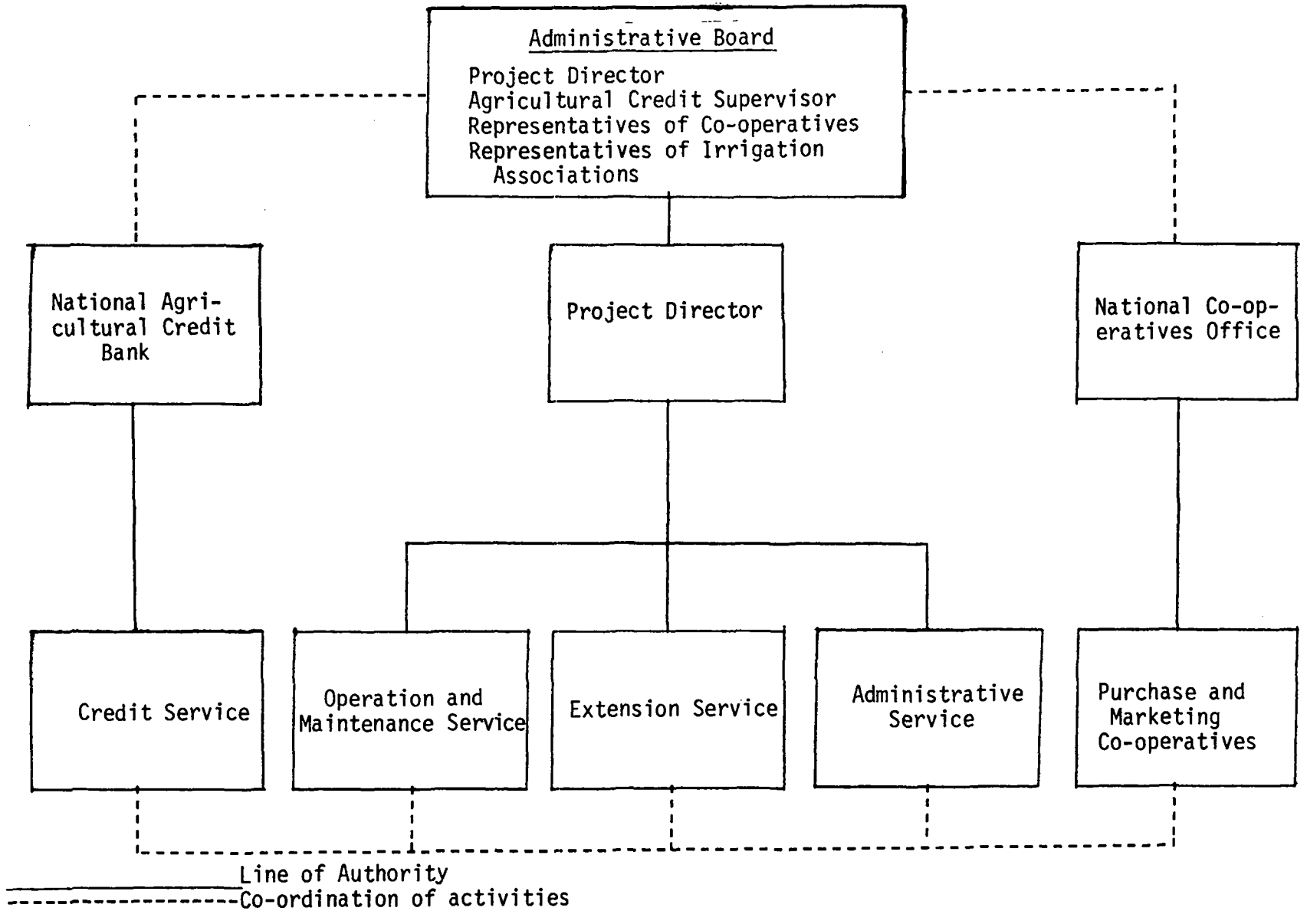
Knowledge itself will not increase agricultural production; it must be accompanied by the means necessary to undertake action at the appropriate time and place, and in the right manner. The regular provision of production inputs is indispensable for reaching planned production levels. The use of suitable inputs, water, and cultivation techniques will no doubt result in increased yields and incomes.

However, this requires considerable running capital which, due to the nature of the agricultural cycle, is spent over the who year but recovered only once after harvest. Few farmers are able to finance their own production without the help of bank loans. Thus, agricultural credit is an essential element in modern farming.

The agricultural cycle is not complete until the produce has been sold. When the market cannot absorb this produce, prices fall sharply. The consequences are demoralizing for those who have expended effort and money to increase production, and remain uncompensated. The efficient commercialization and marketing of agricultural products is thus essential for the economic wellbeing of the farmer.

Finally, the exercise of all these functions requires economic and financial control by the organization in question. An example of an organizational structure covering these functions is given on the following page.

ORGANIZATIONAL STRUCTURE FOR IRRIGATION SCHEMES



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9. THE ORGANIZATION'S STRUCTURE

In all irrigation projects fundamentally there are at least two participants: the government and the farmers. In reality, the participants are many more than these two; the government acts through a certain number of agencies or institutions and the farmers associate in and organize various representative groups. Furthermore, there is always a private sector willing to lend its services for an economic remuneration.

The degree of intervention by these participants determines the types of administration existing in irrigation projects, that is:

- predominant government control: principally colonization and agrarian reform projects:
- predominant farmer control: irrigated districts in the USA, systems managed by irrigation associations in Spain, etc;
- predominant private sector: commercial irrigation in which water is sold or private owners who irrigate with their own resources.

These types of administration seldom exist in a pure form; generally, one of the participants has the overall control but the others participate as well to a greater or lesser extent.

Most countries with a long tradition of irrigation work are very reluctant to change the system traditionally used to manage projects. However, these traditional systems are not always guarantees of good and efficient administration, and indeed are usually encumbered with archaic procedures which do not permit the flexibility required in a modern administration. In this sense developing countries which have recently initiated water development programs are in a favorable position to establish a modern administrative structure.

10. OPERATION OF THE IRRIGATION NETWORK

Once the bases of the organization to administer the irrigation system have been set up, the planner will have to proceed to a detailed description of the activities that will comprise the operational phase of the projcet, describing clearly the procedures, the personnel and the related costs. In this paper we will limit ourselves to a few considerations on activities related to the operation, maintenance and administration of the irrigation network, given that the remaining activities, although very important, are distinct from the management and use of water in the context of the present work.

The organization of water distribution through an irrigation system implies three basic activities:

(i) the scheduling of water distribution to satisfy the requirements of the crops: establishment of shifts, schedules, quantities, etc.;

(ii) the physical operation of the network's structures to distribute the water as planned;

(iii) control (technical and administrative) of water distribution.

10.1 Irrigation Scheduling

This function consists of working out a more or less detailed irrigation program according to the circumstances, which permits satisfaction of the plants' predicted needs as far as the availability of water will allow. This program or schedule of irrigation is one of the most useful instruments available during the operational phase of the system. Its use at the planning level is less important, but is principally justified by the necessity to:

(i) verify the capacity of the network to satisfy projected demand;

(ii) anticipate alternative solutions to problems which could arise, especially during periods of greater demand;

(iii) estimate reasonably the hourly cost of pumping equipment, if used;

(iv) set up the foundations on which future operations will have to be based, thus avoiding future simplifications which, although more simple operations result, do not adequately satisfy each group of soils and crops, thereby notably reducing the efficiency of water use;

(v) establish the limits for recharging groundwater levels when conjunctive use is made of surface and subsurface water.

Irrigation scheduling is closely linked with the technical characteristics of the network. In this connection, we are going to deal with points which are essential in programming the irrigation schedule: the irrigation module, and the duration of the irrigation day.

The irrigation module is the quantity of water than can be employed without difficulty by the user. When farmers lack experience in irrigation, or their plots are small, the module must also be small - 20 or 30 l/s. However, when the cultivators gain experience these modules soon prove to be insufficient or inconvenient. Therefore irrigation systems should, if possible, be designed with a double module, even though during the first years only half will be used. This implies a small increase in the initial investment, but should allow more efficient irrigation in the future.

The length of the irrigation day being 24 hours implies that a considerable number of the users must irrigate at night. This fact is a source of numerous social problems and can result in deficient irrigation at the farm level. As far as possible distribution networks should be supplied with regulation points capable of holding back sufficient water for a night. However, this is generally not feasible in large irrigation schemes.

In this sense the planning of an irrigation schedule provides valuable information on the number of people who will be affected by night irrigation and for how many months. If the number of persons obliged to use this type of irrigation is small, possibly the construction of regulating reservoirs is not economically justified; on the other hand, perhaps the need for them will be clearly shown.

Various methods can be used in setting up an irrigation schedule, depending upon the precision desired. We will not enter into further detail here, since a large bibliography on the topic already exists, and the space and detail required would be outside the scope of the present document.

During the peak irrigation period the distribution systems are generally liable to little flexibility to enable introduction of significant changes in the established rotation. However, outside these periods the availability of water is greater than required implying that one of three choices must be made:

- to maintain the rotation and vary the module;

- to maintain the module and vary the rotation; or,

- to vary both module and rotation.

Of the three alternatives the most recommendable is that of maintaining the module and varying the rotation; in addition to being sensitive from the point of view of distribution, it accustoms the farmer to using a fixed quantity which results in more efficient use.

Irrigation systems that function on demand raise only the problem that in time the irrigation day is considerably reduced because of lack of labor to attend the system. Therefore, the demand is concentrated into fewer hours than planned and a fall in pressure will occur causing deficient irrigation. The problem can be resolved practically at the planning stage using greater freedom coefficients in the design of the network.

10.2 Organization of the Water Distribution

This function consists in organizing a group of persons capable of dealing with the physical operation of the system to distribute water in the quantities and at the times planned.

Two aspects have to be carefully considered here:

(i) the number of persons needed; and,

(ii) their qualifications.

The most reasonable way of estimating these needs is to base them on experience from irrigation system administrations already existing in the country and to extrapolate these results with due caution to the case in

question. An interesting study on determining the coefficients that relate surface area (or the length of the canal) to the number of people necessary for maintenance has been made by Haissman; some of these results connected with the operation of an irrigation network are reproduced in Table 1.

It is important to mention here that the problem of determining the number of people necessary to operate the system and also for the organization of the system in general is primarily one of economic optimum: overestimation of the number would lead to an administration which, although perhaps very competent, would weigh heavily upon the farmers' economy; on the other hand, underestimation of requirements would lead to defective operation.

Another interesting aspect to note is that effective personnel requirements must be met at the right moment. This means that the country must be in a position to provide the qualified personnel at the opportune moment. In this sense human resources do not have the elasticity of other elements that can be bought or imported. Technical engineers from outside the country are rarely available to cover the needs of the operation of irrigation systems.

It is always advisable to distribute operational personnel by hydraulically independent sectors and to give them rapid means of communication and transport.

The costs of operational personnel can be notably reduced by dealing with water in sections rather than by farms or plots (a variable number of plots can make up a section, up to 20 or 30 if they are small); distribution within the section can be carried out by a representative of the irrigators' association of that section.

10.3 The Administrative Control of Water Distribution and Use

The administrative control of water distribution and use provides feedback data for planning operations in future years. Furthermore, this control is indispensable for estimating operational costs. For these purposes the following data must be known:

- total quantities of water delivered (seasonally, monthly, at peak periods, etc.);
- energy or fuel consumed;
- number of hours that equipment functioned;
- number and salaries of people charged with operation;
- areas under different crops.

During the operational phase gathering of these data offers no special problem. Nor does it offer problems at planning level, since these data

Table 1
MANPOWER REQUIREMENTS IN THE OPERATION AND MANAGEMENT OF IRRIGATION SCHEMES*

Agricultural Occupations

Occupation	Qualifications	Activity	Manpower Requirements	Function
Irrigation Eng.	B.Sc. with 15 years profes. experience	Operation of irrigation schemes	1 per 200,000 ha	Director General
Irrigation Eng.	B.Sc. with 10 years profes. experience	"	"	District Chief
Irrigation Eng.	B.Sc. with 5 years profes. experience	"	"	Operations Chief
Irrigation Eng.	B.Sc. with 2 years profes. experience	Operation of main canal	1 per 100 km of main canal	
Irrigation Eng.	"	Operation of irrigation sectors	1 per 20,000 ha	
Irrigation Eng.	B.Sc. without profes. experience	"	1 per 20,000 ha	Assistant Sector Eng.
Agricultural Technician	Agricultural Technical School	Operation of irrigation zones	1 per 10,000 ha	Working in sector of from 2,000 ha to 10,000 ha in 5 years
"	"	Canal Operation	1 per 40 km	
Water Inspector	Agricultural Technician with 1 year experience	Operation of irrigation zones	1 per 10,000 ha	
"	"	Operation of canals	1 per 40 km	

* These standards have been taken from reference I. Haissman (1971). The choice was made to cover the particular aspects of this paper.

must be more or less defined when that stage has been reached. Although the gathering of data is no problem, adequate provision should be made in the administrative unit to take care of keeping these records in a readily available manner.

11. MAINTENANCE OF THE IRRIGATION NETWORK

The maintenance of the irrigation and drainage systems is intended to ensure a state of conservation to allow efficient functioning for as long as necessary. Personnel and equipment needs for these operations vary enormously with the technical characteristics of the project and above all the state of completion in which the project is to be handed over to the users. Some projects are handed over to the farmers without having been completely finished or, more precisely, without taking the water to the farmer's plot; the costs involved in this completion of works should never be considered as maintenance operations and, moreover, should not be charged to the farmer as such but eventually should be part of the repayment made by the farmer to the government.

Another aspect involved essentially with maintenance expenses is the quality of work executed. In general there is an inverse relation between investment costs and maintenance expenses.

When planning the maintenance of irrigation works some general considerations should be kept in mind:

(i) The maintenance of specialized equipment: pumps compressors, electric motors, should be dealt with by specialized personnel; it is thus advisable to sub-contract with specialized firms.

(ii) Well built distribution networks need little maintenance during the first years; when this is the case, provision for necessary personnel and equipment can be held to a minimum in the early stages.

(iii) Good maintenance is in general expensive but cheap in the long term. This programmed maintenance or periodical revision is highly desirable, especially for machinery.

(iv) In the majority of irrigation systems there is a winter pause during which agricultural activity is very low; major repairs can then be carried out at relatively low cost owing to the great availability of labor.

(v) Machinery used for maintenance is not generally in full use throughout the year and thus tends to last much longer than machinery in normal use.

(vi) In humid tropical and even in arid zones the control of grass and weed growth in irrigation and drainage canals can represent more than $20/ha; utilization of certain herbicides can reduce this figure to $4-5/ha.

(vii) Maintenance personnel must have the necessary means and equipment to act rapidly in cases of emergency, mainly ruptures of pipes or canals during irrigation.

12. THE COST AND THE PRICE OF WATER

Before entering into the distinction between the two concepts it is worth noting that to speak of the price of water is a dialectical error, although universally accepted. In reality, one does not pay for water, which is an asset common to humanity, but for the services and/or investment necessary to bring it to the consumer.

Keeping the above in mind, the cost of water is nothing but the sum the consumer must pay for each unit transported in terms of the redemption of the investment plus the variable costs of personnel, fuel, etc. necessary for this transport. Throughout the world experience has shown that agriculture is generally not in a position to pay for the cost of water. Thus the majority of countries subsidize this cost to a greater or lesser extent. The part that the farmer actually pays is the price of water.

The calculation of the cost of water in accordance with traditional economic theory offers no special difficulty and has an extensive bibliography. However, we are referring more particularly to the most frequent methods of actually pricing water.

There are three basic types of charges:

(i) Fixed charges: Water is sold at a fixed price paid once a year. The price is usually fixed by hectare of land irrigated independent of the number of cubic metres consumed. In some cases a total fixed volume of water is paid for.

(ii) Charges for different agricultural uses: A variable quantity per hectare is paid depending on the type of cultivation. This is not a usual practice; it is generally applied in zones were rice (which requires up to three times more water than other crops) is grown with other crops.

(iii) Charges for cubic metres of water delivered: This is perhaps the most desirable method, but has the drawback of requiring heavy expenditure on flow meters, or a large number of operational personnel, both of which ad greatly to the operational expenditure. This last method can exist in different forms:

  (a) Binomial charges: A fixed quantity per annum is paid whether or not water is consumed, plus a variable quantity proportional to the number of cubic metres consumed. The fixed part is used to cover the initial investment and the other charge to cover the variable expenses of operation, maintenance and administration.

(b) Charges decreasing or increasing with deliveries: To encourage the cultivator to purchase water decreased charges are often applied for large quantities.

(c) Fixed charge: A fixed price per cubic metre is applied.

The most commonly used method is without doubt the abovementioned payment for water by hectare. Obviously this method has the great drawback of offering no incentive to the farmer to make better use of the water, but it does have the advantage of administrative simplicity. However, rational use of water will only be adopted if the farmer realizes the monetary value each unit represents. Therefore, it is likely that in the future the tendency will be more and more to charge for water by units consumed.

13. BASIC ELEMENTS FOR THE SUCCESS OF USERS' ORGANIZATIONS

The suggestions listed here are simple general administrative norms applicable to many other branches of this science; this is unfortunately all too often forgotten.

(i) The organization of the system should be as simple as possible. It is the farmer who must understand the structure and functioning and who must work in accordance with the procedure and method established thereby.

(ii) The scope of the organization must be limited to the functions that it can carry out at a given time, expending into other functions only when the first have been completely dealt with. There is always the danger that the planner may try to establish as complete an organization as possible; but by limiting its scope at the beginning, the opportunities of establishing a firmly based organization increase considerably.

(iii) The institutions existing in the country connected with the project's activity must be used by or integrated with the project organization as far as possible. This avoids the duplication of effort and allows advantage to be taken of past experience.

(iv) The authority and responsibility of the organization must reside to a large extent with the beneficiaries of the project. Project organization must not be paternalistic and should as far as possible be led by the farmers for the farmers' benefit.

(v) The government must maintain a certain control and supervision over the project. In most cases the government has provided considerable sums for the construction of the works; also, the farmers use a natural resource - water - considered in the majority of countries to be the property of the nation. So it is only logical that the government holds the right to control the use of an asset entrusted to the community.

(vi) The organization of the project should not depend upon administrative and political boundaries. An irrigation project can cover several provinces or separately administered areas; the necessary coordination should be established with them, but they should not be directly involved in project administration.

(vii) Only an organization that is well founded on adequate regulations which clearly define the responsibilities, obligations and duties of the participants in the irrigation system can work in the most effective manner. The following topics at least should be adequately covered by these regulations:

I. Organization

1. Description of the organization. Objectives.
2. Attributions and functions of each unit.
3. Attributions and responsibility of the users.
4. Promotion program and personnel training.
5. Economic and social factors.
6. Security measures for the equipment and personnel.

II. Operation

1. Operational personnel. Functions.
2. Description of technique. Operation of canals.
3. Obligations and responsibilities of the operational services.
4. Use and metering of water.
5. Communications, requests for irrigation, the type of records, etc.

III. Maintenance

1. Maintenance personnel and equipment. Description. Functions.
2. Maintenance techniques.
3. Periodical checks.
4. Personnel and responsibilities.

There are good examples of these rules which can serve as a basis for the preparation of similar documents; those prepared by the SRH (Secretaria de Recursos Hidraulicos - Technical Manual No. 24) and that currently under preparation by the ASCE (American Society of Civil Engineers) are particularly complete.

(viii) The project director must, in addition to his technical or administrative qualities, be a leader. His capacity to influence the users' decisions is an essential element for the smooth running of the organization.

(ix) A good system of administrative and technical records is the basis for the decisions that the project administration must take at every stage.

FOOTNOTES

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3. The term "organization" is used here generically and should not be interpreted as a unified body whose units are linked by a clear chain of command. On the contrary, the term is used in the sense of social organization where the different units or bodies act under mutual influence toward common aims.

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EVOLUTION AND OBJECTIVES OF RIVER BASIN COMMISSIONS IN THE UNITED STATES

by Walter Kiechel, Jr.*

Introduction

I had the privilege of representing the United States Department of Justice at the First International Conference on Water Law sponsored by the International Association for Water law at Mendoza, Argentina in 1968. On that occasion, I presented a paper entitled "Legal Problems of Regional Water Resources Administration in the Federal System." In my introduction to that paper I noted the wide differences among federal systems with regard to the respective legal and constitutional authority of water resources exercised by the national government and the state or provincial governments. I described the federal system in the United States where the federal government has certain constitutional powers which have permitted an increasing exercise of federal authority over water resources of the nation. I addressed myself particularly to the legal institutions available to the federal government in the United States by which this increased federal authority could be constructively exercised and directed toward the optimum utilization of the nation's water resources.

In specifying the new government institutions with respect to national water resources development, in the United States I pointed to river basin commissions. At the time of the Mendoza Conference in 1968, the River Basin Commissions were of very recent origin, they being authorized for organization by the Water Resources Planning Act of 1965. In the three years preceding the Mendoza Conference four such commissions had been organized. One of these was the Great Lakes Basin Commission. I had been appointed the Commissioner from the Department of Justice on the Great Lakes Basin Commission when it was organized in 1967. I thus have had the opportunity to participate in the workings of that Commission as a Commissioner from its organization until the present. Accordingly, I feel I have the credentials to bring to you now a progress report and indeed an evaluation of the accomplishments of the Great Lakes Basin Commission. And in this way I can analyze the future role of river basin commissions in the United States.

I would say by way of further introduction of this subject, that there are now six basin commissions: three of the original four are still in existence--the Great Lakes Basin Commission to which I have referred; the Pacific Northwest River Basins Commission and the New England River Basins Commission. In addition there have been organized the Missouri River Basin Commission, the Ohio River Basin Commission, and the Upper Mississippi River Basin Commission. A large area of the United States is thus presently included within the jurisdiction of the total commissions organized and presently functioning.

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I. Evolution of the River Basin Commission

The Water Resources Planning Act was enacted by Congress on July 22, 1965, in response to a generally felt need in the United States for an improvement of planning in development of water resources. The Policy of that Act was declared in these terms:

> Sec. 2. In order to meet the rapidly expanding demands for water throughout the Nation, it is hereby declared to be the policy of the Congress to encourage the conservation development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal Government, States, localities and private enterprise with the cooperation of all affected Federal agencies, States, local governments, individuals, corporations, business enterprises, and others concerned.

The Act has three major parts: Title I establishing the Water Resources Council which is the interagency body at the Washington level composed of the federal departments and agencies which have a role in water resources planning and programs; Title II authorizing the creation of the River Basin Commissions; and Title III providing for financial assistance to the states for comprehensive planning grant authorizations. Title II is, in my judgment, the key part of the endeavor to improve water resources development in the United States. The approach in this endeavor was to interface federal and state activities and authority with respect to water resources. The Act provided that the membership of the Commission would be as follows: a chairman appointed by the President, one member from each federal department or agency determined by the President to have a substantial interest in the work to be undertaken by the Commission; one member from each State which lies wholly or partially within the area, river basin or group of river basins for which the Commission is established; one member from any interstate agency already in existence; and when deemed appropriate by the President, one member from the United States section of any international commission whose jurisdiction extends to the waters of the area for which the water basin commission was established. So the river basin commission brings together representatives of the States, the federal agencies, and interstate agencies, all presided over by a Chairman appointed by the President.

An innovative approach in federalism was reflected in the statutory provisions with respect to the creation of river basin commissions. These provisions were reflective of the criticism in recent decades in the United States that agencies and activities were set up at the federal level without adequate consultation at the state and local level. The Act puts creation of river basin commissions at the initiative of the state governments. The President is authorized to establish a river basin commission upon request by the Water Resources Council or by a State and concurred in by not less than one-half of the States within the river basin. In the absence of such formal concurrences from that number of affected States, the federal government is powerless to establish a river basin commission.

The Act establishes rather unique operating procedures, in that it urges the Commission to proceed by general agreement. The terms of the statute are worth setting forth verbatim:

> In the work of the commission every reasonable endeavor shall be made to arrive at a consensus of all members on all issues; but failing this, full opportunity shall be afforded each member for the presentation and report of individual views: Provided, that at any time the commission fails to act by reason of absence or consensus, the position of the chairman, acting in behalf of the Federal members, and the vice chairman, acting upon instructions of the State members, shall be set forth in the record. . . .

It may be of interest to the delegates to be reminded that the word "consensus" was a favorite of President Lyndon Johnson whose Administration sponsored the Water Resources Planning Act of 1965. It is the only federal statute to my knowledge where consensus is adopted as a statutory rule or guideline.

II. Objectives of the River Basin Commissions

The Water Resources Planning Act prescribed with some particularity the duties of the river basin commissions. Their main duty as specified in the Act is the preparation and keeping up to date, to the extent practicable, "a comprehensive, coordinated, joint plan for Federal, State, inter-state, local and non-governmental development of water and related resources." Incidental to this major task of preparation of such a plan was the functioning of the commission as the principal agency for coordination of plans for development of water and related land resources in its area, the recommendations of long-range schedules of priorities for the collection of basic data and for investigation, planning and construction of projects.

Another significant aspect of the statutory scheme is the contemplation of Congress that the river basin commissions were not necessarily permanent organizations. This appears from the provision of the Act that at the time the commission submits its comprehensive plan, it can make recommendations for "continuing the functions of the commission and for implementing the plan, including means of keeping the plan up to date." I should note in this connection that in the ten years experience under the Water Resources Planning Act of 1965 only one basin commission has completed its plan and terminated its life and in that instance, the commission was in effect merged in a newly established commission with a larger geographical area of jurisdiction.

In summary, the objectives of the commission as contemplated by the Act were to consider all of the needs and requirements of the particular area over which the commission had jurisdiction and to include in its comprehensive plan the best means of developing water and related resources of the area.

III. Experience of the River Basin Commission

Evaluation of any government activity is a very difficult task. As a career civil servant I have noted that the success or lack of success of particular government programs is often obscured by the self-serving statements of the particular government activity. And, I suppose that when this process of evaluation is elevated to an international setting, such as we have here, that these self-serving protestations can grow even stronger. I certainly do not demean the accomplishments of our government, in some of which I have had a small part, in water resources planning. But I think it is essential in the spirit of the scholarly discourse that prevails at such a conference that one be candid.

So on that note I would have to say that the accomplishments in the ten years that the Water Resources Planning Act has been in effect and the eight years that at least three of the river basin commissions have been in operation have been somewhat disappointing. I would submit that one of the deficiencies could be demonstrated by the fact to which I have already adverted: only one commission has rendered a comprehensive plan and that was with respect to a comparatively limited geographic area.

From my experience as a Commissioner, the philosophy of the Act as set forth in the provisions for "consensus" may be unduly idealistic. The difficulties of obtaining agreement of eight sovereign states and as many federal agencies to substantial issues is almost self-evident. Of course, the statute does not require consensus; but its emphasis on that as a procedural guideline stresses the need for compromise and accommodation. Accommodation among conflicting views is a desirable process particularly in inter-governmental relationships in a federal system. But, the danger is that there will be more accommodation and less resolution of important issues confronting the particular body. By that I mean that the decision-making capability of the River Basin Commission is very diluted.

Let me give a specific illustration from a recent quarterly meeting of the Great Lakes Basin Commission. In rendering a major report of the Commission, the question arose as to how user fees of locks, harbors and other navigation facilities should be treated in that report. Imposition of user fees is a very controversial issue and it is completely understandable that strong differences of opinion would be reflected in the deliberations of the Commission. Indeed those differences of opinion proved so controversial that the Commission took no position on the issue. And the proposal was made that the report should reflect that suggestions had been made to the Commission that user fees be imposed. But that proposal was accepted only with Commission action requiring the further statement in the report that suggestions had also been made to the Commission that user fees not be imposed.

Another negative aspect of the Commission's procedure is the very deliberative nature of work. To put this into concrete terms: A Commission which meets quarterly, that is every three months, finds it very easy to put over to the next meeting an issue which may be difficult to resolve. The issue, having been put over one meeting, is easily put

over another. Consequently time marches on and some fundamental issues remain unresolved.

An unexpected consequence of the quoted language is that the differences do not necessarily fall on state as opposed to federal lines. The language I have quoted from the Act sets up a mechanism whereby in the absence of consensus the Commission divides into two groups, one the federal and secondly the state, for the recordation of conflicting views. The anticipation of this provision is that on many issues there will be a state position as opposed to a federal position. And surprisingly this has not occurred. In some of the most controversial issues to come before the Great Lakes Basin Commission there were some federal and some state Commissioners on each side of the issue. I report this as a plus or a strength; it is a demonstration that in our federal system there need not be a polarization along state versus federal lines.

IV. River Basin Commissions as Permanent Legal Institutions in the Federal System

By this caption, that is, consideration of the river basin commission as a possibly permanent regional institution, I do not mean to acquiesce in the actual experience of the commissions set up under the 1965 Act continuing indefinitely. I am frustrated that so much time has elapsed and the main task of the Great Lakes Basin Commission remains uncompleted.

But viewing the experience I have reviewed, what is the useful future role of the commission? One of the negative considerations in this connection is the inertia reflected in the past work of the commissions. The creation of a layer of government, intermediate between the state and federal governments, is accompanied by creation of and maintenance of its own bureaucracy. This bureaucracy like all bureaucracies will enlarge the areas of its endeavors if permitted to do so. The main restraint on such tendencies in the usual bureaucratic setting is the day-to-day supervision of the next higher level of authority. This restraint is lacking in the institutional setting of the basin commissions. The commission is composed, except for the chairman of federal and state officials who are necessarily preoccupied with their regular duties. The only occasion when the Commissioners devote their full-time attention to the activities of the commission is the quarterly meeting, usually lasting about a day. However, the "credit" for diversionary or peripheral activities should not be restricted to professional staff members or the Chairman of the commission. States and federal agencies exercise considerable ingenuity in perceiving opportunities to further their own interests by projects or studies of the commission.

On the affirmative side, there should be acknowledged the accomplishments of the river basin commissions. Because of the broad base of the commission, it has tremendous expertise and capability. Professionals of all disciplines from all levels of government working under the aegis of the commission have produced most impressive reports and studies.

CONCLUSION

Reviewing the strengths and weaknesses of the river basin commission based on my observation of eight years performance, I come to these conclusions:

(1) the river basin commission is an outstanding vehicle for discussion and debate among federal, state and local interests, of planning for development of water and related land resources on a regional basis;

(2) The planning process of the river basin commission is tedious and prolonged with no effective milestones or deadlines;

(3) The river basin commission has very limited decision-making capability and would not be suitable for an action or program-operating agency.

THE LEGAL FRAMEWORK OF THE VOLTA RIVER AUTHORITY

By E.Y.M. Dzeble*

1. INTRODUCTION

Being the first major hydroelectric venture in developing Africa, the Volta River Project undertaken by the Republic of Ghana from the early 1960's understandably attracted a great deal of international attention from the conception of the idea until the present stage of development. A number of external and international agencies participated in the project in various ways and this has given rise to a complex body of legal devices and guarantees of various types, including legislation, regulations and contractual arrangements and commitments.

As would be expected, the principal concern was finance and the assurance that the enterprise would be successful and viable.

2. PROJECT DOCUMENTS

Before the firm final decision was taken to embark on the project, it was necessary to find the required initial financing to build the dam, the hydroelectric plant and the initial transmission and substation facilities; and to this end negotiations were intensified at various levels with various prospective lenders and collaborators, especially in the late 1950's. These negotiations were to form the basis of the numerous executive, legislative and contractual documents which have provided the legal framework of the Volta River Project. Many of these documents, which have become known as the Project Documents, were executed together in February 1962. Those of the Project Documents consisting of primary agreements between the Government of Ghana or the Volta River Authority on the one side and the Volta Aluminium Company Limited (Valco) on the other side are termed Scheduled Documents.

3. THE VOLTA RIVER AUTHORITY

As soon as all necessary preliminaries had been completed, the first major legal action taken by the Ghana Government in accordance with its prior undertakings was to enact the Volta River Development Act, 1961 (Act 46) to establish the Volta River Authority as the legal entity with functions to operate the project. The Act came into force on 12 December 1961. The Authority thus created was then in a position to assume direct legal responsibilities within the project set-up and to participate in the creation and assumption of the different complex contractual relationships which form the fabric of the venture. As the Volta River Authority is the main body responsible for the implementation of the project, it might be necessary at this stage to summarize briefly the organization and functions of the Authority under the Act.

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4. ORGANIZATION AND FUNCTIONS OF THE AUTHORITY

As a legal body, the Volta River Authority consists of a Chairman and seven members appointed by the Government, including the Chief Executive of the Authority and the Managing Directors of two major consumers of the electricity generated by the Authority, who have so far been the Volta Aluminium Company Limited (Valco), the representation of which has been made mandatory by a provision in the Master Agreement, referred to later; and the Electricity Corporation of Ghana (ECG). But as an organization, the Volta River Authority is a comprehensive structure comprising a Chief Executive as head and a hierarchy of managerial, professional and administrative staff as well as a large labor force of some two thousand strong. As an organization, the Authority carries out under the control of the Chief Executive, all the functions assigned to it; and its role as the legal body is to give policy direction to the Chief Executive. The Government may also in exceptional cases give directions to the Authority.

The main functions of the Authority are to develop the Volta River for the generation of hydroelectricity for the operation of an aluminium industry as well as for industrial, commercial and domestic use, and to supply the power to certain specified customers. Although in the Act the Authority is empowered to generate electricity from other sources and other Rivers, at present all the electrical power at the disposal of the Authority is from its hydroelectric plant at Akosombo in the southeastern part of Ghana. But there are plans for immediate expansion. Since the Authority is also required to supply the power generated to some customers, it has to develop a network of transmission systems and substation facilities as well as consumer services and accounting control. But it should be emphasized that under the Act the Authority is required to, and does, limit direct supply of electricity to certain types of consumers and to certain minimum quantities. It is another statutory body, the Electricity Corporation of Ghana, which is responsible for distributing electrical power, purchased in bulk from the Authority, to small-scale industrial and commercial consumers as well as for domestic use in Ghana. At present the Authority's major customers are Valco, the Electricity Corporation of Ghana, the Mines and the Republics of Togo and Dahomey.

Apart from these functions relating to the generation and supply of power, the Authority is charged with the development of the Volta Lake, formed as a result of the dam, for fishing and transportation; and with the supply of the health needs of the township of Akosombo, where the dam and plant are situated, and the area surrounding the lake.

The Act has provided for the assumption by the Authority of local authority functions in relation to the township of Akosombo; and, in fact, an executive instrument made under the Act created the Authority the local authority for Akosombo in 1963; and the Authority performed the functions until the end of 1974 when a new system of local administration, somewhat inconsistent with the exercise of those functions by the authority, came into operation in Ghana generally. Even within this new system, the Authority is holding consultations with the appropriate authorities

for special arrangements to enable the Authority to continue to exercise control over certain aspects of the administration of Akosombo as a township, such as planning and development, rating, health and sanitation and security with regard to the hydroelectric plant.

Finally, the Act confers on the Authority powers to make regulations to provide for certain specified controls connected with the protection of its property and generation and transmission systems as well as controls and safeguards with regard to the lake and lakeside area. Two sets of Regulations, one for the protection of the Authority's transmission line right of way, and the other for the regulation of traffic on the Volta Lake, have already been made by the Authority in exercise of the powers conferred by the Act. The Authority also has power, which it has used, to make Standing Orders to regulate its procedures.

5. PROPERTY ACQUISITION AND COMPENSATION

As a legal entity the Authority can own and dispose of land and other types of property. By legislative device, land needed by the Authority in conncection with its functions may be acquired by the Government and vested in the Authority. As the acquisition is made by the Government, assessment and payment of compensation for such land are also undertaken by the agencies of Government. With regard to the assessment and payment of compensation for property such as buildings and crops destroyed through the formation of the lake, the Authority itself was the agency which acted for the Government; and, in addition, the expenses involved have been borne jointly by the Government and the Authority in accordance with a formula laid down in the Act.

6. FINANCE

The authority enjoys exemption from income tax; and there are complex arrangements, partly provided for in the Act and partly contained in agreements with various lenders, which define and limit the Authority's powers and obligations as well as the manner of accounting and financial control. The Project Documents contain provisions relating to investment by the Ghana Government in the project, financial rights and obligations of the Authority and debt servicing obligations, as well as submission of statements of accounts and annual reports.

7. CONTRACTUAL RELATIONSHIPS

Apart from its statutory functions, the Authority has contractual relations with a number of local and foreign organizations, the principal ones being the Electricity Corporation of Ghana (ECG) the Volta Aluminum Company Limited (Valco), the International Bank for Reconstruction and Development (World Bank), the United States Agency for International Development (AID), the Export-Import Bank of the United States (Eximbank) and the Governments of the Republics of Togo and Dahomey. It is impossible to set out, even in outline, all the multiplicity of rights and obligations

created under the different documents involved. But it should be pointed out that some of the most important of these contractual provisions, from the point of view of the Authority's operations, are those which impose restrictions on the Authority's acts. For example, a number of important actions required to be taken by or in respect of the Authority have to be with the consent or prior approval of the Authority's principal lenders and Valco.

8. VALCO

The position of Valco requires explanation. Valco was the aluminum processing company incorporated in Ghana by a United States Consortium, comprising Kaiser Aluminum and Chemical Corporation and Reynolds Metals Company, to serve as a major consumer for the electrical power generated by the Authority, under arrangements, including payment in foreign currency, which gave the lenders the confidence they needed to invest in the project. Valco, therefore, assumed an important role at the initial stages of the project. The Ghana Government, in order to induce Valco to agree to participate in this manner, had to yield many concessions such as guarantees against nationalization, expropriation or intervention; guaranteed rentals and terms for land required by Valco for its operations; mining concessions; low rates for public utilities like water; special immigration quotas and exemptions and special provisions relating to taxes and duties.

9. THE MASTER AGREEMENT

All these special conditions are contained in a contractual document known as the Master Agreement executed between the Ghana Government and Valco. It is perhaps the most important of the Project Documents and constitutes a basic legal instrument relating to the Volta River Project. The Master Agreement generally ensures that the Government of Ghana will not, by legislation or executive action inconsistent with the Scheduled Documents, make it difficult or impossible for Valco to realize its objectives in participating in the project. For example, there is a clause in the Master Agreement providing "that directions contrary to this Agreement or any of the Scheduled Documents will not be given to the Authority under the provisions of the Volta River Development Act, or at all." It will be recalled that under the Act, the Government of Ghana has the power to give directions to the Authority in special cases.

10. VALCO POWER RATE

Apart from these concessions, Valco enjoys a special rate for the power supplied to it by the Authority. The Power Contract between Valco and the Authority is one of the important Scheduled Documents and spells out in minute detail the rights and obligations of the Authority and Valco to supply and pay for power respectively. The Power Contract fixes an agreed rate for power which is to remain unchanged for thirty years from the 25th April 1967, that is, until the 25th April 1997. However,

it eventually became clear that it would be inequitable for the Authority to be pinned down to this very low rate for such a long time in spite of changing world factors; and, accordingly, negotiations have been carried on between the two parties for adjustments, part of which have already been agreed upon and effected.

11. OTHER OBLIGATIONS

There are other far-reaching contractual obligations imposed on the Authority by Valco and the principal lenders. There are many examples to be found of these restrictive obligations in the various provisions of the Scheduled Documents. The prior approval of the World Bank will have to be obtained for the appointment of a Chief Executive of the Authority. None of the Scheduled Documents should be amended or repealed without the consent of some of the important parties such as the World Bank, Valco, AID and Eximbank. The various Loan Agreements also contain strict controls. A typical example from the latest Loan Agreement signed between the Authority and the World Bank in June 1969 is the stipulation that the Authority "shall not incur debt unless its net revenues for the fiscal year next preceding such incurrence, or for a later twelve-month period ended prior to such incurrence, whichever is the greater, shall be not less than 1.5 times the maximum debt service requirement for any succeeding fiscal year on all debt, including the debt to be incurred." This, of course, is a very restrictive requirement because it makes it more difficult for the Authority to raise other loans for expansion and other purposes. In addition, the Authority is required under the Act and some of the Scheduled Documents as well to make certain stated minimum returns on the Ghana Government's investments in the project.

12. SOUND OPERATING SYSTEM

These contractual and statutory obligations and restrictions do not, however, make it awkward for the Authority to operate efficiently. On the contrary, these controls have conditioned the Authority to develop a sound operating system and to build up an enviable record of operational and financial efficiency which has impressed all those having relations with it. In particular, because of strict adherence to the various relevant statutory and contractual provisions, the Authority has steered clear of serious legal problems and major litigation. The Act provides protection for officers and employees of the Authority against civil liability for things done by them for the purpose of executing any provision of the Act; and this protection also gives confidence to the Authority's staff in the performance of their duties.

COMPREHENSIVE MANAGEMENT
and the
WATER PARLIAMENT CONCEPT
in
EUROPEAN WATER MANAGEMENT

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Introduction

The authors have just completed a two year, comparative study of water management policies, programs and institutions in England, France, Sweden, West Germany, Netherlands and Hungary. The final report from this project "Cleaning Up Europe's Waters: Economics, Management, Policies" is now being prepared for publication. The study examines several important concepts of water management, including effluent charge systems, regulatory programs, subsidy policies, comprehensive management and the water parliament concepts. The latter two are the subject of this paper.

The rapidity with which the concept of comprehensive management has been adopted and applied throughout Europe is impressive. Equally interesting is the fact that this movement has not been paralleled in the United States.

Although the comprehensive approach to water management in Europe has generally been triggered by pollution problems once the idea has gained acceptance it has usually been applied to many, and in some cases to all other water management problems as well. At present, the widely held view in the countries studied is that competent water resource management can best be carried out by agglomerating the control of most, if not all, water uses under the jurisdiction of a few regional or a single national water management entity.

The trend toward agglomeration

The movement toward agglomeration might be viewed on a spectrum, at one end of which is an institutional laissez-faire approach illustrated by the historical development in all industrialized countries of small special-purpose water management entities to solve particular problems. Water supply problems usually arose first and were ordinarily solved by creation of small, private or publicly owned water supply entities. Drainage, flood control, navigation, sewage management, and pollution control problems arose later and were each solved by creating additional special-purpose management organizations. In all of the countries studied (plus the U.S.), this process has spawned a multitude of small and large, local, regional and national water management entities usually numbering in the thousands. Now the trend, clearly visible in Europe, is toward unification of these multiple entities into larger, basin-oriented organizations. Although the general direction of these changes is fairly uniform, the precise form of the institutional changes initiated in each country presents a complex pattern. There is great diversity from country to country, depending upon historical, political and economic factors, as well as upon that country's perception of the seriousness of

of the environmental problem, and what institutional structure will be effective for environment improvement while not slowing economic growth.

We can see, therefore, a varied pattern of institutional experiments now being carried on in Europe. It is still too soon after the initiation of these changes to assess their effectiveness. What we can do, however, is to describe and classify them, pointing out those concepts most widely adopted, and recommend the continuing study of the stronger programs to see how effective they prove to be.

This movement is especially interesting in view of the speed with which it has occurred in Europe. In 1957 only a few countries had taken even halting steps in this direction.[1] Until the 1960s (in the United States especially), the major concern was with development rather than management.[2] In 1967 Teclaff made a detailed survey of river basin development and management programs around the world, pointing to numerous efforts at integrated basin planning and development, but he could find only a few, isolated cases of even partially integrated management.[3] White, in 1969 suggested that U.S. water management seemed to be groping toward a system that defied precise description, but could be vaguely defined as being in the direction of regional integration.[4] This regional integration was occurring through loose cooperation among a large number of local, state, regional, and national water management entities, rather than through basin or regionally oriented water management organizations with comprehensive management powers over water resources within their jurisdiction.

Now, in the past ten years the movement in Europe toward comprehensive management has obtained a strong hold. The precipitating factor in most of the recent reforms has been the water pollution problem. This was, incidentally recognized as a serious problem, requiring institutional reform, before the general environmental movement peaked in the late 1960s. However, once the question of institutional structure for water quality management was raised, it often led to discussion and reform of the overall water management institutional structure, covering such other uses as drainage, supply, flood control, and navigation. England and the Netherlands are two of the most striking examples where the total water management institutional structures have undergone, and are continuing to undergo major reform.

The movement toward comprehensive management has been encouraged by recommendations of various international organizations. For example, a seminar organized by the Committee on Water Problems of the U.N. E.C.E. concluded that "for effective organization, it is necessary. . . to establish at both central and river basin levels, the maximum possible integration and coordination of all the interests concerned with water resources management."[5] The

seminar did not, however, recommend any specific organization structure for accomplishing this purpose, believing this could best be worked out by individual countries.

Before analyzing this comprehensive management movement in Europe it may be well to have in mind, for comparative purposes, a bird's eyeview of water management in the U.S. Until well into this century nearly all water management in this country has occurred at the state or local level.6 Private water rights have been controlled through the common law of riparian rights in the east, and the appropriation doctrine in the west. In most states these doctrines have now been enacted into statutes. Municipal and irrigation water supply, drainage, small area flood control, and sewer systems have generally been controlled by cities, towns or special districts created under state laws to carry out those particular functions. Large flood control, irrigation, navigation and multiple-purpose projects have generally been built and operated by the Corps of Engineers and the Bureau of Reclamation; TVA is the most important exception to this general rule. Until the mid-1960s, pollution control was almost exclusively managed by the states through regulations and permits. Increasingly, between 1965 and 1972 the federal government felt constrained to move into a supervisory role over the states for pollution control. Most recently, in the 1972 Water Pollution Control Act Amendments,7 Congress gave EPA authority to take direct action in this area, covering planning, adoption of regulations, and issuance of permits. States can still request and be granted authority by EPA to undertake these responsibilities at the state level, but strictly under the supervision and control of EPA.

Not surprisingly, the European pattern of water management has evolved differently, from differences in geography, population distribution, government organization and historical precedent. Nonetheless in the continuing evolution of water management institutional structures in the U.S. and elsewhere it is instructive to know, and analyze, what is being done in these major industrialized nations. We undertake that description and analysis below.

We can best understand the movement toward comprehensive management by examining it from several different perspectives, described in outline form as follows:

(1) Countries with direct national control over their water resorces as compared to those with decentrailzed basin control. We also examine the degree of national, as contrasted to regional or basin control.

(2) Countries with varying degrees of control over different management tools or powers; e.g., permits, regulations, user charges, disbursement of subsidies, planning, setting goals and standards, owning and operating facilities.

Tenn Valley Authority.

(3) Countries with varying degrees of control over different water uses or functions, e.g., use of water for waste discharge (pollution) purification, supply, drainage, diking, flow regulation, and navigation.

(4) Countries with a single entity that controls more than one resource; e.g., air, water, and land use.

Two approaches: national, regional or basin

In gross terms, two major approaches to comprehensive management are evident in the countries studied, (1) the approach that relies upon direct national control, and (2) the approach that relies on control through regional management entities. Sweden is an example of a country that relies on direct national control,[8] except for the vestigial water courts that still retain some authority over dam construction and operation. Hungary also relies on national authority, although it utilizes twelve basin-oriented District Water Authorities to implement its national policies and programs.[9] We put Hungary in the direct national authority classification because the national level is where basic policy decisions occur, where the policy making, interdisciplinary expertise is found, and where directions are issued for implementation by the twelve subsidiary basin authorities. These authorities are not autonomous but are directly responsible to the National Water Authority. The Netherlands is partly included in this category because the national government has direct, exclusive and complete authority over all "national" waters,[10] that is the larger bodies of water in the country; they are not administered by regional entities, even though they may lie within their geographic jurisdiction.

surface and ground

England, France, The Netherlands (for non-national waters), and the Ruhr Region of Germany utilize the second basic approach, that is they depend upon regional, basin-oriented authorities for their water management. In England,[11] France,[12] and the Netherlands[13] these basin authorites are theoretically subject to national control, but in practice are quite autonomous. This is especially significant in the case of the French basin agencies because France has such a long history of strong national control. The Ruhr Region Associations[14] are legally subject to Laender control, but that too is more theoretical than real; contrary to France, such autonomy is quite consistent with long tradition of decentralization, and with the general federal structure in Germany.

The basin authorities in England and the Netherlands are different from those in France and the Ruhr Region in that the former rely primarily on regulations and permits for water quality control, whereas the latter do not -- they rely on user charges, loans and subsidies. All regulations and permits come from local government authorities, i.e., the Laender in Germany, and the Departments in France.

If one were to classify the countries by the degree of national control over their water resources, the list, moving from the most direct national control to the least direct, would appear in three general groups, like this (1) Hungary - Sweden - Netherlands (for national waters), (2) France, (3) England - Netherlands (for non-national waters) - the Ruhr Region. In Hungary and Sweden the national control is direct and authoritative. Some implementation and enforcement occurs at the regional level but strictly subject to direction from above, both in theory and practice. In the Netherlands national control is also direct and authoritative as to all national waters. As explained earlier the French Basin agencies are surprisingly independent in view of the traditionally strong French national control. Water management in England, the Netherlands (non-national waters), and the Ruhr Region had traditionally been locally controlled and it is thus not surprising to find this tradition continuing in the reforms that are now occurring in England and the Netherlands, and in those proposed for the Ruhr and elsewhere in Germany.

All the countries studied rely at least in part on regulations and permits for pollution control, although the degree of reliance varies considerably. Of all the countries, Sweden probably relies most heavily on regulations and permits to control both pollution and supply, although subsidies are also used for these purposes. Although it can be argued that regulations and permits are essentially negative controls (i.e., the water authority must await the initiative of an applicant seeking a permit or proposing other action that will subject it to regulation), still, it must be recognized that Swedish water quality is very high; the system works, at least for Sweden. In England and Germany-outside-the-Ruhr, regulations and permits are the principal means of controlling pollution and supply. In France, Hungary, the Netherlands (for both national and non-national waters), and the Ruhr Region, effluent charges and subsidies are the primary tools for controlling pollution and providing supplies; regulations and permits are only supplemental devices. In the Netherlands and Hungary basin water authorities both assess the effluent charges, and issue permits although in Hungary the amount of the charges is set at the national level, revenues are turned over to the National Government, and decisions on disbursements are made at that level. In the Netherlands, France and the Ruhr Region, revenues are collected by, allocated, and disbursed by the basin water authorities. In France and the Ruhr Region, while effluent charges are assessed by the regional water authorities, permits are issued by local government authorities -- the Laender in Germany and the Departments in France. The English regional water authorities have statutory authority to levy, collect and disburse revenues from effluent charges, but none has chosen to use this approach to date.[13]

In some respects Germany is like the U.S. was some years ago. Germany and the United States are both federations with constitutions that reserved to the states or Laender significant powers over resource management. The major difference is that during the 1900s the U.S. Supreme Court construed the U.S. constitution -- primarily through the commerce clause -- as giving the federal government power to enact about any legislation concerning water resources that it conceives wise and politically acceptable,16 whereas the German Constitutional Court has construed the German constitution much more restrictively so that the federal government's powers to legislate on water resources are severely constrained.17 For example, all implementation and enforcement of pollution control laws remains in the Laender. None of the other countries studied are federations and none have constitutional limitations that significantly constrain their national governments in the water resources area.

Comprehensiveness can also be measured in terms of the powers that the national or basin management entity has over water resources, for planning, setting goals and standards, financing, constructing, owning and operating facilities, assessing, collecting and disbursing user charges, adopting regulations, issuing permits, and enforcing laws. Again if a scale of comprehensiveness is conceived here, Hungary would be near the top of the scale with its regional and national water authorities having some of the broadest powers found in the countries studied. The Netherlands, with reference to national waters, would be next in that the national government has plenary and direct control over the uses of these waters.[18] One significant difference between the Netherlands and Hungary[19] is that in the latter the basin authorities sometimes own and operate dams, drainage, and purification facilities whereas in the Netherlands the ministry that controls national waters does not own or operate any facilities. If the Netherlands national government wants a purification facility built, it finances such a structure through a basin authority rather than build it itself.

The Netherlands (as to non-national waters) would be next although this forecasts what is likely to occur under the current reorganization[20] rather than what now is actual practice. The Dutch Principal Water Boards will have all of the management powers listed above, over non-national waters within their jurisdiction, although much of the overall planning and setting of goals will occur at the national level. The Ruhr region associations, in a very real sense, exercise most of these powers. They do not actually regulate or issue permits, but these functions are relatively insignificant when compared to the real

control that these associations exercise through effluent charges, construction, operation and management of purification, supply and river regulation facilities. In Sweden the national government sets goals, standards, issues regulations and licenses, and carries out enforcement.21 The national government does not actually own, operate or directly manage facilities, nor does it levy effluent charges. By any standard, however, its powers over different water uses are substantial. The English regional water authorities exercise all the powers listed except the levying of effluent charges.22 Their statutory power is broad enough to permit them to do this,23 but to date none have chosen to do so. The French basin agencies plan, set goals (in cooperation with the National government), and determine standards. Beyond this their powers are limited to levying effluent charges and allocating and disbursing the revenues collected as loans and subsidies.24 They do not issue regulations or permits, nor do they engage in enforcement proceedings, these latter functions being performed by the Departments.

Comprehensiveness can also be measured in terms of the water uses or functions that are under the jurisdiction of the basin or national authorities, including the use of water for waste discharge, purification, supply, drainage, diking, flow regulation, and navigation. The Hungarian, English, and Dutch basin authorities exercise substantial controls over all of these functions. In the Netherlands, of course, the National government controls national waters and the regional water authorities control all other waters. In all four of these countries the regional water authorities also own and operate some purification, river regulation, and water transportation facilities.

The French Basin agencies do not have jurisdiction, or any significant control over most of the country's municipal water supply although they do levy charges for irrigation water supplies, they have no direct jurisdiction over drainage, diking, or river regulation.

One of the problems faced by some of the countries studied in their move toward comprehensive management is that the newly created basin entities neither own, nor have power to control existing water management facilities (sewer systems, purification systems, canals, reservoirs, dams, etc.) yet they have determined that such ownership or control is necessary. In England the plan25 is for the regional water authorities to actually take over both the ownership and operation of these facilities. The four major impediments to such action have been (1) the lack of financial resources of the new Regional Water Authorities with which to acquire and operate locally owned facilities,

(2) reduction in local tax base that results from such takeovers, (3) the potential loss of national subsidies to local governments in support of the construction and operation of these facilities, and (4) normal institutional resistance and self-preservation, specifically the resistance by local governments, private water supply companies, and the British Waterways Board to any reduction in their powers, assets, or jurisdiction. There is also considerable resistance by the former staffs of the River Authorities who were worried about their potential roles with these new entities. The Netherlands is now in the process of creating 22 Principal Water Boards to execute such a takeover;26 they will eventually control and possibly acquire ownership, of locally owned sewage control, waste treatment, and water supply facilities. France has chosen a different path. The six Basin Agencies have not, and do not plan (at least in the immediate future) to assume responsibility for or ownership of any facilities. Waste treatment facilities for sewage and industrial wastes will remain under local or private ownership and control, and water supply facilities under private or local ownership and control. In the Ruhr region of Germany the associations already own and operate most of the dams, dikes, reservoirs, and purification facilities;27 they do not need to acquire them from other public or private entities.

Of all the countries studied, Germany has been able to do the least in moving toward comprehensive management in recent years. At present the various water management functions remain in the Laender (pollution control), cooperative associations (drainage and small water supplies), and cities (large water suppliers and sewage management). There is no overall national planning, control or coordination because of constitutional limitations.28 An effective Federal program in this area will not be possible until the constitution is amended and when that will happen is anyone's guess. In the Ruhr District, supply, effluent charges for waste discharge, ownership of treatment facilities, ownership of river regulating dams and reservoirs, aesthetics, and fisheries (so far as it is affected by pollution control) are under the jurisdiction of the associations. In the past few years the Ruhrverband (pollution control), and the Ruhrtalsperrenverein (river regulation and supply) have merged their administrations and now are working as a single management entity.

None of the countries studied has brought land management or air pollution control functions under the control of the basin agencies. An argument can be made for doing so, at least as to certain aspects of land and air quality management. However all the countries studied have so far determined that the size of the administrative structure, and the non-water relatedness of most air quality and land

management functions argues for their separate administration.29 All the countries expressed a desire to improve coordination of related land, air and water management decisions, but we found little evidence of such coordination to date with the possible exception of Sweden.

Under ideal conditions these land use and air quality decisions might well remain outside the jurisdiction of the water management entity, but the WME, and the air and land management entities would have timely opportunity to review and comment on each other's actions, and the level of decision making would be raised to a point where the Ministry or other decision maker had jurisdiction over both functions and would have to assume responsibility for the tradeoff problems.

The trend toward comprehensive management has been paralleled by a considerably less visible trend toward interdisciplinary planning and management, that is, by planning and management that explicitly recognizes and endeavors to utilize the expertise of disciplines other than engineering. This trend has responded quite naturally to the increasing public concern for environmental, aesthetic, social and recreational aspects of water use. One finds an increasing number of social scientists at the policy-making levels of the national or basin water authorities. The English Department of the Environment strongly urged the adoption of such an interdisciplinary approach to water management, both in staffing and in policy planning, in a circular30 it issued to the new regional water authorities in 1974.

One of the goals sought in the current move toward comprehensive management is internalization of a wider range of costs and benefits of water management decisions. Thus the expansion of both geographic and subject-matter jurisdiction, and the trend toward interdisciplinary management is designed to place decision making in an entity that is responsible for tradeoff effects. This is not to say that creation of a comprehensive WME is the only means of internalization; economists have long argued that often the best means of internalization is to charge people for the resources they use. However such a goal can hardly be achieved without a management entity that has the power to gather opportunity cost data for all the rights, services, and waters provided to all users of water resources.

Another goal sought through comprehensive management is more coordinated, and efficient water management. It is not claimed that comprehensive management will by itself, determine the quality of water that a region or nation shall have. For example, assume that a particular region has 300

small, uncoordinated water management entities and that 60 percent of its municipal sewage receives only primary treatment and 75 percent of its industrial effluent is not treated at all. Assume that a comprehensive management program is adopted for the region. This means only that, given the committed financial resources, the system will operate in a more coordinated and efficient manner. Also, given the goals selected (either by the WME or a national entity), the WME can presumably implement those goals in a more coordinated and efficient manner than would be possible with a multiplicity of small, special-purpose management entities.

An additional advantage claimed for comprehensive management is that it permits a better cost-accounting system. When there is a multiplicity of small, special-purpose water management entities it is difficult to determine who is using what facility, service, or water, and at what cost to others. Under comprehensive management the WME should better be able to use a single data-gathering and accounting system to determine both costs and charges, and to achieve an important goal of effective water management, i.e., informing users as to who is paying for what and who is getting a partial or entirely free ride.

If comprehensive management is accompanied by a Water Parliament composed of those who benefit from, and those who pay for water use, then the flow of information will be facilitated to them, and they will be in a position to assure that accurate cost-accounting occurs.

Water Parliaments

Paralleling the trend toward comprehensive management has been a move toward the use of Water Parliaments (WPs) for the governance of basin authorities. These WPs are usually composed of representatives elected or appointed from groups effected by the WME decisions, i.e., those who use the rights, water, or services provided by the WME. Such entities are now in use in France,31 the Netherlands,32 England,33 and the Ruhr region of Germany.34 In all these countries except England this trend toward WPs has gone hand in hand with the adoption of effluent charge systems. Hungary35 doesnot use the WP concept.

Existing WPs are not merely advisory bodies, but hold the real powers of decision over WME policies. Although WME decisions are technically subject to review and reversal by the national government (by the Laender government in Germany), these supervising governments seldom interfere in WME actions, and in practice the basins are considered quite autonomous everywhere (except in Hungary). Nonetheless the power of review and reversal does exist in all countries and

its existence serves to set the outer limits within which the water parliaments can act. In addition, the supervising governments are, in all cases, the source of important subsidies to the WMEs and this provides a further means of control over policies.

In England the new RWAs are governed by "Authorities" ranging in size from 15 to 50.36 A majority of the authority members are selected by local governments and a minority are appointed by the national government through the Secretary of State for the Environment and the Minister of Agriculture.37 Under the 1973 Law, the members selected by the national government are chosen because of their special knowledge and expertise in water-impacted areas such as recreation, fisheries, agriculture and industry. The authorities determine basic policy for the RWAs, covering such matters as the formulae for charges to users of RWA rights, waters, or services, decisions about facilities to be built, and the allocation and expenditure of revenues.

In France the Basin Agencies are governed by "Catchment Committees"38 whose members are appointed by the national government, although most are nominated by local governments. These members are selected as representatives of various water-related sectors of society, such as agriculture, fishing, navigation, tourism, industry, electricity, local government and the national ministries. The catchment committees generally act on the basis of majority vote, and have the power to determine policy for the Basin Agencies, including the rate of assessment for waste discharges, and the allocation and distribution of revenues collected through the charge system.

In the Netherlands39 the twenty-two new Principal Water Boards will be governed by General Councils composed of owners and users (renters) of open (unbuilt) lands, owners and users of built land, representatives from industry and local governments and those who use the waters for waste disposal. The basic principle of representation is that those groups having a continuing concern for and who benefit by correct water management, will carry the financial burden and will be represented on the governing council of the water boards. The precise composition of these Councils is still being designed, although the general structure was announced in a government study in August 1974.40 It is expected that they will have about 45 members, and will determine such matters as the method and rate of assessments for effluent discharges, how revenues shall be spent, what facilities to build or acquire, and other policy matters.

Hungary has not adopted the water parliament concept.41 Apparently the reason is that the 12 District Water

Authorities are merely operating branches of the National Water Authority. These District Authorites do utilize local advisory councils, however they are advisory only and have no legal powers of decision making.

In Germany the large Ruhr region associations are governed by assemblies composed of representatives of all those who pay for and those who benefit from the association activities.42 The manner of selection of representatives varies considerably among the associations. For example, the Ruhrverband Assembly has about 1200 members, coming from industry, railroads, business, mines and cities.43 The Emschergenossenschaft Assembly is composed of about 100 members coming from various rural and municipal districts which in turn represent industries and municipalities that pay for association activities.44 Voting power on the Ruhrverband, the Ruhrtalsperrenverein and the Emschergennossenschaft is proportional to financial contribution through charges. On the Lippenverband,45 because of a fear of one-industry control, the coal mines are limited to a maximum of 40 percent of the voting power on the Assembly even though they contribute well more than 50 percent of the associations' revenues. On the Brober Erfterband46 a fixed number of seats on the Assembly is allocated to each of the various user groups. These assemblies determine basic policy for the associations, which is then implemented by the professional staffs.

Sweden does not use regional or basin-oriented water management entities and thus does not use a water parliament structure. The NEPB does have citizen advisory bodies that advise it from time to time, but they have no power of decision.

Comprehensive Water Management in the U.S.

Comprehensive water management, through a single water management entity, is a concept that has not been accepted, adopted, or even significantly debated in the United States. The typical water management program in this country is carried out by a wide array of management entities, each having responsibility for only one, or a few, aspects of water use. Generally, the State will control pollution (or the EPA will control it under the 1972 FWPCA amendments).47 If under state control, this function will be closely supervised by the EPA at the national level. Municipal water supply will be provided by each municipality. Sewerage control also will be provided by municipalities, although in some major metropolitan areas joint city-county, or area programs have developed. Irrigation water supply, particularly in the West, will be provided by individual farmers, or by state-created irrigation districts, sometimes obtaining

water through Bureau of Reclamation projects and subject to Bureau control. Drainage is usually performed by local drainage districts, created and controlled by state laws. Flood control on the large rivers is generally provided by the large Corps of Engineers dams. On smaller rivers flood control is often provided through dams owned by flood control districts or other state-created utilities. Navigation is under the jurisdiction of the Corps of Engineers and the Coast Guard.

The National Water Commission in its final report of June 1973[48] argued for the need to consolidate fragmented water services in the nation's major metropolitan areas. Within a typical large metropolitan area there may be hundreds of local jurisdictions -- cities, towns, counties, and special districts -- that divide responsibility for management of the basic water services of the area among them. For example, the Chicago metropolitan area, comprising six counties and approximately 2000 local units of government, has 349 separate water supply systems and 135 separate waste water disposal systems. The city of Chicago treats and delivers water from Lake Michigan to the city and about 70 suburbs. The Metropolitan Sanitary District of Chicago provides main interceptors and waste treatment plants for Chicago and 105 suburbs. Myriad park districts, forest preserves, and similar organizations have responsibilities for water-oriented recreation and for providing and maintaining open space.

The Commission suggested that:

> In some instances, where several agencies are authorized to provide the same service to different parts of a metropolitan area, waste and inefficiency may result. Consolidation of the performance of one or more of the separate tasks in a single water service throughout a metropolitan area, or some significant portion of it, may yield economies of scale that have not heretofore been captured by individual cities or districts pursuing separate courses.

The Commission recommended that:

> Municipalities, county governments, special districts, and other local government units should continue to explore the potential for consolidating separate tasks in providing water services to achieve economies of scale throughout all or significant portions of their metropolitan areas. States should enact legislation authorizing new metropolitan management authorities, which may be created from and made up of existing local entities, to provide and coordinate specified public water

services for particular areas including the main water supply, wastewater treatment, and storm drainage functions. Accompanying the legislation to authorize new management authorities should be additional legislation to establish procedures to insure that the activities of special authorities are coordinated with those of other government units and that the public is fully aware of the activities of special authorities operating within metropolitan areas.49

Davis50 argued that "The existence of numerous local governments, each jealously guarding its prerogatives and each diligently ignoring or working at cross-purposes with its neighboring governments, is one of the major underlying problems of the American polity. The problems posed by pollution accentuate this pattern and reveal its adverse consequences." Rosenbaum51 notes the lack of coordinated planning among government entities. The common lack of such coordination has been so amply demonstrated that the evidence is almost a ritual in administrative reports. Part of this problem, notes the Council on Environmental Quality,52 is that environmental problems are not seen in their entirety, hence responsibility for their management is fragmented among federal agencies and among federal, state and local governments. Fragmented authority, in turn, frustrates a holistic view of environmental ills.53

Texas has not escaped the proliferation of local government units which seems to be a phenomenon of modern society. Local special benefit districts perform specialized services and have limited functions but do not generally possess general governmental powers. In 1969 there were 339 districts dealing primarily with water control, improvement and supply in Texas.54 By statute there are 13 types of water districts. A primary attack on the water district is that it contributes to the weakness of the general government -- rather than attempting to make general government responsive to the needs of the area, the quick but short-sighted answer is the special district, -- the smallness of the water service operations often contribure to increased expenditures and duplication of functions by adjoining districts. A possible solution to this problem is the authorization of a "Master District" which can be created by voluntary action of several individual districts to pool resources and facilities. Unfortunately only one such Master District has been created. This solution is distinctly limited because it depends on the voluntary actions of individual districts.55

Hallmark56 describes the many types of water districts in Oregon and asks why so many are necessary to handle water management problems. He suggests that the separate districting statutes have grown "like topsy" until at present they overlap each other in hopeless confusion; he argues that consolidation would be an improvement.

Some Efforts at Consolidation have Occurred in the U.S.

The Tennessee Valley Authority is an example of an early effort to provide comprehensive management for an entire basin area.57 TVA was created in 1933 as a regional resource development agency. Among its assignments were the construction of dams and reservoirs on the Tennessee River and its tributaries, the promotion of navigation and the contol of destructive floods. All of its major dams also have hydroelectric producing capacity. TVA shares recreational administration of its reservoirs with other federal agencies and with local public and private bodies. It does not have immediate responsibility for domestic or irrigation water supply (except as flow control affects these activities) nor does it have jurisdiction over sewage or other pollution management.

TVA is a federal corporation and is governed by three directors appointed by the President of the United States.

METRO, the Municipality of Metropolitan Seattle was created by vote of the people living in the Metro area in 1958.58 Its primary purpose was, and is, to clean up Lake Washington which was becoming severely polluted by the infusion of untreated or partially treated sewage from Seattle and numerous smaller municipalities bordering the lake. The method used by Metro was to develop a system of interceptor sewers which pick up all sewage headed for the Lake. The sewage is then carried around the Lake, given secondary treatment (some now gets tertiary treatment) and then is pumped into Puget Sound. Metro's role can be described as that of a wholesaler. It does not operate local sewerage systems; instead it connects to them, transports their sewage, treats it, and discharges into receiving waters. Over the past few years Lake Washington has become significantly clearer and cleaner because of Metro's program.

In 1971 Metro was given authority to operate a county-wide transit system and has been successfully performing that responsibility since.

Metro is governed by a "Council" of 36 members selected by and representing the county, the cities and the unincorporated areas within its jurisdiction.

The Wisconsin Valley Improvement Company59 is a private corporation operating a system of reservoirs in northern Wisconsin for river flow regulation of the Wisconsin River. Its primary function is to regulate the flow of the river to enable some 25 hydro-generating plants to generate more electric power during low flow periods. This action also improves water quality by causing dilution during low flow periods, and significantly reduces the hazard of floods.

The company was chartered by special act of the Wisconsin legislature in 1907 as a private corporation whose stock is entirely owned by six paper mills and four utilities who own and operate the hydro-electric plants on the River.

The Delaware River Basin Compact created a multi-state Delaware River Basin Commission with broad planning, regulatory and construction powers.60 Of particular importance is the power to allocate water supplies among the member states in time of shortage (the Commission is noted for its successful management of the allocation problem during the 1965-67 drought). The Commission also has some regulatory power over pollution control, however it is designed basically as a planning and regulatory body, with powers limited rather strictly. It was not designed (as the English Regional Water Authorities, or Dutch Water Boards) as the comprehensive manager and operator of all water-related activities in its jurisdiction.

The five River Basin Commissions created under the authority of the 1965 Water Resources Planning Act61 enacted by Congress have broad study, planning, and advisory powers.62 The Commissions are composed of federal and state representatives, who arrive at decisions by "consensus" and who gather information, initiate studies, and draw up plans for the region of their jurisdiction. They have no powers of implementation, such as to issue regulations, permits, finance projects, or enforce rules or laws, these being retained by the appropriate federal agencies (Corps of Engineers, Bureau of Reclamation) and state and local entities. They have no regulatory control over the many federal, state and local agencies that actually carry out water programs.

Texas has established eleven River Authorites that have jurisdiction over entire river basins.63 The Bravos River Authority is an example. It is a governmental agency somewhat on the order of a special purpose municipality. Its principal purposes are to control,

store, and distribute water, primarily to irrigation farming operations. It has a governing board of 21 members, appointed by the State Board of Water Engineers. Some of these authorities also have entered the sewage control field, however the primary motive for doing so has been to obtain potable water, which the authorities sell, and from which they gain the bulk of their revenues. Most of the authorities have failed to use the broad statutory powers available to them; few have developed satisfactory pollution detection systems, and none has effectively bridged the gap between detection and enforcement. The authorities are financially dependent upon their water and power users and are not inclined to alienate important customers by demanding strict conformity to permit standards.

Numerous other special-purpose entities have been created in various states over the years; especially noteworthy are the Gulf Coast Waste Disposal Authority, The Ohio River Valley Sanitation Commission, and The Muskegon County Wastewater Management.

Literally thousands of special-purpose drainage systems, sewage, diking, flood control, and water supply districts have been created and continue to exist throughout the country in a variety of types and sizes.

None of these entities has jurisdiction or power approaching the comprehensive authority of The English Regional Water Authorities, The Dutch Water Boards, or the Hungarian District Water Authorities. It seems that these European countries, faced with considerably more severe, and immediate problems of water management, have moved further than the United States toward the creation of comprehensive water management entities. There seems little doubt that as the problems of coordination, duplication, overlapping, and conflict increase in the U.S., as they predictably will, that careful study should be made of this European experience.

The Water Parliament Concept and the United States

Just as no comprehensive WMEs comparable to those in Europe exist in the U.S., this country has not applied the Water Parliament concept, at least, to the extent that the Europeans have. It is true that some special representative "Boards" exist, such as for the Metro in Seattle, the Metropolitan Sanitary District of Chicago, numerous irrigation and other special-purpose water districts. However, what does not exist is the special combination of comprehensive general purpose WME, governed by a representative water parliament, selected, either by election or appointment, from the groups that share the benefits and pay the costs of the WME.

A number of specific advantages to the water parliament structure are cited by Europeans: (1) It recognizes the importance of water management questions to the communities they serve and permits a direct contribution by those groups to the decision process; (2) It produces a better systems analysis because it assures participation from all parts of affected society; (3) It encourages adoption of sound economic principles, such as the PPP, by providing better information dissemination to those paying for the WME and thus a better realization of who is not paying their share; (4) It tends to bring in environmental and social goals and values in WME programs, which have sometimes been lost when single-purpose entities were run by engineers or other specialists.

If such a water parliament concept were adopted in the United States, a problem that would have to be faced is the constitutional requirement of one person one vote. Reynolds vs. Sims64 and associated cases have laid down the general requirement that every citizen equally affected by a legislative body's powers is entitled to equal political influence in selecting the members of that body.

A recent case, Salyer Land Co. vs. Tulare Lake Basin Water Storage District (1973)65 recognized an exception to this rule for the election of a board of an irrigation district in California. The basis for the exception is contained in the statement "We conclude that the. . . water district, by reason of its special limited purpose and of the disproportionate effect of its activities on landowners as a group," is a proper exception to the one person one vote rule. However the situations in which this exception to the rule apply are not clear.. In Kramer66 the court carefully scrutinized and struck down a voter restriction scheme under which eligibility to vote on school board elections was restricted to residents who owned or leased taxable property in the district, or had children in school. This was held to violate the equal apportionment requirement.

Some of the members of the WPs in Europe are appointed, e.g., by mayors, city councils, or other public or private entities. Apparently if this method of selection were to be used in this country then the one person one vote rule may not apply -- although the U.S. courts have not spoken directly on the matter. Probably an important consideration would be how much power and what effect the unit has over citizens, e.g., how much of its power might be termed "legislative". If its powers are substantial then one could predict that

the courts would require selection by election instead of appointment, and would apply the one-person-one-vote rule. Of course, if the governing board is in fact selected by election then the rule applies.

In Harper67 the court said

> The need for exacting judicial scrutiny of statutes distributing the franchise is undiminished simply because, under a different statutory scheme, the offices subject to election might have been filled through appointment. . . (we have held that where a county school board is an administrative, not legislative body, its members need not be elected.68

However "once the franchise is granted to the electorate, lines may not be drawn which are inconsistent with the Equal Protection Clause of the 14th Amendment."69

The decisions of the United States Supreme Court in this area have not clearly defined when elections are necessary or when the one-person-one-vote rule will be applied. The basic principle is nonetheless clear,i.e., the more comprehensive, general, and "legislative" in character these powers are, the more likely it is that a court will require elections and will apply the equal apportionment rule.

Applying the above principles to the creation in the United States of a comprehensive WME, such as exists in England, we could fairly predict that a court would apply the one-person-one-vote rule.

Such comprehensive WMEs exercise broad powers that affect all the citizens within their jurisdiction; and the powers they exercise, e.g., adoption of water management policies, creation and adoption of regulations, assessment of charges, and dispersal of revenues, are broad enough to be characterized as "legislative". It would, therefore, behoove anyone considering this type of structure in the United States to give careful study to the apportionment cases.

Summary and Conclusion

I. The trend toward comprehensive or unified management

The six European countries studied show a clear trend to put pollution as well as most other water problems under the control of a single national entity, or a few regional, basin-oriented entities, giving them broad legal powers of management. This appears as a

distinct reversal of earlier pre-1960 water management history when these countries had cretaed a wide range of special purpose, public and private entities -- ultimately numbering in the thousands -- each with limited legal powers and designed to solve only one or two water problems, e.g., providing water supply for town or irrigated farm area, draining a swamp, diking a river, getting rid of or treating sewage, or providing flood or pollution control. As recently as 1957 the "pattern of unified administration" had only been adopted sparsely"70 in Europe. In the United states a series of proposals for unified administration had followed on the heels of TVA but none had been adopted, and, as White reported "Indeed, the number of federal and state agencies involved in water resource development has tended to increase."71

This trend in Europe toward unified administration, or what we call comprehensive management, is further revealed in the tendency to give the national or basin entities increasingly broad legal powers for managing water uses, in some cases including the power to plan, regulate, issue or deny permits, charge user fees, make loans and subsidies, engage in enforcement, and construct own and operate purification, reservoir, and other facilities. Similarly the trend is to give these entities control over an increasing number of water functions or uses, covering, in some cases, control over pollution, supply, navigation, river regulation, diking, drainage, recreation and fisheries.

Although the movement toward comprehensive management is expressed in various institutional forms and is seen at different stages of development in the six countries studied, the overall direction is clear, and it appears to be still gathering momentum.

II. Use of the basin as a management area

Except for Sweden and Germany outside the Ruhr region, all the countries studied have determined that the basin is the optimal area for the management of water resources. At the same time in each country the realities of hydrology and political life have required tempering of this approach, thus for example a Regional Water Authority in England, or a Basin Agency in France, will have jurisdiction over more than one basin area, and the regional authorities in the Netherlands and Hungary will have jurisdiction over only a portion of a large river system (the Rhine or the Danube). Nonetheless the most important theme in the designation of areas to be included under regional management entities is the basin. The widely held belief is that such areas promote optimal coordination,

economies of scale, river regulation, power generation, and management of supplies. Interestingly, none of the basin entities has management powers over either air or land resources.

III. National control of basin agencies

In France, England, Netherlands, and Hungary the regional water entities are subject to the overriding policy control and supervision of national ministries. Once national goals are established the supervising national authority can legally insist upon compliance by the regional authorities. In practice this national authority seems seldom to be asserted, at least directly, and in England, Netherlands, France, and Germany there is a distinct tendency to continue, insofar as possible, the long history of local participation and control. When national authority is exercised it is often done through financing. Thus national sources of funds through subsidies or loans may be available when the regional WMEs are meeting national goals and programs, and are less available - or even unavailable otherwise. National approval of construction plans may also be required, as in England, and may not be forthcoming when the overall economy is doing poorly.

In the Ruhr region of Germany the large water associations are subject to the control of the Laender, rather than the federal government. In practice because of their established expertise and considerable political power, these associations are quite autonomous. In France, England, and the Netherlands, the regional WMEs are surprisingly independent politically, and aspire to increasing independence economically through collection and management of revenues from their own user-charge systems. The commonly stated goal, is that all water users should pay for the water, services or rights they receive. As and when this actually occurs the WMEs should become increasingly financially self-sufficient.

IV. Interdisciplinary planning and management

Interdisciplinary planning and management is another, albeit somewhat less obvious trend that parallels and complements the movement toward comprehensive management. The new English Regional Water Authorities are explicitly exhorted by the Department of the Environment of the national government to apply principles of interdisciplinary management to both internal organizational structure and the selection of personnel. The Franch system reveals a similar, although less explicit movement in this direction, predicated on the need to use sophisticated economic

analyses in setting effluent charges and determining how the revenues are disbursed. In Hungary the UNDP project is an interdisciplinary effort in that it tries to incorporate a wide range of economic, hydrological, physical, agricultural, legal and other data into a sophisticated computer program which will, hopefully, identify the optimum system of water allocation, use, charges, etc., for a basin area. If successful the Hungarians plan to apply this methodology elsewhere in Hungary as well as make it available outside the country. In Sweden the Water Courts were primarily lawyer-dominated. Now the National Environmental Protection Board, which issues most permits and is responsible for national water resource planning, endeavors to bring an interdisciplinary approach to its work. Even the German water associations of the Ruhr region which have historically been engineer-dominated, now appear to be adopting a more interdisciplinary approach as illustrated by the recent employment of an economist at the top management level of the Ruhrverband. Elsewhere in Germany there is little evidence of either unified or interdisciplinary management. In Holland there is no evidence available yet to tell whether the new Principal Water Boards will use an interdisciplinary approach to water management.

V. The "trend" toward internalization of costs and benefits.

Another less visible trend that seems to be paralleling the development of CM in the countries studied is toward internalization of costs and benefits. Recognizing that "externalities" cause misallocations of water and other resources, the tendency has been to broaden both the subject matter and geographic jurisdiction of the WMEs to give them the power more accurately to determine who benefits and who bears the burdens of different water uses, and to assess charges accordingly. We note this as a "possible" trend because we found it an oft expressed hope or aspiration of water managers and others concerned with comprehensive management in different countries. To date, however, we found little hard evidence that it is a reality. It is still true, for example, that much of the current subsidies are national in origin, which results in transfers from one region or source to another, and are thus "external" rather than "internal".

VI. The development of Water Parliaments

The governance of the new, basin agencies is generally in the hands of entities called "water parliaments", whose members are normally elected or appointed by

different water resource user groups. Nowhere except in Hungary are the WMEs operated as direct, subordinate agencies of the national governments. These special-purpose water parliaments range in size from 15 in some of the English RWAs to 1200 in the Ruhrverband Assembly in Germany. Typically they play the role of legislative bodies in the structure of the WMEs, and are responsible for policy formulation, and for giving general direction to WME programs, the execution of which is the responsibility of full-time staff.

Some experts in Europe claim that the existence of these water parliaments serves to inform special interest groups and the public about basin agency actions and to permit direct and timely contributions from these sectors into agency decisionmaking. The water parliaments do provide a direct linkage with local governments, industries, and other water users. For better or worse, their presence also serves to enhance the autonomy of the basin agencies from the control of the national or state (in Germany) governments.

In the United States, locally elected policymaking bodies have been created for various single-purpose WMEs, such as irrigation, water supply, drainage, and flood control districts. Some of the larger sewage management entities, such as METRO in Seattle, also have elected boards, however, one of the most comperhensive water management entities in the United States, the TVA, is governed by a three-person, presidentially appointed board. The evolution of the European water parliaments has resulted naturally from the long history of active local participation and control that has characterized water management in the countries studied. As the smaller, special-purpose WMEs of the past have been consolidated and brought under a single, regional comprehensive management umbrella, the composition of the mini-parliaments has been expanded to include representatives of the new uses.

VII. Coordination with air and land-use controls

Sweden is the only country that has placed both air and water management under the same administrative umbrella. The Swedish national Environmental Protection Board has jurisdiction over the issuance of permits for discharges of wastes into both air or water resources. In all the other countries the WMEs have jurisdiction only over water uses. The consensus of opinion is that sufficient interrelationship exists among different water uses to justify their being placed under a single management umbrella, but

that air quality problems are too different to be included. Experts in each country told us that the responsible entities tried, through voluntary cooperation, to assure coordination between air and water quality control programs, however nowhere, except possibly in Sweden, did we hear that effective coordination was indeed a fact.

The same is true of coordination between water management and land-use planning. Several countries, notably England, Netherlands, Sweden and Hungary, have strong land-use control systems. But nowhere did we get the impression that these systems are effectively coordinated with water use programs. In particular, the disposal of solid wastes is thought to be a serious problem warranting closer cooperation among the parties responsible for producing, transporting, and permanently disposing of this waste. One reason for the lack of coordination may well be the newness of the institutional changes in the management particularly of water resources - changes which in some cases are still occurring. Only time will tell whether the stated intentions about coordination actually will be carried out.

Finis

FOOTNOTES

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8. THE ENVIRONMENTAL PROTECTION ACT OF 1969.

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10. A.C.J. Koot, A.P. Vernimmen and J.C. Plass, "Charging Polluters In Financing Water Pollution Abatement", paper presented at the 6th International Water Pollution Research Conference, June 18-23, 1972, Jerusalem. [hereinafter cited as Koot et al.]

11. Water Act of 1973.

12. Decree No. 66-700 dated Sept. 14, 1966, J.O. Sept. 14, 1966, J.O. Sept. 23, 1966.

13. R. Johnson & G. Brown, CLEANING UP EUROPE'S WATERS: ECONOMICS, MANAGEMENT, POLICIES, Rough Draft April 1975, Chapter 6 at 3.

14. W. Irwin, Wastewater Treatment Assessments, Legal and Administrative Aspects-The German Experience, for the Council on Law-Related Studies of the Environmental Law Institute, Feb. 1971.

15. Under Article 30(1) of the Water Act of 1973, RWAs are empowered to collect charges for "services performed, facilities provided or rights made available in as they think fit." Thus the RWA could charge an industry for the "right" of depositing its wastes into RWA controlled waters.

16. See U.S. v. Gerlach Livestock Co., 339 US 725 (1950); U.S. v. Butler, 297 US 1 (1936); Okla. ex rel Phillips v. Guy F. Atkinson Co. 313 US 508 (1941); Arizona v. California 373 US 546 (1963).

17. R. Johnson & G. Brown, supra note 13, Chap. 4 at 1.

18. Koot et al. supra note 10.

19. S. Kernacs, supra note 9.

20. RAPPORT VAN DE STUDIECOMMISSIE WATERSHAPPEN [hereinafter cited as Report of the Study Commission on Waterboards] appointed by the Crown Nov. 1968.

21. R. Johnson & G. Brown, supra note 13, chap. 6 at 37.

22. D.O.E. Cir. 92/71, Dec. 2, 1971, DOE Cir. 100/73.

23. WATER ACT OF 1973, Art. 30(1).

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28. See footnote 17 supra.

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32. Koot et al, supra note 10.

33. WATER ACT OF 1973.

34. A. Kneese and B. Bower, supra note 27.

35. S. Kernacs, supra note 9.

36. WATER ACT OF 1973.

37. WATER ACT OF 1973, §3.

38. Decree No. 66-700, supra note 31.

39. Rept. of the Study Commission on Waterboards, supra note 20.

40. Id.

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42. A. Kneese & B. Bower, supra note 27.

43. Ruhrverband, Ruhr River Tasks and Organization, unpaginated.

44. A. Kneese & B. Bower, supra note 27.

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47. Federal Water Pollution Control Act Amendments of 1962, 33 USCA 1251-1376.

48. Nat'l Water Commission, supra note 6 at 442.

49. Id. at 451.

50. J. DAVIS, THE POLITICS OF POLLUTION, 120 (1970).

51. W. ROSENBAUM, THE POLITICS OF ENVIRONMENTAL CONCERN, 252 (1973).

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"Historically every local unit of government in the county held itself responsible for taking care of its own waste problems. . . with few exceptions, each local unit acted with only itself and its immediate needs in mind, either constructing some type of sewage treatment plant or discharging wastes into a body of water deemed capable of diluting or assimilating them. . . . The proliferation of local governments (250 municipalities in the Illinois portion of the Chicago metro area) h as resulted in proliferation of sewage treatment plants. Even in the urban region encompassed by the world-famous centralized metropolitan Sanitary District of Greater Chicago, there were 339 treatment plants in 1966." SHAEFFER, THE WATER RESOURCES IN NORTHEASTERN ILLINOIS, 36 (1966).

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62. NATIONAL WATER COMMISSION, SUPRA NOTE 6 AT 417; M. DERTHICK, supra note 57 at 134-157.

63. HOUSTON LAW REVIEW, supra note 54.

64. REYNOLDS v. SIMS, 377 U.S. 533, 84 S.Ct. 1362 (1964).

65. SALYER LAND CO. v. TULARE LAKE BASIN WATER STORAGE DIST. 410 U.S. 719, 93 S.Ct. 1224 (1973).

66. KRAMER v. UNION FREE SCHOOL DISTRICT, 395 U.S. 621, 89 S.Ct. 1886 (1969).

67. HARPER v. VIRGINIA BOARD OF ELECTIONS, 383 U.S. 663 (1966).

68. SAILORS v. KENT, Bk. of Ed. 387 U.S. 104.

69. Harper, supra note 67.

70. White, A Perspective of River Basin Development 22 Law & Contemporary Problems 157, 179 (1957).

71. Id. at 179.

WATER IN THE CLASSICAL BABYLONIAN LAW

Dr. Manuel Jordán Montañés

SUMMARY

- I -

1. The sociologists speak about a fluvial culture in which the communities live depending on their rivers. The water is used for irrigation and/or as a means of transport; their right gathers the standard which both matters establish.

Such is the case of Mesopotamia and Egypt, the governors there worried more about the distribution of water; the well-known channels of Babel - Psalm 136.

This is the reason for having chosen as theme, the Acadiaan-Sumerian law, and in it the epoch which corresponds to the first Babylonian dynasty of which there are several documents.

2. Above all there exists a fundamental well-known text: the Hammurabi Code (CH) and together with it an innumerable variety of contracts, sentences, administrative correspondence and private mail. The series "ana ittisu" meant for teaching the Acadian Scribes the sense of the Sumerian terms, deserves special mentioning; it constitutes an authentic "de verborum significatione" of which the value is incalculable.

3. The importance of water for the Babylonian people is demonstrated by CH's own prologue: there are twentyosix reasons for praising the king in it, and of those, half except one referred to his activity as water ordainer. When in the Hammurabi epilogue it defines its own politics, it says: "I made it possible for my people to recline on well-irrigated fields."

- II -

4. There does not exist water of private dominion; the water supply of subterranean water in the communities favor was one of the limits which rural propietors suffered. The administrative water authority was "rector of the fields", this depended on the Mayor and both, on the local council of which they formed part. The circumscription chief or first civil authority was superior to them.

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In Mari, the authority in water matters was not practiced by the civil authority but by the military chief, due perhaps to the strategy importance of the zone.

The administrative authority established the norms for the use of water, the extraordinary and ordinary works of maintenance. The execution of these last ones was in the continguous propietors charge; these had as a compensation, the fishing monopoly on the part of the channel which affected them.

5 The peak of the administrative hierachy was occupied by the King; among his numerous obligations the one which figured in the first place was that of taking charge of the water administration rights. When the customary norms were not enough the King substituted his lagoons by turning to the analogy and others to perform the will of the Gods. In the difficult cases he turned to the ordeals.

The water ordeal was, on the other hand, reserved for those who were accused of witchcraft and the investigation of women's adultery. Logically, the adultery convict ("woman who humiliated her husband by leaving him on a bad spot") is condemned to death by immersion. Curiously, the tavern-keeper's wife who adulterates the wine which she sells, is also punished to end her life in the water.

Among the sixteen different forms of robbery which are contemplated in the CH, that of robbing a horia or the bucket of a water-wheel is one of the most severely punished; remember the robbery delict of a proviewed well rope in the Manu Code.

- III -

6. In the private rght the watering relations contemplated by the CH, consist in determining the juridical effects of thw different classes of flooding and an article on watering the cattle which perplexes certain authors.

The floods caused by a major force are naturally attributed to the Rain God (Adad). In the case of renting, the floods do not alter at all, the circumstances of the contract. The tenant bears the loss integrally if this occurs after having paid the rent. On the contrary, or in the case of agricultureal partnerships, the owner of the field which is cultivated suffers the damage proportionally.

If the owner or tenant of the flooded camp has applied for a loan, the flood permits him to have a year's moratorium during which he will not pay any interests either even if there were any. The same solution is applied in the case of extraordinary drought.

7. The Babylonian right favored the walling-in of fields. If because of the deficient construction of a wall enclosure, the natural attendance of water became more grievous for his neighbour, then he had to pay for all the damage caused. If he didn't do this, then his field was sold to compensate those which had suffered damage.

The negligence of someone who in the process of watering his own field, floods of his neighbour, he is obliged to pay for the damage caused.

If on the contrary he acted deceitfully, he would be made to pay a fine proportioned to the surface which suffered the effects of the flood and, of course, very superior to the real value of the cultivation if there was any.

8. The hypothesis of the 58th article of the CH supponse that a shepherd takes his cattle out of one field, and takes it to drink in the town and takes it back immediately to the same field. In this case, two obligations would fall upon him: to cultivate the field and to hand in at the gathering season, a minimum amount per unite of surface.

The norm is based on the fact that the cattle may transport from the drinking place to the fields, micro-organisms which could affect it's fertility negatively. After a certain amount of time has passed since the moment of drinking, such possibility disappears,

- IV -

a) The sources of the Acadian-Sumerian law up to the present date are very numerous, and new ones come up every day.

b) An important part of the Babylonian norms are destined to the water laws, with regard to the economic structure of the Mesopotamic people.

c) It is necessary to investigate the official administrative correspondence and especially that which was interchanged between King Hammurabi and Sin-iddiman or Shamash-hasir to know exactly the outset which informed the water laws in the classical epoch of the Acadian-Sumerian juridical system.

Valencia, July, 1975