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Report No. 18322

**INDIA - WATER RESOURCES MANAGEMENT
SECTOR REVIEW**

REPORT ON

**INTER-SECTORAL WATER ALLOCATION,
PLANNING AND MANAGEMENT**

VOLUME I: MAIN REPORT

June 27, 1998

**Rural Development Unit
South Asia Region
World Bank**

**In Cooperation with
Ministry of Water Resources
Government of India**

CURRENCY EQUIVALENTS AND UNITS

Currency Unit	=	Rupee (Rs.)
US\$ 1.00	=	Rs. 35.50 (1997)

WEIGHTS AND MEASURES

1 hectare	=	2.47 Acres
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The metric system is used throughout the report.

FISCAL YEAR

Government of India
April 1 to March 31

Vice President	Mieko Nishimizu
Country Director	Edwin R. Lim
Sector Managers	Michael Baxter/Ridwan Ali
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ABBREVIATIONS AND ACRONYMS

AIIHPH	All India Institute of Hygiene and Public Health
APERP	Andhra Pradesh Economic Rehabilitation Project
BB	Brahmaputra Board
BBMB	Bhakra-Beas Management Board
BCM	Billion Cubic Meters
CBIP	Central Board for Irrigation and Power
CEA	Central Electricity Authority
CETP	Common Effluent Treatment Plant
CGWB	Central Ground Water Board
CMC	Calcutta Municipal Corporation
CMDA	Calcutta Metropolitan Development Authority
CMWSA	Calcutta Metropolitan Water Supply and Sewerage Authority
CPCB	Central Pollution Control Board
CTU	Central Training Unit
CWC	Central Water Commission
CWPRS	Central Water and Power Research Station
DALYs	Disability Adjusted Life Years
DOWR	Department of Water Resources
DVC	Damodar Valley Corporation
EAP	Environment Action Program
EIA	Environmental Impact Assessment
EMOS	Empresa Metropolitana de Obras Sanitarias (Santiago Water Agency, Chile)
EMP	Environmental Management Plan
GAMS	General Algebraic Modeling System
GEMS	Global Environmental Monitoring System
GFCB	Ganga Flood Control Board
GFCC	Ganga Flood Control Commission
GIS	Geographic Information System
GOI	Government of India
HDUG	Hydrologic Data Users Groups
IHH	Institute of Hydraulics and Hydrology
IIT	Indian Institute of Technology
ILGUS	Institute of Local Government and Urban Studies
IMD	Indian Meteorological Department
ISI	Indian Standards Institution (Bureau of Indian Standards)
IWS	Institute of Water Studies
MINARS	Monitoring of Indian National Aquatic Resources System
MOA	Ministry of Agriculture
MOEF	Ministry of Environment and Forests
MORAE	Ministry of Rural Areas and Employment
MOU	Memorandum of Understanding

MOUAE	Ministry of Urban Affairs and Employment
MOWR	Ministry of Water Resources
NABARD	National Bank for Agricultural and Rural Development
NGO	Non-Governmental Organization
NIH	National Institute of Hydrology
NRCP	National River Conservation Plan
NWB	National Water Board
NWDA	National Water Development Agency
NWP	National Water Policy
NWRC	National Water Resources Council
NWRDC	National Water Resources Data Center
O&M	Operations and Maintenance
OMVS	Organisation pour la Mise en Valeur du Fleuve Senegal (RBO for River Senegal)
PWD	Public Works Department
RBO	River Basin Organization
RGNDWM	Rajiv Gandhi National Drinking Water Mission
RWSS	Rural Water Supply and Sanitation
SAIFT	Systems and Agricultural Improvement and Farmer Turnover
SEWA	Self Employed Women's Association
SIFT	Systems Improvement and Farmer Turnover
SPARC	Slum and Pavement Dwellers' Association Resource Center
SPCB	State Pollution Control Board
SWPO	State Water Planning Organization
SWRB	State Water Resources Board
SWRDC	State Water Resources Data Center
THANNI	The Holistic Analysis of Natural Network Information
UFW	Unaccounted for Water
UNDP	United Nations Development Programme
UWSS	Urban Water Supply and Sanitation
UYRB	Upper Yamuna River Board
WALMI	Water and Land Management Institute
WHO	World Health Organization
WP&P	Water Planning and Project Wing (CWC)
WPC	Water Pricing Committee
WRCP	Water Resources Consolidation Project
WRRITP	Water Resources Research Innovation and Training Project
WRM	Water Resources Management
WUA	Water Users Association

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A first draft of this report was issued in 1997 and was followed by a series of workshops and reviews to discuss the report and progressively enhance the analysis and recommendations and their practical applicability in India. The principal discussion fora were: the "Brainstorming Session" held in the World Bank, Delhi office on November 18, 1997, jointly chaired by the World Bank and GOI; three consultation meetings sponsored by MOWR at Baroda, Ooty and Delhi in January 1998; the World Bank review meeting held in Washington on March 10, 1998, including teleconference link-ups with other World Bank offices and MOWR; and, finally, the "National Workshop on Improving Inter-Sectoral Water Allocation, Planning and Management" held in Mussoorie on May 12-13, 1998 and chaired by Arun Kumar, Secretary, MOWR. The World Bank and MOWR/CWC gratefully acknowledge the invaluable contributions made by the many government and non-government participants from different sectors in these various workshops. Following the National Workshop, this report has been further revised to reflect the recommendations emerging from the workshop.

Principal reviewers from the World Bank/FAOCP were: M. Baxter, R. Ali, S. Barghouti, F. Humplick, J. Briscoe, H. Plusquellec, A. Duda, R. Robelus, S. Salman, A. Subramanian, B. Blarel, L. Travers, O. Myint, D. Umali-Deininger, M. Imran, G. Spencer, I. Fraile, S. Balasubramanian, J. Olivares, R. Dubois, A. Kandiah and B. Appelgren. Principal reviewers from GOI comprised: B. N. Navalawala, Krishna Singh, P. Mohandas, R. S. Pathak, D. K. Chaddha, B. S. Minhas and S. R. Shukla. Lists of the participants in the National Workshop and the Brainstorming Session are provided in Volume II.

This report is one of five reports under the "India - Water Resources Management (WRM) Sector Review," task managed by C. Wood and K. Oblitas. The other four reports cover: (i) the irrigation sector, (ii) the rural water supply and sanitation sector, (iii) the urban water supply and sanitation sector, and (iv) groundwater regulation and management. A consolidated report, weaving together all five subject areas in an integrated framework will also be prepared.

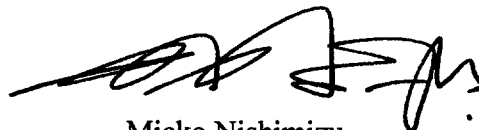
PREFACE

INDIA - Water Resources Management Sector Review Inter-Sectoral Water Allocation, Planning and Management Report

The manner in which countries manage their water resources is well recognized as increasingly crucial for overall economic development, social well-being and environmental sustainability. In India's case it is particularly so. The acceleration in India's economic growth is putting strain on its water resources, and inducing rapid changes in demand, particularly for the burgeoning urban population and the needs of high industrial growth. India, as in other rapidly growing countries, is facing increasing water constraints and competition between sectors, and its future will substantially depend on how it faces these challenges. They are not easy, and as this report abundantly illustrates, the challenge for India is particularly large. As discussed in the World Bank Policy Paper on Water Resources Management (1993), "new challenges call for a new approach", and the issues require a comprehensive framework and multi-sectoral perspectives for their resolution.

This report represents a team-work effort between the Government of India and the World Bank. Its preparation has involved extensive consultation in India and the Bank, culminating in three regional workshops and a final National Workshop, chaired by the Ministry of Water Resources and comprising broad representation from the states of India, different sectoral users and both government and non-government. This is a remarkable achievement and itself attests to the seriousness of India's intentions and the quality of debate underway in India and in the Bank.

The reform agenda discussed in the report is vigorous yet practical. It provides a comprehensive approach, both highlighting the short-term actions to commence the change process and the longer term vision for further reform. I am pleased that the environment has been strongly integrated in all the report's recommendations and that issues affecting women and poverty groups, often neglected by water professionals in the past, are emphasized. The report presents an excellent opportunity for India to tackle its water sector constraints. I expect it will provide a key reference document for many years to come, benefiting not only India but also other countries grappling with these important issues.



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June 26, 1998

PREFACE

For last several decades, the world as a whole has been expressing concern over exhaustible resources. In more recent years environmental issues have reinforced these concerns. Fresh water is a commodity which encompasses both the aspects of these concerns being the most vital resource for the very existence of life. In the five decades since Independence, India has witnessed phenomenal development of water resources and has successfully met the demand of water for diverse uses in the country. As a result, the country has achieved self sufficiency in foodgrains besides providing assured drinking water throughout the country except for a few problem areas. Investments made during the last fifty years in water related infrastructure in the country have resulted in rapid expansion of urban, energy and industrial sectors. Safe drinking water is now available to about 85% of India's urban and rural population. However, due to rapid growth of population, urbanisation and industrialisation, India's finite water resources are now getting stressed with declining per capita availability and deteriorating quality. This, in turn, is resulting in competing demands for diverse uses of water. Inter-sectoral allocations, planning and management of increasing fragile water resources has thus emerged as a major challenge before the nation. If India's aspirations for continued economic growth and improved social and environmental conditions are to be met and sustained, fundamental futuristic and urgent solutions will have to be found to meet this challenge.

While water has multifarious uses, the most important in terms of the quantities required and their essentiality are irrigation and drinking water supply including sanitation. The dimensions involved in the urban demand for drinking, sanitation, which includes the industrial purposes and those in the rural demand for water supply being at considerable variance, the subject of drinking water supply was discussed in two separate Workshops. Ground water development and management presents special challenges and formed a subject by itself in view of its cross-sectoral uses for drinking, as well as for industrial and irrigation purposes both in the rural and the urban areas.

The present report represents the culmination of a joint exercise undertaken by the World Bank and the Ministry of Water Resources, Government of India in reviewing the water resources sector with a view to evolving policies, strategies and Action Plan for its future development and management.

The workshop to finalise the report extensively discussed the existing practices in the country and shortcomings which are likely to affect the future availability and the stress that will result if no remedial measures are taken. Practices considered effective in other parts of the world have been presented as possible alternatives for careful examination and their adoption keeping the country's socio-economic background in view.

Valuable contributions were made in this exercise by the Union Ministries of Agriculture, Environment and Forests, Industry, Power, Rural Areas and Employment, Surface Transport and Urban Affairs and Employment, besides, the Ministry of Water Resources and its organisations, Planning Commission and concerned Departments of the States and Union Territories. I would like to thank the Government's Working Group, the World Bank Team, and officials of the Ministry of Water Resources, other concerned Ministries and Departments of the Union Government and the States and Union Territories for helping the Ministry of Water Resources in carrying out such an exercise and preparing proposals for action.

The report highlights, inter alia, the need for comprehensive, integrated, multi-disciplinary and multi-sectoral approach for development and management of finite and increasingly fragile water resources.

Secondly, it emphasised the need for planning, development and management on the basis of hydrological units such as river basin and sub-basin.

The need for involving stakeholders through conscious devolution of power by the Governments, which plays a predominant role at present is the next key recommendation. A paradigm shift in favour of participatory approach is recognised as the need of the hour.

For achieving the above mentioned objectives appropriate institutions need to be established. This will include the institutions at river basin level, in keeping with the recommendation of planning and management on a hydrological unit, enabling policy involvement including appropriate legislation and regulations which are necessary corollaries of this approach. Centre has to play an important role and should be, more than that of a friend, philosopher and guide. To make it more effective, use of necessary economic and other instruments has been suggested.

Need for technological upgradation, data base analysis, public information systems and exchange of data are among the other highlights. In this process the importance of environmental concern has not been lost sight of and these have been given their due place of pride.

While creation of facilities has often been addressed adequately, lack of dependable and sustainable services, which include timely maintenance either for want of funds or for lack of due attention, have been duly emphasised. Need for providing funds for the purpose has been suitably incorporated in the report.

That we have no options but recognise the emergent problems in the entire team and take decisive and innovative steps urgently to ensure that these problems do not overwhelm us, can perhaps bear repetition.

A handwritten signature in black ink, appearing to read 'Arun Kumar', with a horizontal line underneath it.

(Arun Kumar)

EXECUTIVE SUMMARY

THE NEED FOR BETTER MANAGEMENT

i. India faces an increasingly urgent situation; its finite and fragile water resources are stressed and depleting while different sectoral demands are growing rapidly. If India's aspirations for continued economic growth and improved social and environmental conditions are to be met, fundamental changes in how water is allocated, planned and managed must occur.

ii. This situation has developed incrementally, but is nevertheless dramatic. At Independence, population was less than 400 million and per capita water availability over 5000 cubic meters per year (m^3/yr). Today, fifty years later, population has grown to 945 million and per capita water availability has fallen to hardly more than 2000 m^3/yr . The situation is already critical at river basin and local levels: six of India's twenty major river basins have less than 1000 m^3/yr and environmental problems and localized shortages are endemic in all basins.

iii. Environmental problems include water quality degradation from agro-chemicals, industrial and domestic pollution, groundwater depletion, waterlogging, soil salinization, siltation, degradation of wetlands, ecosystem impacts, and various health-related problems. Environmental and health-related issues are less evident than the more visible quantity-related problems, but are critically important to social welfare and resource sustainability.

iv. The current inter-sectoral and inter-state constraints will build rapidly in the coming years. Population is expected to grow by some 40 to 50 percent before eventual stabilization, and will be combined with major changes in the composition of demand resulting from rising incomes, urbanization and rapid industrialization. Industrial needs will be a high economic priority; agriculture, with two-thirds of production dependent on irrigation and accounting for 83 percent of consumptive water use, continues to remain crucially dependent on water; and the availability of rural drinking water is a fundamental societal need. Conflict between sectoral uses—domestic needs in rural and urban areas, agriculture, industry, energy, ecological, flood control, navigation, fisheries, recreation, ceremonial and religious—is already a serious problem.

v. The past management of the country's water resources has been unable to cope effectively with these issues. Water has been developed rather than managed. Comprehensive management—on a river basin basis, multi-sectorally, conjunctively for both surface and groundwater, incorporating both quality and quantity aspects of water—is largely lacking. Cooperation between states sharing river basins has been limited and sometimes highly contentious. Management of water has been through a top-down approach and has become virtually a government monopoly. A "supply-side" approach—exploiting additional water resources—has been predominantly used. This

approach has resulted in major economic, social and environmental costs. In recent years, however, there has been realization regarding the need to address these problems.

vi. India has major achievements in the water sector to its credit. A major spurt in development of water infrastructure since Independence allowed India to harness much of the country's water resources. These investments have made a vital contribution to India's food security, taking India from a situation of frequent famines and social vulnerability in the 1950s and 1960s to a self-sufficient and even exporting country. Water infrastructure investments have also enabled the rapid expansion of the urban and industrial sectors and the increased availability of safe drinking water in rural villages. Further, as described in this report, a variety of policies, legislation and institutional initiatives have been taken by India to better manage its water resources as resource constraints have become increasingly apparent. In comparison to most other developing countries, it could be said that India's water resources management initiatives are more comprehensive than generally found elsewhere. The problem, however, is that almost in every country there is need for significant improvement. India's needs are particularly severe because of its rapidly developing water constraints, environmental problems, huge population, regional inequalities in water availability, the federal administrative structure, and rapid demographic and economic growth. In such circumstances, while much has been achieved, particularly on the development front, a great deal still remains to be achieved as regards water resources management. India can, and must, allocate, plan and manage its water resources better.

vii. The need to better manage the nation's water resources is well recognized by India's planners and policy-makers. This report, prepared jointly by the Indian Government and the World Bank and benefiting from a "Brainstorming Session", three regional consultation meetings and a "National Workshop" chaired by the Ministry of Water Resources (MOWR) and with multi-sectoral representation from across India (both government and non-government sectors), attests to the actions and broader thinking now underway. The need now is to translate these reflections and initiatives into a more comprehensive action agenda.

THE REFORM AGENDA

viii. There are two broad issues that need addressing. First, solutions must be found for competing inter-sectoral demands. Mechanisms must be developed for allocating scarce water resources between competing uses—irrigation, rapidly expanding domestic and industrial needs, hydropower, environmental requirements, etc. Second, water must be managed on a river basin basis, including between states sharing the same river basin.

ix. The findings of this report are that a comprehensive approach is required. A combination of mechanisms need to be used in the fields of: (i) policy; (ii) legislation and regulations; (iii) institutions; (iv) economic incentives; (v) technology; and (vi) data, analysis and public information. Detailed recommendations in each of these areas forms

the main subject matter of this report. Within this framework, several overarching attention areas have also emerged. First, a public-private sector partnership is required. The present almost exclusive domain of the public sector needs to broaden out to include the private sector—civil society groupings, academics, NGOs, industry, etc.—in decision-making and implementation. Second, decentralization, stakeholder participation, and involvement of grassroots organizations is required. Central to these will be the creation of public awareness, transparency of information and two-way flows of information, and maximal participation in decision-making and implementation by civil society and the various stakeholders involved. Third, the traditional “supply-side” oriented approaches of the past, where response to problems has been sought through primary reliance on exploiting additional resources, must be balanced by “demand management”: improving the productivity of existing resources through the combined use of technology, incentives, public awareness and other actions.

x. A key need is to develop a new “enabling environment” that can influence the myriad of actors involved: each and every household, private businesses, and the various social, administrative and political aggregations (villages, socio-economic strata, municipalities, districts and states). This will require establishing an “incentive framework” that influences these actors. Direct impact will be felt through financial incentives or regulatory actions actually enforced. These translate the policy, legislation, institutional and technical capabilities into impact at the level of the individual. The incentive framework must also provide the right directions for the higher organizational aggregates: state governments and their various water-related departments, river basin organizations, the different Central Government agencies, and grassroots organizations. For these, policies, legislation, institutional structures and interlinkages, approval processes, capacity building, information, and financial incentives and leverages, also come into play.

xi. The Action Plan discussed below has taken into account that, while initiatives are underway at the center and in some states, for most states and river basins, the country is starting largely from scratch as regards water resources management. The change process must recognize the realities from which change must commence. Many of the recommendations are, thus, start-up in nature, comprising primarily the short and medium-term agenda. These actions should not, however, be considered the end of the line. Policy-makers and implementors should keep in their sights the best examples of success worldwide, a number of which are discussed in the main text and in boxes in Volume II.

xii. As the reform program is implemented, a long-term vision needs to be in constant focus. As soon as possible, management of water resources in India will have to be on a river basin basis, including a sophisticated management apparatus, incorporating all sectoral uses and stakeholders and crossing state boundaries. The report’s recommendations start this process, but reported success stories such as the Murray-Darling Basin in Australia, including major emphasis on public awareness and participation, illuminate the possible further actions. The development of water policies,

legislation and regulatory structures in India should look to the world's best-practices, with appropriate adaptations for India's circumstances, even if a phased approach is required to get there. Pricing and other market allocation mechanisms need to evolve as quickly as possible to meaningful instruments guiding resource allocation and usage practices. Appropriate lessons in this regard can be drawn from the tariff structures used by the world's best-practice water utilities (e.g., Singapore, EMOS in Santiago, Chile, and initiatives underway in Buenos Aires, Argentina), water marketing arrangements found in the Western U.S.A. and Chile, and pricing as an environmental management mechanism in the Netherlands. A major drive is required to improve technology for increased productivity of water in all sectors, with lessons for agriculture from countries such as Israel, Jordan and California. Hydrological data and modeling capabilities must progress to the levels found in other advanced countries in the world. The eventual institutional structures in India will be a major transformation from the present and even the initial restructurings in the reform process: for instance, evolution to commercialized water services as found in some countries (e.g., U.S.A., U.K. and Chile); and government agencies eventually restricted to policy, planning and regulatory activities (e.g., the U.K. and evolving in a number of other countries). India's long-term sights must, necessarily, be far-reaching. The eventual goal must be the best, rather than marginal change. This will be essential, and has to be achieved as rapidly as possible if the nation is to achieve its social and economic objectives. The Action Plan summarized below will enable an energetic start in these directions.

ACTION PLAN

xiii. All reform areas—(i) policy, (ii) legislation and regulations, (iii) institutions, (iv) economic incentives, (v) technology, and (vi) data, analysis and public information—require attention, and mutually support each other.

xiv. **Improving the Policy Framework:** India's National Water Policy (NWP) (GOI, 1987) provides a broadly favorable environment from which to begin. It is in need of updating, but the principal problem is that it has not been translated into action. As per Entry 56 of List I of the Constitution, development and management of water is primarily a "State Subject," yet minimal action has been taken at state levels. Very few states have formulated a State Water Policy, and coherent agendas for improving water resources management are similarly absent. Not surprisingly, the implementation mechanisms for managing water are also absent or rudimentary in most states. It is recommended that each state prepare two guiding documents: (i) a State Water Policy responsive to its needs and in line with the principles of the NWP, and (ii) an Action Agenda outlining the specific actions intended. The Central Government should help guide the policy and reform agendas and update the NWP.

xv. **Strengthening the Legislative and Regulatory Framework:** The major gap is at state levels where the enabling legislative and regulatory framework for inter-sectoral

water allocation and management is largely absent. The areas where legislation needs review and revision and, in some areas, creation are:

- Amending legislation to enable: creation of new water allocation and sharing institutions; strengthened regulatory powers, pollution control measures, establishment of multi-sectoral water stakeholder associations, participation of private sector and civil society, and new forms of water tariffs, including volumetric charging;
- Establishing groundwater legislation and a regulatory framework for groundwater management;
- Assessing options for defining and making transferable surface and groundwater rights.

xvi. At central and inter-state levels, there is a need to adjust two existing Acts to enable the center to play a stronger catalyzing role in the creation of river basin organizations (RBOs) and the resolution of inter-state water disputes. The first priority should be to amend the River Boards Act. The Act should be amended to give powers to the Central Government to enable establishment of RBOs. RBOs could take many different forms, ranging from fairly informal structures facilitating dialogue and planning between states, to begin with, to more formal institutions with executive powers, possibly evolving to these over time. A second need is to adjust the Inter-State Water Disputes Act to substantially streamline Tribunal Award procedures within a mandatory time-frame. The adjustments to the Act should include provisions that: (i) the center can establish a Tribunal one year after receipt of a grievance from a riparian state if agreement is not reached between concerned riparian states, and (ii) following a Tribunal decision, a mandatory mechanism for effective implementation and monitoring of the Award is established.

xvii. **Establishing Government and Non-Government Institutions:** Institutional mechanisms need to be created or strengthened, particularly at state, grassroots and basin levels:

- **Creating State-level Institutions:** The most critical gap is at state levels where, apart from a handful of states, there is a complete absence of institutions to plan, allocate and manage water on a multi-sectoral basis and along river basin lines. The needs are: (i) establishing a multi-sectoral state-level institution comprised of a State Water Resources Board (SWRB) and its technical support unit—a State Water Planning Organization (SWPO)—including provisions for environmental capability; (ii) re-organizing the state bulk water supply agency (usually the Irrigation Department) along river basin lines and adjusting its mandate to include a broader role in water resources management; and (iii) creating river basin organizations for basins or portions of basins within the state.
- **Establishing Grassroots Institutions:** Grassroots institutions to implement local-level resource management initiatives need to be fostered. Many water resources management issues—e.g., conflicts between rural water supply needs and agricultural water pumping; or a local industry polluting village water bodies—have their origin and prospects for resolution at such micro levels.
- **Creating Inter-State River Basin Organizations (RBOs):** For all inter-state basins, riparian states should seek to form RBOs as a matter of priority, and should be strongly

encouraged, including provision of incentives, by the center. The report provides guidance on the wide range of models that could be followed, both internationally and from success stories in India.

- **Strengthening Central Institutions:** The Central Government apparatus needs to be more sharply focused to enable it to play a more pro-active role and to better integrate the activities of the different central agencies connected with water. The National Water Resources Council (NWRC) and National Water Board (NWB) need to be strengthened with an operational level Technical Committee and a permanent multi-sectoral professional Secretariat or National Water Planning Organization (NWPO). Also, MOWR and its agencies (e.g., CWC, CGWB and NWDA) should establish mechanisms for closer interaction.
- **Adjusting Central Government's Role:** The center's role should include fostering public participation and change through information and public awareness, and capacity building for local and state-level institutions. For state governments it would provide financial incentives, appropriate instruments and facilitation of state initiatives and capacity building through: (i) monitoring of state water resources reform agendas as part of Plan approval processes during consideration of water investment proposals; (ii) encouraging inter-state cooperation through usage of a River Basin Development Fund for multi-state basin developments where a RBO and basin plan exist; and (iii) providing technical assistance support and related financing of consultancies, training and equipment to states for their reform and capacity building programs.
- **Building Non-Governmental Participation:** This orientation should underlie all initiatives. Initially, given government's present monopoly role, the lead in this process will have to come substantially from government. Civil society, academia, NGOs, industrialists and water user groups should be brought into decision-making and institutions as quickly as possible. Particular attention should be given to fostering involvement of traditionally marginalized groups which have a large stake in water resources issues, such as women and the poor. As non-governmental participation is developed through public awareness and capacity building, and additional responsibilities are shouldered, the center and state institutions can modify their role accordingly.

xviii. **Introducing Economic Incentives:** Major change is required in the system of prices and other economic incentives affecting water use and allocation. Although price instruments exist, the levels of existing incentives and the form in which they are applied result in minimal, and in some cases negative, impact. There is urgent need to bridge this "incentive gap" through:

- **Intra-Sectoral:** (i) establish meaningful water prices (usually requiring significant increases) for irrigation, urban and rural water supply and sanitation, at least reflecting the costs of service provision and charged volumetrically; (ii) increase agricultural power tariffs and charge volumetrically to establish incentives for groundwater and power conservation; (iii) tackle distortions in agricultural commodity and input prices and domestic marketing policies currently encouraging excessive water use and regional imbalances; (iv) establish pollution taxes and other incentives to encourage

adoption of water conservation, treatment, reuse and pollution control practices; and (v) establish, where required, targeted measures to protect poverty groups.

- **Inter-Sectoral:** Develop economically-based water re-allocation systems by: (i) introducing economic analysis and compensation packages in administrative re-allocations; (ii) developing the brokering of compensated water trades (between, for instance, agricultural water users associations and industries or municipalities); and (iii) piloting, with appropriate social and environmental safeguards, voluntary water transactions through formal water markets.
- **Inter-State:** Encourage multi-component (including non-water investments) basin development plans for inter-state river basins enabling mutually beneficial gains.

xix. **Technological Improvements:** All water sectors have substantial room for improving the productivity of water use. A major drive should be launched in all sectors to: (i) increase water use efficiency; (ii) improve productivity of end use; (iii) employ water conservation, water treatment and water recycling and reuse technologies; and (iv) enable transfer and reuse between sectors.

xx. **Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information:** Significant improvement is also required in data and analysis, necessary to support all of the above actions. The main needs are to: (i) prepare river basin plans, state water plans incorporating river basin or sub-river basin plans within the state, and environmental management plans; (ii) strengthen hydrological measurement networks and institutions; (iii) establish performance and environmental monitoring systems for water provision services in all sectors; (iv) involve stakeholders in all water planning and allocation decision-making; and (v) launch a major public information program to educate and enlist the support of the general public for the reform agenda.

GETTING STARTED

xxi. The above Action Plan is presented in full in Matrix 2 of the main report, including state and central-level responsibilities and a suggested time-frame. Particularly at state levels, there will be need to take into account the specific circumstances of the state concerned. No uniform prescription or blueprint will be appropriate for all circumstances. The key need is to make a start. A strategic, but also opportunistic, approach will often be needed, tackling first those issues considered most important and susceptible to change. Some actions, however, are particularly critical at the beginning, as they provide a foundation for other subsequent steps (refer Diagram 2—"Getting Started").

xxii. **State-level Start-up Actions:** The first need in each state will be to set out a policy framework and Action Agenda. To this effect, an Interim Water Resources Task Team should be established quickly to assess the situation in the state and to draft two guiding documents establishing the agenda for change: the State Water Policy and the Action Agenda. These documents should be reviewed extensively within the state, including

consultation with civil society and major constituencies. The following actions will be likely short-term needs:

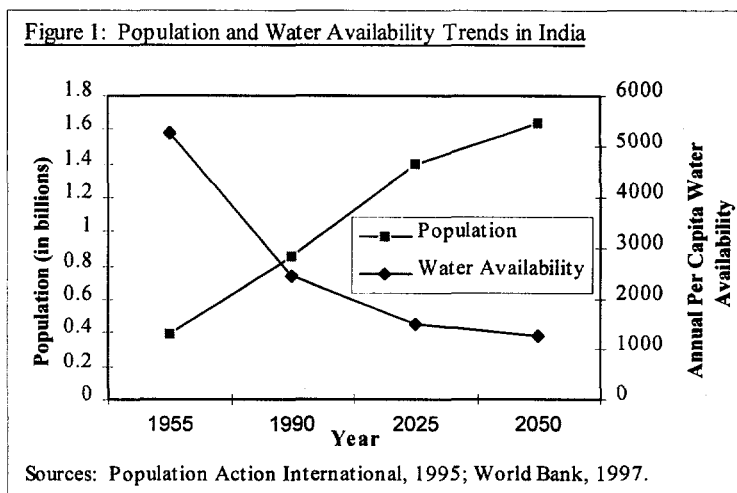
- Establish Institutional Capability: Forming a SWRB and its SWPO will be required to steer and implement further actions.
- Create Public Awareness: A multi-media campaign should be launched to create awareness and understanding of the changes required.
- Review and Establish Economic Incentives and Mechanisms: A review should be made of existing incentives for water use and conservation, focusing on areas particularly in need of change and where change can be introduced quickly.
- Initial Review of State Water Legislation: A review should be undertaken to identify key areas requiring change or enactment of new legislation, for example on groundwater protection and management.
- Launch Initiatives for Inter-State Basins: Possibilities will vary depending on the present degree of cooperation between the concerned riparian states. In all cases, some steps towards further cooperation are possible and should be identified and undertaken.
- Introduce Technological Improvements: A quick review should be undertaken in all sectors of opportunities for enhancing productivity and water use efficiency.
- Improve Modeling, Data, Performance and Environmental Monitoring, and Public Information: Identify the state-specific actions needed and implement.

xxiii. Central-level Start-up Actions: Actions in the short term should be to help create awareness of the issues amongst civil society and government. At the level of the states, it would provide technical assistance and create financial incentives and levers encouraging change. At the central level, it would make targeted adjustments in the institutional structure and legislation. To get these actions underway, a cross-ministerial Interim Water Resources Task Team should be established to prepare a short-term Action Agenda for Central Government's role. The following actions will need to be at the forefront:

- Public Awareness: A vigorous program to this effect should be launched, including use of media, literature, workshops and study tours.
- Guidance and Capacity Building: This will require multi-disciplinary capabilities, and an advisory role ranging from the general and conceptual to highly specific advisory capability to help states devise and implement specific actions. The center should also help train and build capacity of local-level institutions.
- Funding for State Initiatives: A funding provision should be provided for ready access by states to finance initiatives at the state or basin level.
- Applying Approvals Leverage: Develop and apply in the Plan-approvals process a system for monitoring state progress in water resources management reform.
- River Basin Development Funding: Provide centrally-sponsored-scheme Plan funding for multi-state river basin development where RBOs and basin plans exist.
- Reviewing Existing Legislation and Procedures: Amendments of the River Boards Act and the Inter-State Water Disputes Act should be a priority.
- Strengthening Central Institutions: The short-term need is to establish or strengthen capacity to handle the areas above, including making the NWRC more operational.

I. THE NEED FOR BETTER MANAGING INDIA'S WATER RESOURCES

1.01 This report¹ addresses an increasingly urgent situation in India: stressed and depleting water resources faced by rapidly growing demand. This situation has developed incrementally, but is nevertheless dramatic in its impact. As shown in Figure 1, India's population at Independence was less than 400 million. Now, fifty years later, India's population stands at some 945 million and is projected to grow to some 1.4 billion by year 2025.² Water availability per capita was over 5000 cubic meters (m³) per annum in 1950. It now stands at hardly more than 2000 m³ per capita, or only 40 percent of water availability at Independence. By year 2025, per capita availability is projected at only 1500 m³ per annum or 30 percent of availability levels at Independence.³



1.02 Such aggregate indicators only partly illustrate the development of water constraints in India. Annual averages do not reflect the extreme temporal variability in rainfall (dry versus monsoon seasons) or the inequalities between basins and regions in water resources endowments. While resources may be plentiful in such areas as Eastern and Northeastern India, in other areas rainfall is unreliable and in some areas acutely short. Utilizable water is further reduced by difficulties in capturing run-off and problems of water pollution. Substantially exacerbating the situation is the concentrated nature of human settlement and economic growth. There are now few states or river basins in India where water availability or quality issues are not present.

¹ This report represents the combined outcome of a joint work program between the Government of India (GOI) and the World Bank. It is one of five reports under the "India - Water Resources Management (WRM) Sector Review." The other four reports cover: (i) the irrigation sector; (ii) the rural water supply and sanitation sector; (iii) the urban water supply and sanitation sector; and (iv) groundwater regulation and management. A consolidated report, weaving together all five subject areas in an integrated framework, will also be prepared.

² World Bank, 1997a and 1998g.

³ The water availability index does not incorporate factors, such as water quality, which affect effective water supply, e.g. surface water pollution in India has been found to be linearly related to GDP growth which increased threefold between 1963-1990 alone (Brandon and Hommann, 1995). It is, therefore, reasonable to assume that the index represents an upper bound on per capita water availability.

1.03 Examples of water constraints in India abound. In states such as Punjab, Haryana, and Tamil Nadu and in large localities of most other states in India, the dominant issue is no longer how to develop water resources, but rather how to manage them within already full utilization levels and to allocate such resources between competing uses. Conflicts between different sectoral and regional uses are now wide-spread, as illustrated in Box 1.

Box 1: Examples of Emerging Water Issues and Imbalances in India

- The decades-old disputes between states have still not been resolved. Even where Tribunals have proposed Awards, implementation is proving difficult.
- In some basins, the riparian states are investing massively and disjointedly in new construction simply to lay claim on future utilizations. Meanwhile, more pressing needs, such as maintenance and modernization of existing systems, are neglected.
- Chennai (formerly Madras) is regarded as acutely water short, and is clearly so if considered from the perspective of existing per capita consumption. Gross water availability (i.e., not including system losses that are at least 50 percent) is 440 million liters per day, for a population of approximately 4.5 million. Water is now being transported to Chennai from another basin, the Krishna, and consideration has been given to inter-basin transfers from even further afield. Yet, immediately adjacent to Chennai are large water aquifers from which farmers pump groundwater, with electricity provided free of charge, to intensively water two or more crops of paddy per annum.
- Delhi's water needs are increasingly encroaching upon agricultural consumption, but without formal mechanisms to achieve this harmoniously.
- Irrigation efficiency on India's surface irrigation schemes is typically only 30 to 40 percent, and unaccounted for water losses in domestic supply schemes range from 30 to 50 percent.
- In Jaipur, which obtains nearly all of its water from groundwater, the aquifer is being depleted rapidly and is also being severely polluted due to inadequate sanitation facilities.
- In Kondenahally village in Kolar Taluk, Karnataka, illustrative of many other villages around India, less than five percent of the village households are pumping groundwater to intensively water their agricultural crops. This has depleted groundwater levels, resulting in the village drinking water wells successively going dry. Yet the villagers have still not found a grassroots mechanism to sensibly regulate water usage for agriculture and protect the needs of the majority. And the government is still providing power for agricultural pump sets free of charge.
- In Maharashtra alone, 0.7 million people suffer from water-related illness, out of which almost a thousand die each year. Pollution of drinking water, inadequate maintenance of water delivery systems, and poor sanitation facilities are the principal causes.
- The lakes of Udaipur are no longer teeming with the Mahaseer fish, otters, crocodiles and migratory birds and flamingos as they once were, due to contamination by industrial and human wastes.
- For many water sustainability, environmental, or public health water issues, the general public has limited understanding of the nature of the issues and their consequences. The threat of salinization from rising groundwater levels in Northern India, for instance, is not understood by the general population until the water table has reached the root zone, already late for remedial actions.

1.04 Under its current water management practices, India is facing serious water constraints. Yet India is not really water scarce. The present per capita availability of water in India of approximately 2200 m³ per annum,⁴ actually compares quite favorably with a number of other countries. As shown in Box A1.2, per capita availability in many countries throughout the world is far less than in India. Yet, a number of these countries (e.g., Jordan and Israel) have by and large managed to harness their water resources to

⁴ World Resources Institute, 1997.

support intensive agriculture, to fulfill drinking water and sanitation needs of both rural and urban populations, and to satisfy the needs of industry. The handling of environmental issues has also been managed more successfully.

1.05 India has major achievements in the water sector to its credit. Significant infrastructure was created in the 19th century, and even much earlier, and is still serviceable. There has been a major spurt in development of water infrastructure since Independence, allowing India to harness much of the country's water resources. These investments have made a vital contribution to India's food security, taking India from a situation of frequent famines and social vulnerability in the 1950s and 1960s to a self-sufficient and even exporting country. Water infrastructure investments have also enabled the rapid expansion of the urban and industrial sectors and the increased availability of safe drinking water in rural villages. Further, as described in this report, a variety of policies, legislation and institutional initiatives have been taken by India to better manage its water resources as resource constraints have become increasingly apparent. In comparison to most other developing countries, it could be said that India's water resources management initiatives are more comprehensive than generally found elsewhere. The problem, however, is that almost in every country there is a need for significant improvement. India's needs are particularly severe because of its rapidly developing water constraints, environmental problems, huge population, regional inequalities in water availability, the federal administrative structure, and rapid demographic and economic growth. In such circumstances, while much has been achieved, particularly on the development front, a great deal still remains to be achieved as regards water resources management. India can, and must, allocate, plan and manage its water resources better.⁵

1.06 The need to better manage the nation's water resources is well recognized by India's planners and policy-makers, and in particular in the 1987 National Water Policy. This recognition has, however, not been effectively translated into action. India's policy-makers have, thus, called for more comprehensive measures, to which this report responds. This report is the culmination of a joint work program between the Government of India (GOI) and the World Bank and incorporates the comments and recommendations from a series of workshops chaired by the Ministry of Water Resources (MOWR) and attended by state and Central Government representatives, NGOs and academics: a "Brainstorming Session" held in Delhi on November 18, 1997; three consultation meetings sponsored by MOWR at Baroda, Ooty and Delhi in January 1998; and the "National Workshop for Improving Inter-Sectoral Water Allocation, Planning and Management" held in Mussoorie on May 12-13, 1998. It also includes the findings of the GOI/Central Water Commission-chaired Sub-Committee on Inter-Sectoral Water Planning and Allocation (GOI, 1997a).

⁵ Refer to "Water Resources Management," World Bank Policy Paper (World Bank, 1993b) for general overview and guidance on water resources management issues and policy.

The Issues Framework

1.07 From this work program and its various discussion fora, it has been found that two broad issue areas need addressing:

- **finding solutions for competing inter-sectoral demands.** Mechanisms must be developed for allocating scarce water resources between competing uses—irrigation, rapidly expanding and highly specific domestic and industrial needs, and other uses such as hydropower, navigation, etc.
- **allocating, planning and managing water on a river basin basis, including between states sharing the same river basin.** Inter-state mechanisms must be found for handling geographic disparities in water use and availability between different states sharing the same river basins.

Both issue areas require addressing not only water quantity, but also water quality and environmental considerations. In addressing these issues, comprehensive approaches are required, recognizing river basins as hydrological units and the integral nature of surface and groundwater resources. Solutions also need to be found within the realities of India's administrative structures: state boundaries that do not match river basin boundaries, and even within states, the very location-specific nature of water allocation issues requiring grassroots participation for their effectiveness. Much can be learned from already existing examples of successes and inadequacies both from within India and in other countries.

1.08 The findings of this report, as discussed in the following chapters, are that the resolution of India's water resources management problems is not an easy task. In common with most other countries, water resources management is fraught with difficulties. By its nature, water is multi-dimensional. It involves users from different sectors with widely different needs: millions of individual households and firms, each acting in its own interest in response to the physical and incentive environment within which it is situated; multi-layered levels of social organization and public administration, ranging from village and societal groupings to local administrations, such as panchayats, and to larger aggregates such as blocks, municipalities, districts, states and the nation as a whole; government administrations where executive responsibilities for water are typically and perhaps necessarily split between many different government departments; and a question of the respective roles of government, civil society and the private sector. India's task is made all the more difficult by its enormous population and its federal administrative structure. The undoubted virtue of democracy, which is one of India's blessings, can sometimes make decision-making more difficult. Pragmatic and often unique solutions will need to be found by India.

1.09 As India addresses the changes required, it will be important to keep in constant focus and comparative review the status of water resources management found in countries that have successfully dealt with the issues that India faces now. Based on these countries'

experiences, it will usually be found that change has been a step-wise and evolutionary process. Nevertheless, such examples can form reference points for India's long-term vision. A number of international examples are given in this report: successful river basin organizations and stakeholder participation; highly evolved pricing and water allocative mechanisms that effectively guide resource use and pollution control; and institutions that have evolved over time to commercial entities for water service provision, with government roles redefined to functions such as planning and regulatory activities. A number of the report's recommendations represent start-up actions towards these goals, but the long-term objectives should be kept in constant sight.

1.10 Several core themes have emerged from the analysis and discussions leading to this report. Improving water allocation, planning and management in India, both between sectors and between riparian states, requires first and foremost a **comprehensive approach, using in combination a number of mechanisms, in the fields of: (i) policy, (ii) legislation and regulations, (iii) institutions, (iv) economic incentives, (v) technology, and (vi) data, analysis and public information.** Detailed assessment of what needs to be done in each of these areas forms the report's main analytical framework. Within this framework, however, several broad attention areas have also emerged from the analysis. One aspect is that a **public-private sector partnership** is required. The present almost exclusive domain of the public sector needs to broaden out to include the private sector—civil society groupings, academics, NGOs, industry and other entities such as water users associations—in decision-making and implementation. Second, centralized bureaucracy needs to devolve to a more participatory approach: directions emerging from this analysis include greater degrees of **decentralization, stakeholder participation and involvement of grassroots organizations.** Third, the traditional “supply-side” oriented approaches of the past, where response to problems has been sought through primary reliance on exploiting additional water sources, needs to be balanced by much greater emphasis on **“demand management”**:⁶ finding ways to improve the productivity of the existing resources through the combined use of technology, incentives to encourage conservation and more efficient utilization, public awareness, and other actions.⁷

1.11 Also emerging from the analysis is that the change process towards better management of water resources can only partly be directed. An essential need is to establish an **enabling environment for change** within which the myriad actors involved can be influenced. Key to this is the **incentive framework**. For the individual, economic and financial incentives are particularly important, but they are not the only factors. Regulation based on legislation and institutional capacity to apply such regulation is also

⁶ An overview review of demand management opportunities, including world-wide examples, is in Postel (1992).

⁷ “Demand management” does not preclude also augmenting water supply through harnessing additional sources of water (referred to as “supply-side” solutions). The key point is that the past almost exclusive reliance on supply-side solutions is missing a major opportunity to enhance effective water availability through better management and utilization of existing resources.

required. Policies, technology, and, above all, institutional structures to implement all of the above are also required.

1.12 Given that the central need is to introduce comprehensive measures to handle water resources issues in India, the report will assess the needs and options in terms of the intervention areas described in para. 1.10: (i) policies, (ii) legislation and regulation, (iii) institutions, (iv) economic incentives, (v) technology, and (vi) data, analysis and public information. Within this framework, the other attention areas mentioned above are also discussed. In the following chapter, the existing water resources issues and constraints are further examined. Chapter III discusses the intervention mechanisms currently in place in India and assesses their adequacies. Chapter IV explores the options that are available given India's particular circumstances. In Chapter V, based on the preceding analysis, a Strategy and Action Plan is proposed to establish an enabling environment and a process of change to rectify current inadequacies and build on existing positive initiatives.

II. THE RESOURCE SITUATION AND EMERGING ISSUES

2.01 Resolving India's water allocation, planning and management issues needs to take account of the current resource situation and the issues that have emerged in recent decades. As discussed in Chapter I, the issues are cumulative in impact and progressively exacerbated by the narrowing scope for manoeuvre. A finite resource base has been subjected to rapid development, primarily for irrigation, over the past few decades. Resources are no longer plentiful and constraints exist in most basins. Meanwhile, water demand has grown rapidly, and particularly rapidly in the case of the non-irrigation sectors. This chapter reviews the present water availability situation (Section A) and the issues that have developed over time: sectoral water demand trends and emerging inter-sectoral issues (Section B), the development of inter-state water issues (Section C), and the increasingly complex web of environmental issues confronting the sector (Section D). The costs of inadequately managing these issues are discussed in Section E.

A. WATER RESOURCES ASSESSMENT

2.02 Rainfall: The average annual rainfall in India is about 1170 mm. There is considerable variation in rain both temporally and spatially. Most rain falls in the monsoon season, confined to three or four months in the year, necessitating the creation of large storages for maximum utilization of the surface run-off. Within any given year, it is possible to have both situations of drought and of floods in the same locality. Regional variations are also extreme, ranging from a low value of 100 mm in Western Rajasthan to over 11,000 mm in Meghalaya in Northeastern India. Higher rainfall is found in Eastern and Northeastern India and some deltaic localities—for instance, Assam, eastern parts of Uttar Pradesh, Bihar, West Bengal, Northern Orissa, and the Cauvery delta—where rainfall is typically greater than 1000 mm. In Western India—Punjab, Haryana, Western Uttar Pradesh, and Rajasthan—and in rainshadow areas of the Deccan plateau, rainfall ranges from 300 mm to 800 mm.⁸

2.03 Surface water: India's average annual surface run-off generated by rainfall and snowmelt is estimated to be about 1869 BCM. However, it is estimated that only about 690 BCM or 37 percent of the surface water resources can actually be mobilized. This is because: (i) over 90 percent of the annual flow of the peninsular rivers and over 80 percent of the annual flow of the Himalayan rivers occur over a four-month period; and (ii) potential to capture such resources is complicated by limited suitable reservoir sites. Water availability is highly variable, with the Himalayan rivers being semi-perennial due to snow-melt supplies as well as rainfall, while most peninsular rivers are dry for about eight months

⁸ Such regional variations have evident impacts for all water users. For instance, in agriculture, in the higher rainfall areas of India, supplemental irrigation has a positive impact on agricultural productivity because of the unpredictability of and gaps between monsoon showers. In dryer areas, irrigation is essential for achieving high productivity agriculture.

of the year. Utilizable run-off is very variable. For some rivers a substantial part of run-off is being or could be utilized. By contrast the Brahmaputra-Barak, due to its flood flow nature, may only be able to utilize 24 BCM out of its average annual flow of 586 BCM.

2.04 Groundwater: India's rechargeable annual groundwater potential has been assessed at around 452 BCM in aggregate terms. About half of this amount is located in the Ganga-Brahmaputra-Barak system. On an all-India basis, again using aggregate figures, it is estimated that about 30 percent of the groundwater potential has been tapped for irrigation and domestic use. However, these figures are substantially influenced by the surplus areas of Eastern and Northeastern India. The regional situation is very different and large parts of India have already exploited almost all of their dynamic recharge. Haryana and Punjab have exploited about 94 percent of their groundwater resources. Areas with depleting groundwater tables are found in Rajasthan, Gujarat, most of Western Uttar Pradesh, and in all of the Deccan states. In Tamil Nadu and Karnataka, for instance, basins with falling groundwater tables are increasingly found and are already negatively impacting sources of rural water supply and groundwater irrigators. Resource depletion trends are quite alarming. For instance, in 1984-5, 253 of the 4272 administrative blocks were classified as "over-exploited" or "dark" (i.e., seriously depleting) in the Central Ground Water Board's classification system.⁹ By 1992-3 this number had reached 383, representing an increase of over 50 percent. The converse situation—rising groundwater tables and salinization—are also increasingly found in India, due to poor drainage or the cumulative impact of irrigation. In particular, this is a problem in localities of Northern and Western India: for instance, in Uttar Pradesh, Haryana, Punjab, and Rajasthan. Paradoxically, these are amongst the same states where the more general and widespread problem of depletion is found.

2.05 Water Resource Availability: India's current and future situation can be gauged by the trend in water availability, already shown in Figure 1. More revealing still is analysis by river basin. Occurrence of water availability at about 1000 cubic meters per capita per annum is a commonly taken threshold for water indicating scarcity (UNDP).¹⁰ Based upon this criterion and water availability assessment, presently six of India's twenty major river basins—namely, Sabarmati, east-flowing rivers between Pennar and Kanyakumari, Pennar, east-flowing rivers between Mahanadi and Godavari, Cauvery and west-flowing rivers of Kutch and Saurashtra including Luni—fall into this category (refer Box A1.1). By the year 2025, five more basins will become water scarce. According to one estimate, by 2050 only

⁹ The total number of blocks does not include Andhra Pradesh, Gujarat and Maharashtra. The number of over-exploited and dark blocks/talukas/mandals/watersheds does not include blocks in Kerala and Maharashtra, mandals in A.P., talukas in Gujarat and watersheds in Maharashtra. The groundwater resource situation is discussed in more detail in the "India - Water Resources Management (WRM) Sector Review, Groundwater Regulation and Management Report" (World Bank, 1998d).

¹⁰ Falkenmark, 1989.

the Brahmaputra, Barak, and west-flowing rivers from Tadri to Kanyakumari would be water sufficient.¹¹

2.06 Investment to capture additional surface run-off will become increasingly more difficult and expensive in the future. This is a natural consequence of India's past success in developing its irrigation sector. The massive investment in irrigation development since the 1950s, which resulted in surface irrigation expanding from 16 million hectares in 1951 to an estimated 45 million hectares by 1996,¹² is now reaching practical limits in many of India's river basins. Further investment in water augmentation is now no longer possible in some states and basins. Even where significant expansion remains feasible, the development options are usually more technically difficult and costly. As described above, groundwater resources are also increasingly limiting. The expansion of groundwater usage has been even more dramatic than that of surface water. From 1951 to 1996 groundwater irrigated area expanded almost seven-fold, from 6.5 million hectares to an estimated 44.3 million hectares.¹³ In short, for both surface and groundwater resources, the earlier situation of substantial under-utilization and considerable development potential has been transformed in little more than a generation to a situation of constrained water resources and limited development options.

2.07 Impact of Global Environmental Trends on Water Availability: In long-term planning, the possible impacts from global warming and other predicted or observed long-term trends on water availability also need consideration. Changes in rainfall patterns in the coming decades could affect India. In Northern India, snow-melt patterns from the Himalayas may change, altering the timing of run-off. Box A1.3 discusses some of the global water issues involved, which should also be integrated in India's basin modeling and national planning perspectives.

B. SECTORAL GROWTH TRENDS AND EMERGING INTER-SECTORAL ISSUES

2.08 The historical situation in which relatively plentiful water resources have been used primarily for irrigated agriculture, with demands in other sectors insignificant relative to resource availability, is changing rapidly:¹⁴

- Expanding Domestic Demand: Domestic (urban and rural) water use is at present 25 BCM or about 5 percent of utilizable water consumption. This is expected to rise to

¹¹ Refer Indian Water Resources Society (1997). These water availability indices are for surface run-off only. Groundwater resources are not taken into account. Counter-acting this, actual surface water availability is only about 37 percent of the total run-off figures used for these estimates.

¹² This figure is the (targeted) created irrigation potential; 39.1 million hectares is the (targeted) utilization (CWC, 1996).

¹³ This figure is the (targeted) created irrigation potential; 40.8 million hectares is the (targeted) utilization (CWC, 1996).

¹⁴ Figures on sectoral demand trends are from the report prepared by the GOI/CWC-chaired Sub-Committee on Inter-Sectoral Water Planning and Allocation (GOI, 1997a).

about 52 BCM by 2025. While still relatively small compared with irrigation, these demands are by their nature a basic and essential need. Domestic water supply must be 100 percent reliable, has high quality requirements, is location-specific, and, especially for large cities, is spatially concentrated.

- Rapidly Growing Industrial Requirements: The current water demand of 67 BCM for industry, energy generation and other uses is projected to grow at a rate of 4.2 percent per annum, reaching approximately 228 BCM by 2025.
- Continuing Pressures for Irrigation Expansion: Water use in irrigation stood at 460 BCM in 1990 or approximately 83 percent of total water consumption. Based on government's current development plans, irrigation's usage would increase by approximately 70 percent to 770 BCM by 2025.
- Needs for Other Uses: Other uses—for instance, ecological, hydropower, navigation, fisheries, flood control, recreation and ceremonial—although not significant in terms of consumptive use, will continue to be important and have specific quantity, quality and temporal needs.

2.09 The above sectoral planner's figures would result in total demand for water increasing from the current 552 BCM to 1050 BCM by 2025. This would represent virtually the entire utilizable resources of the country, casting some doubt on the ability to meet projected demand in all of these sectors. What is clear, however, is the rapid increase in non-irrigation demands. Consumption for industry and domestic purposes is expected to increase about three-fold and its share of overall water consumption to increase from 17 to 27 percent.

2.10 Alterations in water requirements and relative claims by sectors is partly a reflection of their changing significance in the economy and India's process of development. Although industrial development was quite slow in the years following Independence, industrial growth rates have accelerated in recent years, exceeding agricultural sector growth and peaking at 11.6 percent in 1995-6. This is resulting in a role reversal between the industrial and agricultural sectors. Agriculture remains the major employer in India's economy, with about 67 percent of the labor force, compared with 13 percent for industry.¹⁵ However, as shown in Box A4.1, the industrial sector now exceeds the agricultural sector in terms of its contribution to India's economy. Rapid industrialization, accompanied by urban migration, has been a driving force behind India's consistently strong macro-economic performance.¹⁶ Industrialization is the main trend in India's development and the basis for future economic growth and the generation of employment. Nevertheless, irrigation has been the principal engine of growth for the agricultural sector and its role will remain crucial in the future.

¹⁵ World Bank, 1997a.

¹⁶ In 1996-7, India experienced GDP growth rates of approximately 7 percent for the third consecutive year (World Bank, 1997a), a level that the Indian government aims to sustain as indicated in the Ninth Five Year Plan.

2.11 Current water resource constraints, therefore, can be expected to manifest themselves even more rapidly in the coming years. While population growth rates have stabilized and are expected to gradually diminish over the next several decades, the composition of demand is significantly changing as a result of rising incomes and of rapid urbanization¹⁷ and industrialization, with exacting requirements in terms of high reliability, water quality, and the localities where water must be delivered. Such developing requirements do not necessarily coincide with the natural distribution of water resources. In the first two decades after Independence, such developments were less marked, and, more importantly, as resource availability often exceeded local demands, there was still substantial room for finding ad hoc solutions to meet specific needs. Now, as the gap between the availability of water resources and the demands on such resources narrows, such an ad hoc approach to water allocation, planning and management is no longer tenable. Competition for water between urban and agricultural sectors will be a major challenge in the forthcoming century. Further, expansion in irrigation, industry, and domestic water demands will have serious implications for competing non-consumptive uses, such as hydropower.¹⁸ Weaknesses and inefficiencies in existing institutional and operational mechanisms for allocating and re-allocating water between sectors will have to be rectified.

C. INTER-STATE WATER ISSUES

2.12 Inter-State Cooperation: The second broad issue is the competition for water between riparian states in a river basin. The catchment areas of all major river basins in India are located in more than one state, and many rivers have a number of riparian states. For instance, the Ganges basin is shared between eight of India's states (Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Delhi, Madhya Pradesh, Bihar and West Bengal) and is also shared with Nepal, Bangladesh and China; the Krishna Basin is shared between Maharashtra, Andhra Pradesh and Karnataka; and the Cauvery is shared between Karnataka, Tamil Nadu, Kerala and Pondicherry. It is well recognized that water planning and management needs to be done on a river basin basis, and this is clearly stated in India's National Water Policy. In India's Constitution, regulation and development of inter-state rivers and river valleys, to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest, is a "Central Subject." However, subject to the above, water is a "State Subject" and under India's administrative structure, the states have substantial autonomy over water usage within their jurisdiction (refer paras. 3.07 and 3.08). Complicating this is the very limited

¹⁷ Current urban population is 244 million, or 26 percent of total population. Urban population growth rate is 3.1 percent per annum, significantly higher than overall population growth rate (approximately 2 percent), and urban population is projected to grow by a factor of three from the present level to some 658 million by the year 2025. "India - Water Resources Management (WRM) Sector Review, Urban Water Supply and Sanitation Report" (World Bank, 1998e).

¹⁸ The actual and potential timing conflicts between hydropower and irrigation are a particularly difficult problem.

development as yet of administrative structures for managing water on a river basin basis and especially across state boundaries. As a result, there is limited cooperation between states for cross-state riparian issues.

2.13 In the early decades after Independence, the limited institutions and legal structures for holistically managing water on a river basin basis and especially across state boundaries did not materialize as major constraints. This was primarily because in most river basins potential for further development was still present, enabling piece-meal investment and usage without the appearance of conflict. In few basins does this remain the situation. In some basins, for instance the Cauvery and Krishna basins, inter-state riparian competition has been highly visible for some time. In most other basins, recognition of actual or potential competition between states is growing, but the instruments to deal with this are still rudimentary. This situation is further exacerbated by the mounting pressures from urban and industrial demands, also crossing state boundaries. The needs of Chennai (formerly Madras) are now being partly met by water from the Krishna basin outside Tamil Nadu State. The growing water needs of Delhi will need to be serviced from such states as Haryana, Punjab, Uttar Pradesh and Himachal Pradesh. The need to build inter-state cooperation is further accentuated by rapidly growing environmental issues.

2.14 Inter-basin Transfer of Water: Inter-basin transfers of water from surplus basins to deficit basins have been considered a solution to regional and inter-basin disparities in water availability. However, the necessity to construct large reservoirs to store monsoon flows and to divert water involves enormous economic, social and environmental costs. Additionally, concurrence of the basin states on the fact that the basin is indeed surplus and on the extent of that surplus is also required. This is a politically sensitive and difficult task given states' reluctance to relinquish water perceived as rightfully theirs. A recognition of these problems has yet to take hold in India and be translated into a study of more cost-effective, feasible options.¹⁹ These include water-saving technologies in irrigation and industry, recycling and reuse of municipal and industrial wastewater, agronomic options (e.g., improved water management, agronomic practices requiring less water, and the introduction of less water-intensive crops), and watershed and groundwater management (e.g. groundwater recharge).²⁰ Technology improvement, water conservation and reuse and other forms of demand management need to be given much more emphasis than the traditional supply-side oriented approaches of the past.

¹⁹ This does not preclude the option of inter-state basin transfers where economically, socially and environmentally feasible.

²⁰ A further concept is the possibility of "virtual water" import through foodgrains and industrial products from water surplus to water-short basins, as discussed by Tony Allan (London's School of Oriental and African Studies).

D. ENVIRONMENTAL AND HEALTH-RELATED ISSUES

2.15 An important set of issues that permeate the two major areas above relate to the environment. They include issues of water quality ranging from agro-chemical, industrial and domestic pollution; impacts of water use on groundwater levels (including depletion or conversely waterlogging and salinity); soil erosion and siltation; degradation of wetlands; impacts on flora and fauna; and various health-related problems. Many of these problems are less evident to the general population than the more visible quantity-related issues. Groundwater-related issues, for instance, are gradual in impact. Rising water tables in Northwest India due to over a hundred years of irrigation have only in some localities reached the root zone, yet if this trend continues without appropriate drainage, large tracts of currently irrigated lands will become salinized and go out of production. Similarly, the impacts of pollution are only gradually perceived, yet the costs in terms of human and environmental health can be enormous.

2.16 Water quality and quantity issues are inter-linked. The preservation of water quality has direct implications for water supply as water quality determines effective water availability. Similarly, a minimum quantity of water is required to maintain the assimilative capacity of a water body to receive effluents and/or guard against contamination (e.g., saline intrusion).²¹ The inter-relationship between water quality and quantity is clearly demonstrated in large cities, such as Delhi, where limited water supply is often unsafe for consumption (refer Box A2.11). Environmental and health issues are, therefore, integral to both inter-sectoral and inter-state issues and are discussed within these contexts in the recommendations of this report. Below is a summary typology of some of the environmental and health issues involved (refer Box A2.1).

2.17 Agricultural Pollution: Agro-chemicals—fertilizers and pesticides—are the main contributors to surface water pollution from agricultural areas. Although the average rate of fertilizer per hectare is relatively low in India,²² the use of agro-chemicals is unevenly spread throughout the country. In states where consumption is high, such as Punjab, Tamil Nadu, Andhra Pradesh and Haryana, eutrophication of lakes, reservoirs and tanks is an environmental concern. Additionally, a number of pesticides classified by the World Health Organization (WHO) as highly hazardous that are either banned or highly controlled

²¹ This, for instance, is a need being studied for India's Yamuna River, a possible conduit for release of salts in drainage water from fertilizers. In Africa the OMVS, the river basin organization to manage the Single River for the governments of Mali, Senegal and Mauritania, is studying the use of once yearly artificial floods to mimic the former natural conditions prior to construction of Manantali Dam: flood recession agriculture, dry season pastures for semi-nomadic peoples, fisheries which depend on flooding, aquifer recharge for drinking water supply for villages, etc.

²² Average world fertilizer concentrations per hectare of arable land in 1991 were 95.2 kgs., while for Japan, Korea, USA, Pakistan and India, the amounts were 400.1, 416.2, 97.0, 91.2, and 74.3 kgs., respectively.

in Western countries, are commonly used in Indian agriculture.²³ The impact is far more permanent on groundwater resources (refer para. 2.23).

2.18 Industrial Pollution: The release by industry of untreated toxic organic and inorganic wastewater into watercourses is also a widespread problem.²⁴ Initiatives have begun to address this problem, including the establishment of Common Effluent Treatment Plants (CETPs) for clusters of small-scale industries (refer Box A6.3). However, in addition to implementation problems, the majority of industries are not connected to CETPs and only about half of the large and medium-scale industries in India have effluent treatment systems (many of them only partial). Even amongst those industries with systems, few have yet achieved stipulated emissions standards.²⁵ A total of 1,532 “grossly polluting” industries have been identified in 24 states by the Central and State Pollution Control Boards.

2.19 Domestic Pollution: Rapid population growth and urbanization have also placed tremendous pressure on the country’s fragile water resources. The primary sources of water pollution from the domestic sectors (urban and rural) include human and animal waste and run-off from solid waste, garbage dumps and street litter accumulation. Lack of water delivery and sanitation facilities, in addition to poor system maintenance, has resulted in severely contaminated water and a high incidence of water-related disease. The complex and multi-faceted impacts of such pollution on the economy and well-being of local communities is illustrated in the case of Bellandur tank at Box A2.2.

2.20 Environmental-related health problems: At least five million urban dwellers are estimated to lack access to clean drinking water, and a far larger number of people do not have access to even the simplest of latrines. Degradation of water quality from industrial and domestic pollution is a major cause of environment-related illness. In large cities such as Mumbai (formerly Bombay) and Calcutta, contamination of water in piped distribution systems due to inadequate maintenance has resulted in high rates of water-borne infection, including diarrhea and enteric disease.

2.21 In rural areas unsafe drinking water due to discharge of raw sewage and inadequate disposal of domestic solid waste is a major health problem. In many cases, existing tubewells and hand pumps have broken down and remain out of operation, forcing users to

²³ The data on the presence of pesticides in water are very limited. However, studies which have been undertaken on the Ganga River, for example, indicate levels of various chemicals (HCH, DDT, endosulfan, methyl malathion, malathion, dimethoate, ethion) which exceed international quality standards.

²⁴ Industrial effluents contribute substantially to organic pollution, and in some cities represent over 50 percent of urban organic load. In the Cauvery basin, for example, the contribution of industrial effluents to the total urban load (domestic + industrial) ranges from 1 percent (District of Coorg) to 81 percent (District of Mandya).

²⁵ It has been estimated, based on information obtained through interviews with State Pollution Control Board senior officers, that in Andhra Pradesh alone, there are 526 large/medium- and 1208 small-scale polluting industries. Out of these, only 29 percent are complying with standards.

collect water from unsafe sources.²⁶ Given that 80 percent of rural domestic water supply is from groundwater (50 percent for urban areas and industry), contamination from agricultural and industrial sources means that water availability of a required quality is already strained.

2.22 The health costs associated with impure water are staggering. In Maharashtra alone, about 0.7 million people suffer from various water-related illnesses, out of which approximately one thousand die each year. For children the situation is particularly serious: 0.5 to 1.5 million children under the age of five die annually from diarrhea alone.²⁷ It is estimated that approximately 30.5 million “disability adjusted life years” (DALYs) are lost each year in India due to poor water quality, sanitation and hygiene.²⁸ These and other issues are a constant preoccupation of the various government health departments involved and of agencies such as the Rajiv Gandhi National Drinking Water Mission. Some notable successes have been achieved, such as the eradication of guinea worm. However, sanitation remains a critical issue and is likely getting worse as population pressures build. Problems with trace elements also need handling: for instance, presence of arsenic in groundwater in parts of West Bengal or high fluoride levels in parts of Karnataka.

2.23 Groundwater Degradation: The presence of naturally occurring trace minerals—e.g., fluoride, arsenic, iron—is a source of groundwater contamination.²⁹ However, toxicity of groundwater has been increased further by the leaching of agricultural as well as industrial chemicals into soils. In states such as Gujarat, groundwater has been degraded by increases in nitrate concentrations due to applications of fertilizer to cultivate cash crops, including oil seeds, cumin, sugarcane, cotton and groundnut. Land disposal of untreated wastewater and hazardous wastes from industries poses a severe threat to groundwater quality as illustrated in Box A2.4. Heavy metal contamination is particularly common in thermal power, tannery and mining intensive areas. Additionally, excessive withdrawals of groundwater, coupled with decreased recharge rates, have resulted in contamination from salt water intrusion in coastal areas. Aquifer degradation is a particular problem in states such as Gujarat, West Bengal and Tamil Nadu.³⁰

2.24 Groundwater Depletion: The number of blocks that have been classified to have reached either the “over-exploited” status or the “dark” status is less than 10 percent of the

²⁶ In a study conducted by AIHHPH (1993b), it was observed that almost 90 percent of the villagers use pond water for bathing and washing utensils and clothes. More than 50 percent use the same for cooking.

²⁷ World Bank, 1997c.

²⁸ DALYs aggregate morbidity and mortality estimates into a single indicator. DALYs are a combination of: (i) discounted and weighted years lost as a result of death at a given age; and (ii) disability as a result of morbidity, adjusted by severity (Brandon and Hommann, 1995).

²⁹ In many parts of India, these toxic inorganics are found to be beyond permissible water quality limits for drinking purposes and present a severe health risk.

³⁰ In Gujarat, chloride levels over 1,000 mg/l have been detected (CGWB, 1991). In Tamil Nadu, saline intrusion in one area where groundwater is extracted to supply water for Chennai (Minjur well in Chingelput district) increased from 2 km inland in 1969 to 8 km in 1991 (CGWB, 1991).

total number of blocks.³¹ However, blocks classified as dark or critical have been growing at a continuous rate of 5.5 percent, as indicated in para. 2.04. At this rate, 36 percent of the blocks would have become over-exploited within 20 years.³² Furthermore, substantial declines in the water-table occur before a block reaches the “dark” or the “over-exploited” status. Such declines have impact on a number of users. Of particular concern, reductions in water-level due to over-extraction by irrigation users have resulted in drying up of domestic water wells in many areas.

2.25 Waterlogging and Salinity: Overuse of irrigation water and lack of adequate drainage has led to environmental damage in the forms of waterlogging and increased salinity levels. The Ministry of Agriculture estimated in 1990 that the extent of land affected by waterlogging in India was 8.5 million hectares. A Working Group constituted by MOWR on “Waterlogging, Soil Salinity and Alkalinity Problem Identification in Irrigated Areas with Suggested Remedial Measures,” in its report submitted in December 1991, estimated that 2.46 million hectares, 3.06 million hectares, and 0.24 million hectares (total 5.76 million hectares) are affected by waterlogging, salinity and alkalinity, respectively, under the irrigation commands of major and medium projects in the country. This works out to about 20 percent of the potential created and about 25 percent of the potential actually utilized, which is quite significant.³³ Yet, farmers and the general public are often insufficiently aware of the long-term impacts resulting from waterlogging, such as salinization.

2.26 Watershed and Catchment Degradation: Weaknesses in land management are inextricably linked with India’s water resource management problems.³⁴ Mounting population pressures with still insufficient techniques applied for watershed, land and water resource management have caused over-grazing and loss of forest land. About 6,000 million tons of top-soil are lost annually in India through erosion. Not only are soils degrading but also the retentive capacity of the land is reduced by lack of vegetative cover. Flash flood run-off is thus exacerbated rather than the more beneficial percolation of rainfall as groundwater. This further limits cropping possibilities on residual moisture and exacerbates groundwater depletion, including drying up of traditional sources of rural drinking and domestic water. The many catchment management and local-level micro-catchment management techniques already known and promoted in India need more wide-spread adoption.

³¹ Figures do not include Andhra Pradesh, Gujarat and Maharashtra, and come from CGWB (1995).

³² “India - WRM Sector Review, Groundwater Regulation and Management Report” (World Bank, 1998d).

³³ Estimates of waterlogging vary by source because some estimates include areas waterlogged during the monsoons as well as lands affected by seepage from canals and poor on-farm irrigation practices.

³⁴ The following reports also deal with these issues: (i) “India - Review of Rain-fed Agriculture and Watershed Development” (World Bank, 1988a); (ii) “India - Review of Wasteland Development” (World Bank, 1988b); (iii) “India - Irrigation Sector Review” (World Bank, 1991); and (iv) “India - Policies and Issues in Forest Sector Development” (World Bank, 1993a).

2.27 River, Reservoir and Canal Siltation: Part of the above top-soil losses flow into the streams and rivers causing changes in their hydraulic regime. Siltation is a problem in surface water canals and India's many reservoirs and tanks. This adds to maintenance costs in canal and drainage networks and, for the reservoirs and tanks, significant loss of storage capacity, at an annual rate estimated to range from 0.5 to 1.2 percent.³⁵ Losses in storage translate into reductions in hydroelectric power production, inadequate irrigation water storage, and reduced flood protection.

2.28 Biodiversity loss and Wetlands Reduction: Most of India's wetlands are directly or indirectly linked with the major river systems such as the Ganges, Brahmaputra, Tapi, Godavari, Krishna and Cauvery. Despite the fact that a significant proportion of the country's wetlands are under some form of protection, many of these systems are threatened from increasing and uncontrolled human pressures on the country's natural habitats. The primary cause of biodiversity loss in wetlands has been the conversion of natural ecosystems for agricultural and industrial development and the expansion of urban areas, as well as the environmental destruction these activities have generated. Water-related projects have, additionally, had a major impact on the ecological integrity of water systems. The construction of dams and the diversion of rivers for irrigation, hydropower and navigation have increasingly resulted in modification and loss of India's aquatic ecology (refer Box A2.10).³⁶

2.29 Coastal Zone Habitats: Coastal habitats are also at risk. For instance, the destruction of coastal areas due to human encroachment has decimated mangrove forests along the Indian coastline. In estuaries or other brackish water environments shrimp culture, as well as other fauna and flora, have sometimes been affected by pollutants. Typical coastal environment issues and coastal management possibilities are discussed at Box A2.3.

E. THE COSTS OF INADEQUATE MANAGEMENT

2.30 A growing recognition of the severity of the water problem has prompted debate on water utilization throughout India. Positive examples of comprehensive approaches to water development and allocation exist in India. However, as also typically found in other fast developing countries where water resource issues have emerged only recently, these success stories are still exceptions rather than the norm. In most instances water decisions are still fragmentary, do not fully exploit multi-sectoral usage opportunities, are conceived

³⁵ In Tamil Nadu, where there are 61 major reservoirs and about 39,200 tank storage systems, studies conducted by the Institute of Hydraulics and Hydrology and by the Gauging Division (Water Resources Organization/PWD) have shown high losses in the capacity of reservoirs and tanks, with rates of siltation reported as high as 2.6 percent annually and loss of capacity reaching as high as 58 percent (Kundah reservoir).

³⁶ For example, the fresh water Gangetic Dolphin, endemic in the Ganga river, is on the verge of extinction due to the destruction of its habitat from changes in the river hydrology.

within a context of discrete geographical units rather than basin-wide, and do not fully incorporate long-term demand trends or environmental concerns. The environmental, social, fiscal and opportunity costs of the current approach are likely to be substantial. Some examples of the costs are:

- Historically, water projects, while often designed for multi-purpose uses (e.g., irrigation bulk water supply for domestic uses and hydropower), have been hampered by limited usage of systematic basin planning and modern modeling techniques. Involvement of stakeholders in planning decisions has also been very limited. Such an approach has resulted in large foregone mutual benefits to various sectors deriving from water projects. The absence of comprehensive river basin development plans has meant that interdependencies between projects have not been exploited. Benefits have, therefore, been lost from lack of basin-wide coordination, poor prioritization of expenditures on projects, and inadequate public participation.
- The proportion of the national budget absorbed by the water sector—including debt servicing of water projects, operational deficits, and overt subsidies—represents a huge cost to the economy. The subsidy for irrigation alone was nearly 0.3 percent of GDP in 1994-5 (World Bank, 1996). Despite such expenditures, investment levels are not enough to cater for India's rapidly growing industrial and domestic needs and to handle the environmental problems, or to handle the needs of irrigation. Within such a situation, inefficient investment and management of water resources is clearly unaffordable.
- A continued over-emphasis on traditional structural means for increasing water supply will translate into exorbitant costs of future provision (both fixed and unit costs) since the easiest and least expensive water projects have already been exhausted. It is unlikely that such water supply schemes can be successfully undertaken given growing budgetary constraints and limited public sector investment funds. Furthermore, it is not clear whether such methods, in themselves, will be able to cost-effectively supply the required quantity and quality to all of the various uses. Already, urban areas and industry are facing high water costs in being forced to develop ever more distant sources as opposed to tapping nearby sources currently used by agriculture.
- Water pollution and reduction in water quantity have adversely affected various income-generating water uses and activities.³⁷

2.31 It has not been possible to quantify the costs, either opportunity or actual, of issues discussed in this chapter. Some sense of their dimensions may, however, be obtained from

³⁷ For example, the disappearance of the Hilsa fish has had a negative impact on the livelihood of fishermen at Patna, Allahabad and Buxor. The migration of the Hilsa fish, which used to be abundant and found up to 1,500 km upstream of Hoogli estuary, was affected by Farakka Barrage. The numbers have decreased in Patna, Allahabad and Buxor by an estimated 95 percent.

the following. In the irrigation sector some 325 billion rupees³⁸ or over US\$ 9 billion were spent in the Eighth Plan. If as little as 10 percent of this expenditure were inefficiently allocated due to inadequate planning, this would represent a cost of nearly US\$ 1 billion. The provision of improved water and sanitation services to all portions of the population now under-served would reduce the incidence of water-related DALYs by an estimated 14.3 million, or by 47 percent. This represents a savings of US\$ 3.1 to 8.3 billion in terms of avoided deaths and illness.³⁹ If, through better demand management, a saving of 10 percent of urban water were made feasible, this would be equivalent to a 10 percent addition to India's entire urban water supply infrastructure measured in current-day replacement cost terms.

³⁸ World Bank, 1997a.

³⁹ Brandon and Hommann, 1995.

III. EXISTING MECHANISMS AND LIMITATIONS

3.01 Tackling the water resources issues described above will require comprehensively addressing the various mechanisms available for improving the situation. This chapter will assess each of these mechanisms in turn: (a) policy, (b) legal and regulatory, (c) institutional, (d) economic, and (e) technological. The discussion will examine both their positive features and their present limitations with a view to identifying the areas where change is required.

A. POLICY FRAMEWORK

3.02 Under India's Constitution, subject to Entry 56 of List I, water is considered a "State Subject," with legislation and administration substantially framed within the context of state boundaries. The most comprehensive water policy statement issued at the GOI level is the National Water Policy (NWP), adopted by the National Water Resources Council in 1987. In only a few cases has the national policy been translated into specific state-level policies. The NWP is, nevertheless, a significant conceptual document and is frequently referred to in discussions of water policy in India. It calls for a holistic and integrated basin-oriented approach to water development, the promotion of conjunctive use of surface and groundwater, and water-conserving crop patterns and irrigation and production technologies. It also defines priorities for different uses, including drinking water as first priority, discusses various environmental issues, proposes participation of beneficiaries in water management, and provides for water pricing to cover the costs of operations and maintenance and part of capital investment costs.

3.03 On specific issue areas other policy statements also have a bearing: for instance, on environmental issues, the 1992 Policy Statement for Abatement and Pollution, the 1992 National Conservation Strategy and Policy Statement on Environment and Development, and the 1988 National Forest Policy.⁴⁰ The "Report of the Committee on Pricing of Irrigation Water" (GOI, 1992) is the most detailed official document on water pricing. Policy directions are also contained in the Five Year Plans, Finance Commission Reports, policy statements on the agriculture sector, and other government statements. More recently, the New Economic Policy of 1991 and subsequent policy statements relating to liberalization of the economy, market-based approaches to economic management, privatization of urban water⁴¹ and decentralization of irrigation management have established a broader and more economically-oriented environment for water policy debate.

⁴⁰ The Policy Statement for Abatement of Pollution is the most significant of the three. It emphasizes pollution prevention in place of the conventional "end-of-pipe treatment" of effluents and also identifies the adoption of best available and practicable technologies as the key element for pollution prevention.

⁴¹ For instance, the "India Infrastructure Report" (GOI, 1997b).

3.04 The National Water Policy (NWP) and other government policy statements such as those mentioned above are broadly in the right direction. For the NWP, now ten years old, it would, nevertheless, be appropriate to revisit this document and update it in line with the further evolution of thinking in India and internationally.⁴² There are several conceptual issues where improvement is desirable. Generally, there is an over-emphasis on administrative mechanisms for water allocation, rather than value-based or compensatory mechanisms. This approach is reflected in the existence of priorities, which allow limited flexibility for value-based criteria to influence water allocation between sectors or uses. Further, priorities have been determined without reference to the social and economic value of the activities concerned. For instance, water for industrial use is considered as fifth and last priority, whereas value-added (and possibly employment generation) would typically be greater than water used for irrigation which is listed in second priority (after drinking water). Subsidy-based approaches to water provision are advocated in the NWP, in part contradiction to statements on cost recovery and substantially out of line with more recent thinking under the New Economic Policy. Provisions for environmental issues also need updating. Throughout, the NWP's effectiveness as a policy guide is reduced by its generality, understandable given that it was the outcome of a national consensus exercise.

3.05 The principal problem, however, is that the NWP and other policy statements have not been translated into action. As discussed below, the NWP is not supported by enabling legislation, and in some cases is actually contradicted by the existing water laws. Even more important, the national policy is neither reflected in corresponding and state-specific State Water Policies⁴³ (the primary administrative unit in India's federal structure), nor in basin-level policies and action plans. In the majority of situations in India the enabling framework for implementing sound water allocation, planning and management is largely absent.

B. LEGISLATIVE AND REGULATORY FRAMEWORK

3.06 The existing constitutional provisions and water legislation in India do not provide a legal framework with which to tackle water sharing issues between sectors and between individuals:

- Primary powers are vested at state levels which do not correspond to river basin boundaries.
- Surface water rights are not clearly defined and are not secure, and such rights cannot be commercially transferred

⁴² Refer, for instance, to the World Bank Water Policy Paper (World Bank, 1993b).

⁴³ While most states still do not have State Water Policies, this situation is changing. For instance, Tamil Nadu (1994) and Orissa (1995) States have formally issued State Water Policies, and Rajasthan and Punjab are in the process of finalizing State Water Policies. Andhra Pradesh has issued an Irrigation Sector Policy (1998), which also discusses water resources management issues.

- Groundwater rights are in a purely private good context, ignoring externalities, and such rights cannot be transferred independently of land.
- Environmental laws have not been comprehensively operationalized.
- Regulatory standards are either not enforced or do not exist.

State Powers over Surface Water

3.07 Under Indian statutory law, as interpreted and applied by the courts, all surface water is public property, whether it is natural flow in a river or storage behind a dam or natural lake. In other words, the Indian Government has the right to regulate, develop, and administer surface water, and riparian claims to the use of such water are subordinate to this right.⁴⁴ The responsibilities apportioned to the states and the Union by the Constitution fall into three categories as listed in Schedule VII: The Union List (List I), the State List (List II), and the Concurrent List (List III). Water is mentioned in both List I and List II as follows:⁴⁵

List I (Union List), Entry 56:

“Regulation and Development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by Law to be expedient in the Public Interest.”

List II (State List), Entry 17:

“Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to provisions of Entry 56 of List I.”

3.08 In the de facto interpretation of these responsibilities the power of the states has emerged as pre-eminent. Thus, notwithstanding the powers conferred on the Union Government in Entry 56, water has come to be perceived as a “State Subject,” per Entry 17. This has serious ramifications for inter-state water development and allocation. Surface water needs to be managed on a river basin basis. The fragmentation of basins by state boundaries and lack of cooperation between them is a critical issue. It is also a hazy issue in that, except through specific inter-state agreements or Tribunal Awards, the actual rights of each state are not clearly defined. Indian policy and law-makers implicitly understand that inter-state waters need to be shared and that other riparians have rights.

⁴⁴ Although British legislations in India during 1859-77 recognized the customary rights of individuals and groups over water resources, a radical shift occurred with the Easement Act of 1882 which made all rivers and lakes the absolute rights of the State (meant in the generic sense of polity).

⁴⁵ Although List III, the Concurrent List, does not have an entry on water, it does mention “Economic and Social Planning.” Since water is a significant input in agricultural development and industrial development which are indicators of economic development, and since water is a primary need (drinking and sanitation) for social planning, water resource development could be covered under the Concurrent List also.

Nonetheless, each state interest argues for as large a share as possible, without legal clarity on what these shares are.

3.09 Individual usufructuary rights for surface water are also unclear, as the legislation has failed to devise a structured system and process for providing secure, defensible and enforceable surface water rights. Riparian rights, where a person abutting upon a stream can use water without disturbing a similar benefit to other riparians, have been accepted by the Indian courts as natural rights.⁴⁶ However, individualized rights of abstraction and use of such water can only be established through expensive and time-consuming litigation in the courts. Consequently, the right to abstract water from natural rivers and streams is left in a legal limbo at best, and to an adversarial-style process of claiming such rights at worst. Not only does the legal uncertainty surrounding water rights openly invite conflict, but it also creates imbalances in water development, stifles private sector investment in water projects, and seriously constrains the allocation and re-allocation of water resources across sectors. These problems are compounded by the legal question of whether original government-granted assurances of water allocation can be withdrawn in favor of new uses (e.g., water originally committed to agriculture diverted for domestic uses, industry, etc.) or whether this amounts to a violation of an established riparian right. While this issue falls in a gray area and is yet to be tested by the courts of law, it is likely to increasingly appear in the future given changing water use priorities. There are also difficult questions concerning how rights are claimed. Riparian rights based on geographic principles alone neglect the legitimate claims of those located away from the water body. The ill-definition and insecurity of water entitlements equally applies to different sectoral users: users of irrigation canal water, industries, and rural and urban water supply systems. Thus, states' sovereign and absolute rights over surface water have in the past been challenged in courts by riparian landowners who claimed their rights had been infringed upon by the government in pursuit of its irrigation projects. Nothing prevents the courts from entertaining such litigation in the future and possibly making the legal question less clear.⁴⁷ Unless surface water rights are better clarified, conflict and litigation are likely to be increasingly common in the future.

Groundwater Rights

3.10 The issue for groundwater is that rights give groundwater a purely private good context in its management, ignoring social and environmental costs. Moreover, even where private ownership of groundwater is clearly defined, transferability of ownership independently of land is not. For groundwater, the legal and absolute right rests with the

⁴⁶ Notably, this form of water rights system is recognized only in the case of natural streams, but does not apply to waters flowing in irrigation canals or stored in man-made reservoirs (in which case water can be drawn only with a government-issued permit).

⁴⁷ For example, both the Madras High Court in 1936 and the Bombay High Court in 1979 have established that the Government's sovereign rights do not amount to absolute rights.

owner of the overlying land.⁴⁸ All groundwater existing and found beneath private property, therefore, is fully under the control of the owner of that land who is free to extract and use it as he or she sees fit. Tying water rights to land rights has implications for access to water and the distribution of benefits from water use. This system has led to de facto rights at the field level where larger farmers with higher pumping capacity and deeper tubewells have a disproportionate claim over the resource than others. Inadequate regulatory restrictions on the exercise of private property rights in groundwater (e.g., well-spacing and depth norms, power supply manipulations) has resulted in excessive withdrawals in many areas, spelling disaster for the sustainability of groundwater stocks and water supply (refer para. 3.13).⁴⁹ The current inseparable linkage between land ownership and ownership of groundwater rights also constrains the potential for inter-sectoral allocation (refer para. 3.45).

Limited Application of Environmental Legislation

3.11 For environmental protection, the key problem is inadequate application of the laws that already exist. These include: (i) the 1974 Water Prevention and Control of Pollution Act⁵⁰ which established water quality and effluent standards and the requirement that polluting industries must seek permission from the SPCB to discharge waste into water bodies; (ii) the 1977 Water Cess Act⁵¹ which allows a cess (fee) on water consumed by industries and local authorities; and (iii) the 1986 Environment Protection Act which authorizes the Central Government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the siting and/or operation of an industrial facility on environmental grounds (including the closure of any firm that violates the Act's restrictions regarding effluent discharge). The Act also permits individuals to initiate legal action against anyone violating it. For example, industries and other polluters not meeting environmental standards are required to develop a remedial

⁴⁸ Groundwater is considered an easement connected to land under land tenure laws and the 'dominant heritage' principle implicit in the Transfer Property Act IV of 1882 and the Land Acquisition Act of 1894. Under the law of riparianism applicable in India, ownership of groundwater accrues to the owner of the land above and its use and disposition are governed by the tenancy laws. By virtue of these laws, groundwater is "attached like chattel" to land property and cannot be transferred separately from the land to which it is attached (Singh, 1992).

⁴⁹ Prompted by equity and ecological concerns a few Indian state legislatures have passed legislation seeking to regulate groundwater extraction and use. The sparse legislation which exists, however, tends to be limited in its scope of application. For instance, legislation in Maharashtra focuses on protection of the sources of drinking water supplies. Legislation has also consistently failed to address the issue of groundwater extraction rights, favoring instead regulation of the depth of the wells, as with Gujarat's legislation regulating tubewell construction. In West Bengal, regulation of power connections to pumping equipment has been introduced and effectively implemented since 1993 as a result of administrative initiative and practice.

⁵⁰ Amended in 1978 and 1988.

⁵¹ Amended in 1995.

program within a specific time or close down.⁵² These laws are insufficiently used by the states for protection of water resources due to incomplete monitoring and enforcement. Moreover, there is need to adapt these laws to the rapidly changing circumstances and new environmental protection needs that have emerged in more recent years. For instance, as discussed in para. 3.43, the permitted levels of fines or polluter fees for industry in existing legislation are usually so small as to have no impact.

Limited Application and Enforcement of Regulatory Standards

3.12 A number of standards have been provided for regulating water quality. The Central Pollution Control Board (CPCB) defines water quality requirements for five different categories of inland/fresh waters and these are largely being followed by the states (refer Box A2.5). The Bureau of Indian Standards (formerly the Indian Standards Institution (ISI)) established drinking water quality standards in 1983 (refer Box A2.6). WHO guidelines are utilized for parameters not covered by the ISI standards' list. Under the 1986 Environment Protection Act, effluent standards with respect to more than 60 categories of industries were developed.⁵³ Hazardous Waste Rules were issued in 1989, providing important tools for the management of hazardous substances and, consequently, the prevention of surface and groundwater contamination. Another regulatory change mandated after 1992-93 requires firms to conduct annual environmental audits and submit their findings to their respective State Pollution Control Boards (SPCBs). These various standards are broadly in line with international practice. The need is to better apply them, requiring more complete measurement and monitoring systems and capacity to enforce compliance.

3.13 By contrast, the regulation of groundwater extraction suffers from a major gap in enabling legislation and the resultant regulatory environment. Apart from a limited Act for the Chennai metropolitan area and, more recently, a Bill in Maharashtra for protecting drinking water supply and a groundwater Bill in Gujarat, none of the states in India have groundwater acts. Providing investment and operation is privately funded, there are thus no controls on well-spacing and abstraction. An indirect attempt is made through the access rules applied by the National Bank for Agricultural and Rural Development when providing credit for investments in wells and pump-sets. The application is assessed against the degree of development of the aquifer ("over-exploited", "dark", "gray", or "white" areas) as assessed by the state groundwater authorities. There are also rules for

⁵² Three other environmental laws that include provisions to reduce environmental problems in the water sector are: (i) the 1991 Public Liability Insurance Act; (ii) the 1980 Forest (Conservation) Act; and (iii) the 1995 National Environment Tribunal Act. This last has created a tribunal with power to award compensation for damages to persons, property, and the environment arising out of any activity involving hazardous substances.

⁵³ The standards are to be achieved within a period of one year from the date of their notification. If a particular SPCB desires, it may reduce the time limit and also specify more stringent standards within their jurisdiction. The board cannot relax either the time limit or the standards.

minimum spacing between wells. Similar rules are also applied by State Electricity Boards for power connections. However, they are frequently bypassed.⁵⁴ Apart from their inability to control resource depletion and ecological degradation, they are also inequitable as they restrict the new entrants who are mostly resource-poor farmers and more importantly, offer no protection to the poor farmers relying on traditional water-lifting technologies.⁵⁵ Pricing of electricity at a fraction of real economic value (refer para. 3.39) further exacerbates the virtual vacuum in regulation of groundwater abstraction.

Introduction of Environmental Impact Assessments

3.14 An encouraging development has come under the 1994 Environmental Impact Assessment (EIA) Notification. Under this regulation an EIA has been made mandatory for 29 categories of development activities involving investments of Rs. 500 million and above. The list includes various industrial and mining enterprises, river valley projects (hydropower, major irrigation, flood control), ports, harbours, airports, highway and tourism projects. The environmental clearance is given by the Ministry of Environment and Forests (MOEF). Application of this recent initiative is progressively increasing awareness amongst state and central government development planners, and increasing awareness of environmental issues at implementation levels. It has had some effect on screening out projects with serious environmental problems and, for many others, has enabled design modifications better catering to environmental issues, or mitigation measures to reduce negative environmental impact.

C. INSTITUTIONAL MECHANISMS

3.15 The present institutional arrangements in India, including central, state and local institutions, and both formal and informal structures, do not enable comprehensive water allocation, planning and management. The main problems that exist are:

- Inadequacies in necessary institutions for comprehensive water allocation, planning and management, particularly at state and basin levels where they are frequently absent.
- Lack of coordination between institutions, duplication of responsibility and responsibility gaps.
- Inadequate fostering of grassroots institutions.
- Lack of involvement of civil society—local communities, NGOs, the private sector and academia.

⁵⁴ Dhawan, 1989.

⁵⁵ Dhawan, 1990; Moench, 1992.

State-level Institutions

3.16 The interpretation of the constitutional division of power between the center and the states primarily places the development and management of water under state-level jurisdiction, subject to certain limitations in cases of use of inter-state river waters. However, effective state-level institutions governing *multi-sectoral* water use and allocation are, in most states, conspicuous by their absence. With few exceptions (refer para. 3.18), there are no formal institutional mechanisms that consider the different sectoral demands and plan and manage water between them. Because irrigation is the largest user of water, state irrigation departments have been responsible for construction, maintenance and management of water resource development schemes. An obvious outcome of this arrangement is that irrigation demands have received priority over water requirements in other sectors. This has been further exacerbated by a strong orientation towards civil works construction, resulting in very limited attention to water planning and management, even within irrigation. Most irrigation departments still contain a cultural bias towards civil works rather than water management stemming from their origins as public works departments. In the case of Tamil Nadu, the laudable recent step to create a specialist Water Resources Organization was, for instance, only carried out in 1994.⁵⁶ The other specialist government departments (for RWSS, UWSS, power, etc.) also have not been given a mandate for multi-sectoral water planning. The combined result is that, while irrigation departments (and other specialist government departments) have all tried to consider water in a broader context, they have seldom fully succeeded because of the “institutional gap” as regards specific institutions and mechanisms for handling inter-sectoral issues.

3.17 Another problem is the frequently found fragmentation of responsibilities for water sector issues between different departments. Groundwater is frequently handled by another department (e.g., in Bihar, Kerala, Rajasthan and Uttar Pradesh, and formerly in Orissa). Major, medium, and minor irrigation are also sometimes split between departments (e.g., in Andhra Pradesh, Bihar, Maharashtra and Uttar Pradesh). Environmental issues connected with water are usually handled by separate departments, such as Environment, Health, Forestry, State Pollution Control Board, etc. Water quantity and water quality issues are usually handled separately and by different departments. In nearly all states, urban water supply and sanitation, rural water supply and sanitation, and irrigation are in separate departments, without formal mechanisms to assure cross-coordination on water issues.

3.18 Recognizing the need for tackling such inadequacies, a number of states are taking measures to improve inter-sectoral coordination of water issues. Under their World Bank-assisted Water Resources Consolidation Projects (WRCs), Tamil Nadu has created a State Water Resources Council and Orissa, a State Water Resources Board. Both are chaired by a neutral senior party (respectively, the Chief Minister and the Chief Secretary)

⁵⁶ This was a result of the Institutional Study carried out by Government of Tamil Nadu as part of its preparation exercise for the World Bank assisted Tamil Nadu Water Resources Consolidation Project.

(refer Box A3.7). These are permanent committees with membership from all key government departments with interest in water. For each, a technical secretariat has also been created to act as convenor of meetings and to provide the professional staff inputs on a multi-sectoral basis for preparing river basin plans and examining inter-sectoral water issues, including environmental issues. Maharashtra has established a Water Resources Authority, Punjab is proposing to establish a Water Resources Council, and similar considerations are under way in Rajasthan.

Local-level Institutions

3.19 There is similar need for development of water institutions within the states, including at grassroots levels. With very few exceptions there has been no attempt to create river basin organizations to manage water comprehensively within a river basin or, for inter-state rivers, the part of a river basin within the state. The need for a river basin approach is becoming urgent in many cases. For most rivers where resource utilization is already high, the issues described in Chapter II (including competition between sectors, industrial and urban pollution, and difficult necessary decisions regarding future allocations or re-allocation) are readily apparent. The positive steps currently being taken by Tamil Nadu to establish a Vaigai Basin committee with stakeholder participation merit emulating much more broadly (refer Box A3.8). In addition, the states should consider decentralizing their water resources departments along river basin lines, as has been done by Haryana, Tamil Nadu and Orissa under their WRCP programs (refer Box A3.7). This is enabling more effective management of water along hydrological lines than had been possible previously.

3.20 Grassroots Institutions: Not least in importance is the need for effective grassroots management of water. Many water management issues have their origin and their solution at very local levels. For instance, availability of water is becoming a critical issue for rural water supply throughout India, especially in the Deccan plateau and arid Western regions. Because of over-use by irrigation, local groundwater levels are depleting. Contamination of drinking water is also a problem, especially from cities with inadequate effluent treatment and larger villages which typically do not have sewage disposal networks. Severe sources of point pollution of rivers and groundwater are also a rapidly developing problem due to industrial expansion without associated effluent management. Very often, these issues are entirely resolvable if the community got together and took pragmatic action. For example, a farmers' water users association (WUA) in Tambaraparani Basin, Tamil Nadu, has expressed concern about the additional extractions of water and the pollution resulting from new industrial development. The WUA has been encouraged to take steps to form a cross-sectoral stakeholders association, including industrial representatives and the local government apparatus. Initiatives should also be undertaken to encourage the participation of women and other minorities who have been overlooked in the past. In particular, women are larger stakeholders in water than men as they are the primary fetchers of water and users of water for household purposes, are most directly

concerned with sanitation, pollution and health issues, and have a significant role in agricultural production.⁵⁷

3.21 In even more frequent cases, particularly in rural areas, problems and solutions are at micro levels: the village or the panchayat. For example, a village has in its power the ability to make decisions about protection of local ponds or other water bodies from pollution resulting from human and animal waste. Similarly, excessive extraction of groundwater by a few farmers, resulting in drying up of rural drinking water wells, can also be controlled, as can pollution from local small industries. Traditional village institutional structures for managing water (especially for tanks, ponds, wells, and minor irrigation schemes) have been a part of India's history. Many of these, however, have eroded over time, partly as a result of the increased involvement of government in managing water schemes during this century. Such informal or formal water user groups now need to be fostered again.

3.22 Two developments provide major opportunity. The first is the decentralization movement in India and, in particular, the options available under the 73rd and 74th Constitutional Amendment Acts of 1992 to establish or revive local government structures at district, block and municipal levels. These Acts support reforms in local governments and promote the development of local-level participation, primarily through: (i) shifting administrative functions to the local level by giving more decision-making authority to panchayats (village governments) in rural areas and Nagar Palikas in urban areas; (ii) promoting fiscal decentralization by increasing the percentage of state resources reaching local institutions; and (iii) creating a planning system for villages and municipalities and entrusting implementation to the Panchayat Raj and urban local-level institutions. While creation of such bodies under these Acts is still in its infancy, potential is available for adding responsibilities and powers (legal and financial) for managing water. This may need specific water committees within the panchayat institutions to carry out these functions.

3.23 A second major potential is offered through the promotion of irrigators' water users associations, including an expanded role in water resource management. India is now ready for a breakthrough in this regard. In states such as Andhra Pradesh and the WRCP states, major programs are underway to help establish water users associations in conjunction with improvement of the irrigation systems.⁵⁸ The eventually envisaged role is

⁵⁷ In water scarce areas, such as in Rajasthan, women travel as far as 2 km. to collect water. Also, by some estimates, women spend as much as 60 percent of their time on agricultural production activities in the field.

⁵⁸ In the WRCP States of Orissa and Tamil Nadu, WUAs are being established under the Systems Improvement and Farmer Turnover (SIFT) components. In Orissa, and now being designed into the Tamil Nadu program, an agricultural intensification program linked with the SIFT is also included (SAIFT: Systems and Agricultural Improvement and Farmer Turnover). The same is under preparation under the proposed Rajasthan WRCP. The boldest WUA program is being commenced in Andhra Pradesh under the proposed Andhra Pradesh Economic Rehabilitation Project (APERP) Irrigation Component. In AP, the following initiatives have already been undertaken: (i) issuance of a Farmers

for WUAs to fully manage the lower-level irrigation systems and to be federated into management committees for participation in management of whole commands, which could also be extended to participation in river basin management. The new GOI-World Bank strategy for irrigation management⁵⁹ emphasizes establishing WUAs on an India-wide basis, presenting obvious opportunity for their further adaptation to include other stakeholders and handle water resource management issues more broadly.

Inter-State Institutions

3.24 Inter-state institutions for allocation, planning and management of water resources in basins crossing state boundaries are even rarer in India than state-level institutions. Yet, as discussed in Chapter II, the catchment areas of all of India's major river basins are inter-state, making the resolution of inter-state water allocation issues of critical importance. There is urgent need throughout India to establish river basin organizations (RBOs) or various forms of inter-state coordination.⁶⁰ There is, fortunately, a host of examples internationally and a few successful examples in India. In India, the Bhakra-Beas Management Board, successfully operates and maintains the headworks and parts of the main system providing water to Punjab, Haryana, parts of Rajasthan, and Delhi. The Ganga Flood Control Commission undertakes planning and coordination of works related to flood control across seven riparian states. The Brahmaputra Board is responsible for coordinated flood control across seven states and union territories. The Upper Yamuna River Board is responsible for allocating available flows between Haryana, Uttar Pradesh, Rajasthan, Himachal Pradesh and Delhi. These and other Indian examples are described in Box A3.3 and have all had positive impacts. The more general case, however, is a complete absence of any institution for handling river basin issues across states.

3.25 Another means to reach progress towards institutional cooperation between states is through the River Boards Act of 1956 which enables states to enroll the Central Government in setting up an advisory River Board. This mechanism, however, has never been used, suggesting that changes are required to make it more effective. The present Act

Management of Irrigation Systems Act in 1997; (ii) state-wide elections in June 1997 for WUAs across the state (10,292 WUAs have been constituted); (iii) elections in November 1997 of Distributory Committees (federations of minor-level WUAs at distributory level); and (iv) commencement of an intensive training and support program for the WUAs. As with the WRCP states, the WUA activities are paralleled by improvements of the distribution systems and an agricultural intensification program. These actions are highly consistent with the recommendations in the "India - Water Resources Management (WRM) Sector Review, Irrigation Report" (World Bank, 1998f) and with the recommendations of the Committee on Pricing of Irrigation Water (GOI, 1992).

⁵⁹ "India - WRM Sector Review, Irrigation Report" (World Bank, 1998f).

⁶⁰ It should be noted that the term "river basin organization" as used in this report, is a generic term, referring to any form of institution or institutional coordination mechanism which facilitates inter-sectoral water allocation, planning and/or management on a river basin—whether intra-state or inter-state—basis. This is in contrast to past usage of the term "RBO" in India, which has tended to refer to more formalized types of RBOs and to inter-state RBOs.

requires prior consultations with the states concerned before setting up a river basin organization, and the boards so set up only have power to advise. As the River Boards Act comes under the "Union List" of the Constitution (List I, Entry 56), the constitutional powers are already present for amendment of the Act to provide greater capacity for the center to intervene where greater state cooperation would clearly be in the public interest.

3.26 The second legal mechanism is the Tribunal Award system (provided for under the Inter-State Water Disputes Act of 1956 established under Article 262 of the Constitution⁶¹). The Tribunal has been the primary mechanism used for resolving inter-state water disputes. Five Tribunals have been established thus far: (i) Krishna Water Dispute Tribunal, (ii) Godavari Water Dispute Tribunal, (iii) Narmada Water Dispute Tribunal, (iv) Ravi Beas Water Dispute Tribunal, and (v) Cauvery Water Dispute Tribunal. Decisions in the cases of the first three, which include the awarding of specified quantities of water based on the principle of equitable apportionment, have been accepted by the states involved. It required, however, years for such Tribunal decisions to be made, and in the case of the Krishna Tribunal, this is coming up for re-award in 2000. Since at the time of re-award, decisions are based inter-alia on water usage claims, there is a tendency for states to make public investments in an unplanned manner (refer Box A3.2). A better mechanism would be to consider future rights on the basis of the adequacy of current water management practices and to actively discriminate against such inappropriate investment.

3.27 Although better than nothing at all, and arguably as good as many other legal mechanisms for resolving disputes found in other countries, India's Tribunal Awards are acknowledged to have a number of deficiencies. First, it can take years before a water issue ripens into a fully blown dispute, prompting the states even to consider seeking to establish a Tribunal. Second, even when a Tribunal is constituted, the decision-making process is extremely lengthy and time-consuming; it takes an average of 15 years to issue the final Award. Inability to determine the facts of the case is the primary cause for inordinate delays in the final decision. This is often due to disagreement and haggling over supporting data by the states involved. The adversarial nature of this process, as well as the Tribunals' membership consisting only of representatives of the legal profession, has resulted in over-emphasis being placed on the effectiveness of presentation and legal minutia. As a result, facts tend to get blurred and judges are forced to sift through often biased evidence submitted by claimants. Such Tribunal discussions also tend to become highly politicized as, for instance, in the case of the still unsuccessful Cauvery River Tribunal.⁶² These and other issues surrounding the limitations of the Tribunal system are

⁶¹ "Parliament may by law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-state river or river valleys" (Article 262, clause 1 of the Constitution).

⁶² The contested (by Karnataka State) interim Award rendered by the Cauvery River Tribunal in June 1991 is no exception, in view of its interim nature. It is also true, however, that the Tribunal has since been incapable of addressing Karnataka's objections, to the extent that the Tribunal has been boycotted by that state and its chairman resigned in 1995. Direct negotiations between Karnataka and Tamil Nadu are reportedly in progress, thus by-passing the now de facto disbanded Tribunal.

described further in Box A3.1.⁶³ Unless Tribunal procedures can be improved, the difficulties of Tribunal Awards are likely to become more apparent over time as inter-state water issues grow in intensity.

Union-level Institutions

3.28 At the central level, the Ministry of Water Resources (MOWR) is recognized as the nodal ministry responsible for water. Under MOWR a number of technical agencies, such as the Central Water Commission (CWC), primarily concerned with surface water; the Central Ground Water Board (CGWB), handling groundwater; and the National Water Development Agency (NWDA), primarily assessing inter-basin transfer options, have been created. Other entities linked with MOWR include the Indian National Committee for Irrigation and Drainage, sponsoring some research activities, and the Indian Water Resources Society, a non-governmental organization which sponsors networking and publications. MOWR also sponsors a number of national research institutes, including the Central Water and Power Research Station (CWPRS) and the Central Training Unit (CTU), both at Pune, and the National Institute of Hydrology (NIH) at Roorkee.

3.29 Many other ministries and agencies are also involved with water. Water quality and environmental matters come under the Ministry of Environment and Forests (MOEF), although MOWR also considers these matters. The MOEF is entrusted with coordinating India's Environment Action Program. It has also launched a number of environmental initiatives including the Wetlands Conservation Program and the National River Conservation Plan. Urban water supply and sanitation projects come under the Ministry of Urban Affairs and Employment. Rural water supply and sanitation is handled by the Rajiv Gandhi National Drinking Water Mission in the Ministry of Rural Areas and Employment. Water for hydro and thermal power involves the Ministry of Power and the Central Electricity Authority. There are other ministries and agencies with evident strong interest in water, such as the Ministry of Agriculture (for irrigation), the Ministry of Health and Family Welfare, Wasteland Development Board, Ministry of Surface Transport, Inland Waterways Authority of India, and for financing and planning, the Ministry of Finance, the Planning Commission, and the Finance Commission. Some of the current environmental programs ongoing in India and environmental tasks and programs by agency are described in Boxes A2.7 and A2.8.

3.30 An issue well recognized by water professionals in India is the need for much better coordination between these different entities. Water responsibilities are highly fragmented. Some of the divisions are detrimental to comprehensive analysis and treatment of water issues: for instance, the split of surface and groundwater which has discouraged unitary analysis as a combined resource and conjunctive use. The division between water quality

⁶³ Further discussion of the Tribunal Awards system and the five Tribunals established thus far is provided in Salman (1998).

and water quantity is also artificial. The separation of main water services—irrigation, urban, rural, etc.—does not foster comprehensive planning and tackling of issues such as re-allocation from agriculture to urban and industry, water sources for rural drinking water, and pollution of water bodies by industries. Furthermore, in some cases responsibility divisions are not clear, leading to overlap or, much worse, inadequate handling of issues. In particular, environmental issues are often the victim of unclear responsibilities. For instance, the Central Pollution Control Board (CPCB) and the State PCBs focus on control and abatement of industrial pollution, while pollution from agricultural activities is often neglected.

3.31 The MOWR, with support from other ministries, has taken various initiatives to encourage coordination and a unitary approach to water resources issues. The National Water Resources Council was established in 1983 and, amongst other achievements, produced the National Water Policy. Strong encouragement is also provided by MOWR and its agencies to river basin planning and holistic water management. It is still recognized, however, that there remains much to be done to more effectively achieve the cooperation required at central level. Better cooperation would also enable the center to have greater impact on water issues at state and inter-state levels.

Civil Society and the Private Sector

3.32 Finally, the potential contribution of civil society has been greatly neglected. By their nature, decisions on water allocation, planning and management directly impact on communities and individuals. No recommendations will be successful without the acceptance of the people. Additionally, a considerable reservoir of talent exists in the academic community, the private sector, NGOs and local communities. The essential involvement of grassroots institutions, such as panchayats and WUAs, including involvement of local industrialists and other members of civil society, has been discussed earlier (refer paras. 3.19 to 3.23). An important role can also be played in management at the macro-level—state, basin and national. For instance, many universities have capabilities in basin modeling, hydrology, and other related technical and economic subjects. Interest amongst industrialists is clearly present, as evidenced by the Indian Water Works Association, sponsored by the private sector. If given the opportunity, NGOs are also likely to step forward and could play an important role in motivating and organizing communities.

3.33 A substantial reason for the limited involvement to date of civil society and the private sector is the limited efforts of government agencies to inform the public on water sector issues. In particular, outreach to women has been neglected, yet women are the most interested and involved in rural water supply, domestic urban water consumption, health and sanitation issues, and are at least equally concerned as men in agricultural production. More generally, the public at large has not been comprehensively informed about water sector issues. In order to foster an environment for change, including on

difficult policy decisions, such as water pricing, and to encourage public involvement in water management, there should be an “awakening” to water issues of common concern. Information and dialogue must also be a multi-directional flow, not only from government to civil society, but also from civil society to government and between different sectoral users within civil society and government.⁶⁴

D. ECONOMIC MECHANISMS

3.34 The existing incentive structure underlies the paradoxical phenomenon that unlike other goods where scarcity prompts efficiency and conservation, water resources continue to be depleted and misused, even under conditions of scarcity. Key features of India’s current sub-sectoral/intra-sectoral water pricing regime are:

- Water charges for surface irrigation that are a fraction of costs of supply, have not been adjusted for years in most states, and are not volumetrically-based, resulting in no incentive to conserve water either by farmers as consumers or by irrigation agencies as providers. This is further exacerbated by lack of transparent information on the costs of water provision and on water charges.
- Charges for groundwater only through the indirect mechanisms of the prices of diesel fuel or electricity charges. In the case of the latter, electricity prices are less than 20 percent of long run marginal cost and are levied on a flat rate basis, rather than by unit of consumption, providing no incentive to conserve either water or power.
- Agricultural pricing policies and a domestic commodity trading regime which distort cropping patterns and, consequently, water use.
- Subsidized water and highly centralized water management in the rural water supply and sanitation sector which have resulted in poor water service at high cost.
- Water charges for urban domestic consumers that are usually below costs of service provision and are un-metered.
- An inadequately developed and under-priced system of economic incentives and disincentives to control pollution and encourage water saving or reuse technology.

3.35 The absence of sub-sector pricing which reflects the cost of production and delivery of water and the underlying scarcity value of water has also served as an obstacle to the smooth transfer of water between sectors and states. Further, economic incentives for efficient inter-sectoral allocation—either through negotiation or “automatic” market mechanisms—largely do not exist in India, with the core problems being:

- Absence of a value-based administrative mechanism to facilitate re-allocation and compensation from lower-valued to higher-valued uses.
- Absence of institutional, legal, regulatory, administrative and technological mechanisms to enable development and operation of formal water markets for sale or lease of water between users and sectors.

⁶⁴ The term “awakening” was specifically suggested in the National Workshop to reflect the major changes required in the area of public awareness and participation.

Intra-Sectoral Water Allocation and Pricing

3.36 Irrigation Pricing: The agricultural sector is the largest user of water (83 percent of water use in India in 1990) and the deficiencies here thus have particular significance on India's overall water allocation efficiency. In the decades subsequent to the 1950s, irrigation pricing was influenced by a tendency to regard water as a social good and to rationalize its subsidization as in the public interest.⁶⁵ This philosophy progressively became a convenience for vested interests in water pricing and, in particular, for not adjusting water rates over time. Very infrequent adjustments became the norm, and in some cases states did not adjust rates for over a decade.⁶⁶ The cumulative result of these policies is that today's rates are a fraction of costs of water provision. Prices are now so low that not even the costs of operations and maintenance (O&M) are currently covered by existing rates.⁶⁷ Costs, both capital and O&M, have escalated substantially, particularly for associated staff salaries (refer Box A4.2). This situation has seriously impacted on the viability of irrigation. Subsidies on irrigation amounted to 0.3 percent of GDP in 1994-5.⁶⁸ Further, the revenues that are received go into the general state exchequer rather than to the irrigation department, providing no linkage between irrigation expenditures and revenues and little incentive to improve the service. Expenditures on maintenance works have long been recognized as chronically deficient, resulting in progressive deterioration of infrastructure.

3.37 A second issue is the method by which water rates are assessed. Charges are levied on a per hectare basis, with different rates by crop and season, in an attempt to at least partially capture different water uses by crop and varying values of water by season. This system does not, however, charge for water in relation to its actual use by the individual. A volumetric system would be better, but it also needs to be paralleled by prices that are sufficient to have some impact on farmer decisions on water usage. Present water rates are so low that they are negligible relative to gross and net agricultural returns, usually comprising less than 2 percent and 5 percent, respectively.⁶⁹ Water charges as a percentage of water productivity are also nominal: in the largest irrigation states, charges are only between 0.3 percent (West Bengal) and 7.1 percent (Uttar Pradesh) of the difference

⁶⁵ This is in contrast to the situation prior to Independence. The British treated irrigation projects as commercial ventures and devised water rates based on the full costs of provision, including capital costs plus a return on capital, commensurate with the interest rate then prevailing in the London money market. Water rates were periodically revised upwards. The assessment and collection of these water rates, covering all costs plus a return on capital, were strictly enforced.

⁶⁶ Most states have not revised water rates since the 1980s. Punjab and West Bengal have not changed rates since the mid 1970s (and in 1997, Punjab made irrigation free of charge), while Tamil Nadu last revised charges in 1962 ("India: Irrigation Sector Review," World Bank, 1991; "India - WRM Sector Review, Irrigation Report," World Bank, 1998f). Change is now beginning. For instance, Andhra Pradesh implemented a three-fold increase in its water charges in 1997, and several other states have made smaller increases (e.g., Orissa and Haryana).

⁶⁷ "India - WRM Sector Review, Irrigation Report" (World Bank, 1998f).

⁶⁸ World Bank, 1996.

⁶⁹ "India: Irrigation Sector Review" (World Bank, 1991).

between the productivity of irrigated and un-irrigated lands.⁷⁰ The net result of these inadequacies is that water pricing has negligible impact on water use decisions for over 80 percent of current water usage.

3.38 A substantial factor behind the paralysis described above has been the lack of transparent public information on water charges, the necessary costs of effective O&M, the actual expenditures on O&M, the breakdown of expenditure needs and actual expenditures between maintenance works and operations, and analysis and public information on the structure of staff costs in O&M and identification of inefficiencies. The size of existing subsidies, what they are for and where they are going (to wealthy or poor farmers) has also not been made transparent. As a result, the public is uninformed, uninvolved and highly susceptible to irresponsible manipulation. This issue also applies to groundwater pricing (electricity prices for pumpsets) and, though usually to a lesser extent, to the urban and rural water supply and sanitation sectors.

3.39 Groundwater Pricing: The present groundwater pricing structure provides minimal incentives for efficient and sustainable groundwater resource use, and in the case of agriculture, by far the largest user of groundwater, almost zero price incentives. There are no charges on groundwater itself, its pricing being indirect through diesel fuel or electricity prices. For diesel powered pumpsets, a variable cost (the price of fuel) is incurred in near direct proportion to groundwater usage. For electric pumpsets, almost throughout India, charges are levied on a flat rate basis per quarter or per month in proportion to the size of the pumpset. Such non-volumetric charging only very indirectly bears relation to actual water use. Further, in most states, pumpset owners pay the equivalent of less than 20 percent of the average cost of electricity provision and in several states (including Tamil Nadu, Karnataka and now Punjab), power is provided free of charge at enormous fiscal cost. Although many factors influence groundwater exploitation, studies that are available in India and elsewhere point to water pricing as a significant determining factor. For instance, a study in Gujarat shows the expected normal demand curve with an inverse relationship between consumption of groundwater and groundwater prices (refer Box A4.3). Within this backdrop, it is not surprising that in many states and districts in India, groundwater depletion has become a major issue (refer para. 2.24). This also has significant inter-sectoral and equity impacts in that indiscriminate agricultural groundwater use—very often by a relatively small number of larger farmers—has caused the drying up of many rural community drinking water wells (refer para. 3.41).⁷¹

3.40 Agricultural Pricing and Marketing Policies: Distortions in the prices and markets of agricultural outputs and inputs also contribute to inappropriate production incentives and contamination and misuse of water. For instance, the centrally-financed fertilizer subsidy leads to serious fertilizer imbalances, in particular the over-application of nitrogenous fertilizer which through seepage and run-off deteriorates the quality of surface and

⁷⁰ "India - WRM Sector Review, Irrigation Report" (World Bank, 1998f).

⁷¹ Groundwater issues are discussed in detail in "India - WRM Sector Review, Groundwater Regulation and Management Report" (World Bank, 1998d).

groundwater resources. A review by Government of Karnataka in 1995 found a variety of distortions favoring indiscriminate use of water (refer Box A4.9).⁷² Output price and market distortions, however, have more dramatically impacted agricultural production and, thereby, water use. Domestic food policies distort cropping patterns and prevent an efficient allocation of resources—through regional specialization based on comparative advantage—which results in inefficient water use. Domestic food policies do so by blocking the development of an integrated domestic market, and by taxing crops in those regions where they would have a natural comparative advantage, while subsidizing crops in those regions with less of a comparative advantage. Water-intensive crops thus tend to be promoted in water-scarce states (e.g., sugarcane in water-scarce districts of Maharashtra,⁷³ and paddy in Punjab, Haryana, Western Uttar Pradesh⁷⁴), while water-intensive crops tend to be oppositely influenced in water abundant states and/or regions (e.g., sugarcane in Eastern Uttar Pradesh and Bihar, paddy in Eastern India, and in the deltas of Andhra Pradesh and Tamil Nadu).⁷⁵

3.41 Rural Water Supply Pricing: Within the rural water supply and sanitation (RWSS) sector itself, there are many problems regarding water pricing. Although rural drinking water can be considered to have both social and economic good features, there has been an overwhelming tendency to subsidize water. Coupled with a past governmental approach to the sector—with limited cost sharing and community participation in investments, operations and maintenance—water subsidies have paradoxically resulted in a poor service, many schemes that are not functioning at all, and high costs to the local communities. Probably the largest price influences on rural water supply, however, are the present very low and non-volumetric charges for electricity used for agricultural pumpsets and the also low and non-volumetric water charges for surface irrigation (refer paras. 3.36 to 3.39). These two distortions provide minimal encouragement for resource use efficiency in the agricultural sector and, as a direct consequence, have constrained water availability for rural domestic consumption. Many cases of rural drinking wells running dry or becoming seriously contaminated have been documented by various state governments and

⁷² Distortions include: (i) subsidies for rice production, on fertilizer, pesticides and herbicides; (ii) subsidies on sugar cane seed; and (iii) agricultural power provided free of charge.

⁷³ According to some estimates, over 75 percent of irrigation water in Maharashtra is used for sugarcane cultivation which occupies only 3 percent of the state's agricultural area. Refer Box A4.8 for details on how domestic sugar policies (both central and state-level) interact to distort the incentives for location of sugarcane production.

⁷⁴ The Food Corporation of India policy of concentrated procurement of paddy and rice in water-short Northwest states/regions discriminates against the development of an integrated rice market, and also discourages paddy production in Eastern India while encouraging paddy production in the Northwest regions. Rice policies in some states, such as restrictions imposed by Government of Andhra Pradesh on exports of rice to other states, tax paddy farmers and discriminate against paddy production in the irrigated or high rainfall regions in that State.

⁷⁵ For further discussion, refer to the ongoing commodity study series prepared by the World Bank in cooperation with GOI: (i) "The Indian Oilseed Complex: Capturing Market Opportunities" (World Bank, 1997b); (ii) "India's Sugar Industry: Priorities for Reforms" (World Bank, forthcoming 1998a); (iii) "India Cotton and Textile Industries: Reforming to Compete" (World Bank, forthcoming 1998b); and (iv) the ongoing study of foodgrains (World Bank, forthcoming 1998).

the Rajiv Gandhi National Drinking Water Mission. Under India's NWP, drinking water has first priority. However, in practice, largely because of the existing distortionary price regimes both within and outside the rural sector, it often does not receive its due priority.

3.42 Urban and Industrial Water Supply Pricing: Pricing and cost recovery tend to be better in the urban water supply and sanitation (UWSS) sector than in irrigation and RWSS. This is largely because industries are charged higher fees to cross-subsidize domestic consumers. However, as concerns water management, the key problem is that pricing has negligible influence on both consumers and suppliers of water. For consumers, in most cities only industries are subject to water metering and volumetric charging. Although some cities are attempting to meter domestic consumers, tariffs remain so low that there remains virtually no incentive for users to conserve water. For the UWSS agencies, very few are structured as independent commercial entities. Losses are absorbed by government and there is, thus, little incentive to be efficient, including in resource usage (e.g., attention to leak detection and reducing unaccounted for water). There are few financially viable UWSS agencies. Meanwhile, urban water supply is under intense pressure from increasing costs. Between 1992-1996 costs increased by 45 percent whereas water rates for domestic users increased by only 33 percent and 20 percent, respectively, for the first two tiers of the water pricing structure.

3.43 Incentives for Pollution Control: A positive feature is that both the legislation and the institutions exist for applying incentives and disincentives to control pollution. The legislative structure is already well developed (refer para. 3.11). All states have pollution control boards, putting such legislation into practice. Moreover, various forms of pollution fees already exist. The problem is that such fees are usually so nominal that they are ineffective in sending the appropriate signals to potentially polluting industries. Thus, Tamil Nadu Pollution Control Board has introduced a sophisticated structure of fees with differentials applied according to the classified potential for pollution of the industry concerned. However, as shown in Box A4.4, the differential fees between "green", or lightly polluting industries, and "red", or heavily polluting industries, are quite marginal. Also, the bulk of pollution taxes are not actually related to the amount and toxicity of effluent produced, but are based on the size or nature of the industry. Such fees based on potential to pollute do not encourage measures by industries to control effluents. In other states, "pollution fees" bear even less resemblance to actual pollution. For instance, in Andhra Pradesh (refer Box A4.5), a pollution fee is levied solely on the water consumption of the industry concerned, with no differentiation by type of industry and its pollution potential. The fee structure also favors more water-consuming industries. In many states, pollution taxes seem to be aimed more at providing the fiscal basis for the operation of the pollution control board than at actually regulating industrial pollution. Furthermore, under existing pollution tax rates it is likely that the cost of compliance with environmental standards for industry is higher than the cost of non-compliance. Even when incentives have been used to encourage industries to use pollution control equipment, there have been cases where the costs of installation and operation outweigh the penalty associated with non-compliance. Similarly, municipalities are not adequately taxed against effluent

discharge, discouraging investment in sewerage treatment. This problem is exacerbated by poor monitoring and regulation of pollution generally.⁷⁶

Inter-Sectoral Economic Allocation Mechanisms

3.44 Current Allocation Mechanisms: Decisions on allocation and investments tend to be made with only limited reference to economic analysis and assessment of alternatives. Decisions are largely administrative in nature and made on an ad hoc basis rather than through a comprehensive planning process involving the stakeholders concerned. Allocation mechanisms, where they exist, are usually inadequate to meet pressing needs for water as they arise, without adversely affecting existing users and the environment. Allocations of water to the various sectors are largely bound by history and re-allocations are increasingly made according to a prescribed priority ordering of uses. The criteria used to make such allocations have rarely included consideration of the relative value of water in the various uses or sectors. Reallocations of water, typically from agriculture to domestic or industrial consumers, are done through compulsory acquisition and usually without compensation. The critical constraint is the lack of a comprehensive analytical framework or decision support system encompassing all water using sectors that enables the appropriate determination of pricing and allocation decisions in line with considered development objectives (refer Box A7.4). Better integration of social and economic factors in water allocation and management will thus require the complementary development of institutions, planning and analytical capabilities.

3.45 Water Trading and Water Markets: Water resource transactions in India exist, but they are generally limited to very localized informal water trading between adjacent farmers, where the practice is quite common especially for groundwater.⁷⁷ An example of a more organized grassroots water market that has developed in the Vaigai basin is discussed further in para. 4.56 and in Box A5.6. India has, however, not yet developed formally organized inter-sectoral water trading or markets as found, for instance, in Chile, Western U.S.A., and Australia. Unlike in these countries, in India the institutions, legislation and regulatory framework do not exist for more formal transactions between, for instance, an agricultural water users association and a municipality or industry. In particular, the absence of formal rights to surface water and of formal rights to sell groundwater has hindered transactions in water from low-value uses to uses with higher productivity. Water trading, recognizing that water is an economic as well as a social good, would allow for voluntary transactions rather than the present involuntary and typically uncompensated expropriations. Water resource transactions would enable water to be sold or leased from one willing user to another, making possible a re-allocation of water to higher productivity use. The introduction of the more formal water markets where feasible could further provide opportunity for efficient re-allocation using market

⁷⁶ For further discussion of these issues, see Bhatia, et. al. (1994).

⁷⁷ As discussed in "India - WRM Sector Review, Groundwater Regulation and Management Report" (World Bank, 1998d).

mechanisms. Such water market systems need, however, to be accompanied by appropriate local administration and regulation to ensure fairness in their operation and to safeguard social and environmental concerns (refer paras. 4.58 to 4.59).⁷⁸

Inter-State Economic Allocation Mechanisms

3.46 As with inter-sectoral allocation (refer para. 3.44), inter-state decisions, largely based on history, are also administratively determined with only limited reference to economic and regional development considerations. In addition, little thought has as yet been given to the possibilities of selling or leasing arrangements between states or of multiple-objective development programs for shared river basins (transportation, power, water and other infrastructure), enabling mutually beneficial development for all riparians (refer para. 4.61).

E. TECHNOLOGICAL MECHANISMS

Technology and Water Productivity

3.47 Within the technical field, there is substantial scope to alleviate competing pressures on available water through measures to improve the efficiency of delivery systems, to enhance productivity, and to manage demand (refer paras. 4.62 to 4.66). India's water use efficiency in all sectors is low compared to international standards. In the case of irrigation, losses in the water conveyance system are high. In an unlined system, system irrigation efficiency is typically 30-40 percent. Where groundwater recharge would be beneficial, as is frequently the case, low efficiency of irrigation systems is appropriate. However, the productivity of end use, in terms of the agricultural productivity per unit of water used, is still poor. For instance, on-farm water management is inefficient due to limited or non-existent water courses and field channels. Thus, the actual productivity of irrigation is even lower than the irrigation efficiency indicated above. System irrigation efficiency captures the percentage of water received by the fields, but does not capture the effectiveness of irrigation in terms of its reliability and timeliness relative to crop water needs. Excessive use by head-end farmers is also widespread because of deficiencies in water delivery systems. Head-end farmers take all the water they can from an unreliable system in case they later do not receive water. This is exacerbated by the usual absence of communal structures, e.g. WUAs, to help improve water sharing. At the on-farm level, water efficiency is substantially improved through use of drip and sprinkler irrigation systems. Agronomic options to use less water through water-saving agronomic practices and the use of less water-intensive crops are also possible. Better water harvesting through watershed management practices has also shown effective use of available water.

⁷⁸ The potential pitfalls with water markets if such measures are not in place are many. Chapter IV discusses the particular features required in more detail and recommends that before introduction of a water market study tours to other countries and careful piloting should be undertaken.

3.48 Similar inefficiencies are found for rural and urban water supply. As discussed in the India - Water Resources Management (WRM) reports on these two sectors,⁷⁹ infrastructure is often in such poor shape that unaccounted for water losses in pipeline systems typically account for 30-50 percent of the water delivered from treatment plants. Construction of simple rural water supply systems are also not always up to standards and in many instances are not operational, forcing villagers to resort to unclean water supplies. Water use efficiency in the industrial sector is also poor when compared to usage of similar industries in other countries. Substantial water, and often cost, savings can be obtained by introducing water-saving technologies, treatment and reuse of wastewater, and changing industrial processes.

Data, Basin Modeling and Performance Information Systems

3.49 Hydrological Data Gaps: Addressing India's water resource management issues also requires substantial improvement in the data and analytical base and dissemination. First, the network of measuring stations for river flows, groundwater levels, water quality and meteorology is insufficient. This inadequacy is compounded by the need to improve the quality of measuring equipment, the methods of data collection and collation. Second, many agencies are involved in collecting similar data.⁸⁰ There is need to develop a coordination mechanism between these different agencies to standardize measurement quality and measured data, and to synthesize data in centralized data banks. Third, such data are often not easily accessible by concerned users. And, moreover, as users are not involved in decision-making about the required type of data, data quality and data networks, the data collected may have limited relevance to user needs. Overall, there is a need for further professionalization of data and information systems, including training and improved equipment for the cadres involved. A systematic and integrated approach to the spectrum of activities involved is required: measurement, collection, collation, quality control, storage, retrieval, dissemination and analysis. This integrated approach is getting underway in the eight states and five central agencies (CWC, CGWB, IMD, NIH and CWPRS) participating in the Hydrology Project.⁸¹

3.50 Limited Basin Modeling and Basin Planning: Actual basin modeling is even more limited than the hydrological data gaps above. It tends to be restricted to reservoir simulations specifically related to an investment proposal or dam safety, and

⁷⁹ "India - WRM Sector Review, Rural Water Supply and Sanitation Report" and "India - WRM Sector Review, Urban Water Supply and Sanitation Report" (World Bank, 1998c and e, respectively).

⁸⁰ CWC, CGWB, CPCB, Health, Environment, Rural Water Supply, the Indian Meteorological Department, etc. from the center; similar fragmentation at state levels; and a number of other actors such as industries and research centers. Box A7.1 illustrates this diversity.

⁸¹ The eight participating states are Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu. The World Bank/Netherlands-assisted Hydrology Project was approved in 1995.

comprehensive basin plans are either not present or are rudimentary. A few of India's centers of excellence and states are forging change: at the center, the CTU, CWPRS and NIH; and at the levels of some states, particularly in Orissa, Tamil Nadu, Rajasthan and Gujarat. However, such initiatives need to be generalized throughout India, and there is need for access to state of the art modeling software (refer Box A7.4).⁸²

3.51 Gaps in Performance Measurement and Monitoring: Performance measurement and monitoring are also inadequate. On only a few irrigation commands, for instance, is there accurate information to assess the impact of irrigation as a basis for making improvements. Even statistics on irrigated area can be unreliable, and usually the data available on irrigation efficiency and crop productivity are inadequate. Remote sensing is also seldom used. Better performance monitoring is also needed in the urban and rural water supply sectors. While smaller overall users of water, their performance levels are probably no better than in irrigation. Improvement by all sectors is essential to under-pin the drive to increase productivity.

3.52 Transparency, Public Information and Participation: Most important of all, there is need for full transparency of all such data to the general public, as well as public dissemination and public information and education campaigns on matters where the public should be particularly well-informed. This would further foster a demand-driven environment for change.

⁸² Assistance to these efforts is being provided by the World Bank. All WRCP projects contain a Water Planning and Environmental Management component, including basin modeling for all of the state's basins. This has included establishment of consultancy and training linkages with Hydraulics Research, Wallingford (U.K.), Delft Hydraulics (the Netherlands), various U.K. and U.S.A. universities, and several international consultancy firms. An inter-active decision-support model (using GAMS—general algebraic modeling system—software), has also been adapted for the Vaigai basin by a World Bank-Harvard team (refer para. 4.68). Support has also been provided through software and consultancy to the CTU.

MATRIX 1
EXISTING MECHANISMS AND LIMITATIONS

POLICY FRAMEWORK	
EXISTING MECHANISMS	LIMITATIONS
National Water Policy	<ul style="list-style-type: none"> • does not reflect the recent thinking stated in New Economic Policy, current Five Year Plan, "Report of the Committee on Pricing of Irrigation Water," and other experiences of the sector since 1987 • pre-determined priorities, inconsistent with social and economic value of activities concerned • over-emphasis on administrative mechanisms for water allocation, rather than value-based or compensatory mechanisms • inadequate emphasis on application of economic instruments such as water pricing and cost recovery • environmental issues inadequately addressed • weakness as policy guide due to generality • absence of legal provisions to operationalize and effectively implement • contradicted by existing laws in some cases • inadequately reflected in corresponding state-specific State Water Policies and basin-level policies and action plans • no mention of encouraging private sector participation • less emphasis on participatory approach to water resources management • inadequate focus on multi-sectoral approach to planning and management

Matrix 1 (cont.). Existing Mechanisms and Limitations

LEGISLATIVE AND REGULATORY FRAMEWORK	
EXISTING MECHANISMS	LIMITATIONS
State Powers over surface water as per the Constitution	<ul style="list-style-type: none"> • state jurisdiction fragments river basins • absence of a structured system and process for providing well-defined individual usufructuary rights for surface water • legal uncertainty surrounding water rights potentially creates conflict and imbalances in water development, stifles private sector investment in water projects, and constrains inter-sectoral allocation
Groundwater rights	<ul style="list-style-type: none"> • rights give groundwater private good context in its management and ignore social and environmental costs • inseparable linkage between land ownership and groundwater rights constrains potential for inter-sectoral allocation
Environmental Legislation <ul style="list-style-type: none"> • 1974 Water Prevention and Control of Pollution Act • 1977 Water Cess Act • 1986 Environmental Protection Act (EPA) 	<ul style="list-style-type: none"> • incomplete monitoring and enforcement • inadequate adaptation of laws to changing circumstances and new environmental protection needs
Regulatory Standards <ul style="list-style-type: none"> • Surface Water Quality Classification (CPCB) • 1983 Drinking Water Quality Standards (ISI) • Effluent Standards (EPA) • 1994 Environmental Impact Assessment Notification (EIAN) (MOEF) • 1989 Hazardous Waste Rules 	<ul style="list-style-type: none"> • inadequate application (except EIAN) • inadequate measuring and monitoring to enforce compliance • inadequate regulation of groundwater extraction, including absence of groundwater acts in virtually all states, no controls on well-spacing and abstraction, and ineffective indirect attempts at regulation by NABARD and State Electricity Boards

Matrix 1 (cont.). Existing Mechanisms and Limitations

INSTITUTIONAL MECHANISMS	
EXISTING MECHANISMS	LIMITATIONS
<p>State-level Institutions</p> <ul style="list-style-type: none"> • Irrigation/Water Resources Departments • Department of Agriculture, Urban Water Supply and Sanitation, Rural Water Supply and Sanitation, Industry, Environment, Health, etc. 	<ul style="list-style-type: none"> • absence of formal institutional mechanisms for coordinated multi-sectoral planning • bias towards irrigation and over-emphasis on civil works • fragmentation of responsibilities for water sector issues between different departments
<p>Local-level Institutions</p> <ul style="list-style-type: none"> • District and block administration • Village panchayats (revived under 73rd and 74th Constitutional Amendment Acts of 1992) • Water users associations 	<ul style="list-style-type: none"> • inadequate fostering of grass-roots institutions • lack of effective grass-roots management of water because of limited capacity (financial, technological, etc.) • erosion of informal and formal micro-level water user groups and lack of capacity (financial, technological, etc.) to effectively manage water resources
<p>Inter-State Level Institutions</p> <ul style="list-style-type: none"> • Advisory River Boards (under River Boards Act, 1956) • Adjudicatory inter-state water Tribunals (under Inter-State Water Disputes Act, 1956) 	<ul style="list-style-type: none"> • limited effectiveness of River Boards Act • limitations in Tribunal including: lengthy decision-making process, limited information-based decision-making, inadequate representation of disciplines, and lack of effective implementation and monitoring mechanism
<p>Central-level Institutions</p> <ul style="list-style-type: none"> • Ministry of Water Resources (including specialized organizations, e.g., National Water Resources Council, Central Water Commission, Central Ground Water Board, National Water Board, National Water Development Agency) • Other Ministries involved in water, including Ministry of Environment and Forests, Ministry of Urban Affairs and Employment, Ministry of Rural Areas and Employment, Ministry of Agriculture, Ministry of Power, Ministry of Surface Transport, etc. 	<ul style="list-style-type: none"> • fragmentation of water-related responsibilities, including surface and groundwater, water quantity and water quality, and sectoral water users • unclear responsibility divisions, over-lap, and inadequate handling of issues • lack of systemic cooperation among central-level institutions • inadequate coordination between GOI institutions and those at various levels (e.g. state, local, etc.)
<p>Civil Society and Private Sector</p> <ul style="list-style-type: none"> • Academic community • NGOs • Local communities • Private industry 	<ul style="list-style-type: none"> • limited efforts of government to inform public on water issues and thus general lack of awareness and participation, particularly of historically marginalized groups such as women and the poor • general neglect of potential contribution in multi-level water management, consultancy, technical assistance and training • hindered by various policy, legal and regulatory, and institutional barriers/obstacles (e.g., current water service charges and rates of cost recovery are incompatible with private sector participation)

Matrix 1 (cont.). Existing Mechanisms and Limitations

ECONOMIC MECHANISMS	
EXISTING MECHANISMS	LIMITATIONS
Intra-Sectoral Allocation and Pricing	
Irrigation Pricing	<ul style="list-style-type: none"> • current rates much lower than water provision costs due to no or very infrequent water rate adjustments • inadequate O&M and capital cost recovery • area-based charges unrelated to actual water use not effective for efficient water use • nominal impact of low rates on farmer water use decisions • lack of transparent information on water charges, the necessary costs of effective O&M, actual expenditures on O&M, the size of existing subsidies, environmental costs, etc.
Groundwater Pricing	<ul style="list-style-type: none"> • absence of direct charge for water use from groundwater sources (indirect pricing through diesel power costs (price of fuel) and electricity pricing) • no disincentives for water waste and excessive extraction of groundwater due to low (in some cases zero) rural power charges and flat rate (non-volumetric) pricing for electric pumpsets • lack of transparent information on actual costs of power provision, the size of existing subsidies, environmental costs, etc.
Agricultural Pricing and Marketing Policies	<ul style="list-style-type: none"> • indiscriminate water use due to subsidization of agricultural inputs (fertilizer, herbicides, etc.) • distortions in cropping patterns and consequent inefficient water use due to commodity pricing and marketing systems affecting crops and regions differently
Rural Water Supply Pricing	<ul style="list-style-type: none"> • overwhelming tendency to subsidize water • predominantly government-managed (as opposed to locally or community managed) • inadequate cost recovery and poor service
Urban and Industrial Water Supply Pricing	<ul style="list-style-type: none"> • infrequent rate adjustments and low water charges • lack of comprehensive metering and volumetric water charging, particularly for domestic consumers
Incentives for Pollution Control <ul style="list-style-type: none"> • Fiscal incentives for pollution control (offered to industries by GOI) • Pollution taxes (set by environmental control boards) 	<ul style="list-style-type: none"> • taxes/penalties ineffective in sending appropriate signals because fees are nominal and not linked to amount of pollution emitted • poor industrial compliance due to low cost of non-compliance (e.g. inadequate regulation and enforcement, low penalties)

Matrix 1 (cont.). Existing Mechanisms and Limitations

ECONOMIC MECHANISMS (continued)	
EXISTING MECHANISMS	LIMITATIONS
Inter-Sectoral Allocation	
Current Allocation Mechanisms	<ul style="list-style-type: none"> • allocations are administratively determined and decisions are made on ad hoc basis, not through a comprehensive planning process with stakeholder involvement • allocations are largely bound by history and re-allocations are made according to prescribed priority ordering of uses, rather than through consideration of relative value of water in various uses • re-allocations typically done through compulsory acquisition and without compensation or participation of stakeholders involved
Water Trading and Water Markets	<ul style="list-style-type: none"> • absence of well-defined water rights, regulatory framework, institutional structure and enabling technology does not enable formal transactions in water and development of inter-sectoral water markets • existing water markets, typically in groundwater for irrigation, localized and fragmented
Inter-State Allocation	
Current Allocation Mechanisms	<ul style="list-style-type: none"> • decisions are largely based on historical use and are administratively determined, with limited reference to economic and regional considerations and limited participation of concerned parties • limited consideration of possibilities for selling/leasing arrangements between states sharing a river basin • lack of multiple objective development programs on a river basin basis

Matrix 1 (cont.). Existing Mechanisms and Limitations

TECHNOLOGY & DATA AND ANALYSIS	
EXISTING MECHANISMS	LIMITATIONS
Technology and Water Productivity	<ul style="list-style-type: none"> • poor water use efficiency and productivity of end use in all sectors due to physical deficiencies in water infrastructure (e.g., delivery/conveyance systems), inadequate application of water-saving technologies (e.g., drip and sprinkler irrigation, treatment and recycling/reuse of urban and industrial water) and inadequate application of water-saving techniques (e.g., watershed management, water harvesting) • over-emphasis on supply augmentation through traditional structural means and limited efforts to conserve water through demand management, including use of water-saving technologies/techniques, pricing incentives, regulation and public awareness
Data, Basin Modeling and Performance and Environmental Information Systems	<ul style="list-style-type: none"> • hydrological data gaps including: gaps in measurement stations for river flows, groundwater levels, water quality, and meteorology; poor quality of measuring equipment, methods of data collection and collation; poor coordination between institutions involved in data measurement, collection, collation and storage; limited relevance of data to user needs and restricted dissemination of available data • limited and incomplete use of basin modeling with stakeholder participation to analyze various water resource development scenarios and to assist in decision-making • gaps in performance and environmental measurement and monitoring • lack of transparency, public information and participation

IV. REFORM OPTIONS AND RECOMMENDATIONS

4.01 The review in Chapter III of the nation's existing mechanisms for water resources allocation, planning and management—their limitations and opportunities for improvement—sets the stage for the reform options and recommendations discussed in this chapter. The recommendations will necessarily need to begin from the current status of water resources management in India. Thus, many, especially at state and basin levels, can be considered as starting actions in what will need to be an energetically implemented process of change. The change process should aim to reach longer-term goals exemplified in the various cases of successful water resources management referred to in this report. Such longer-term vision is further discussed in Chapter V (refer paras. 5.02 to 5.03).

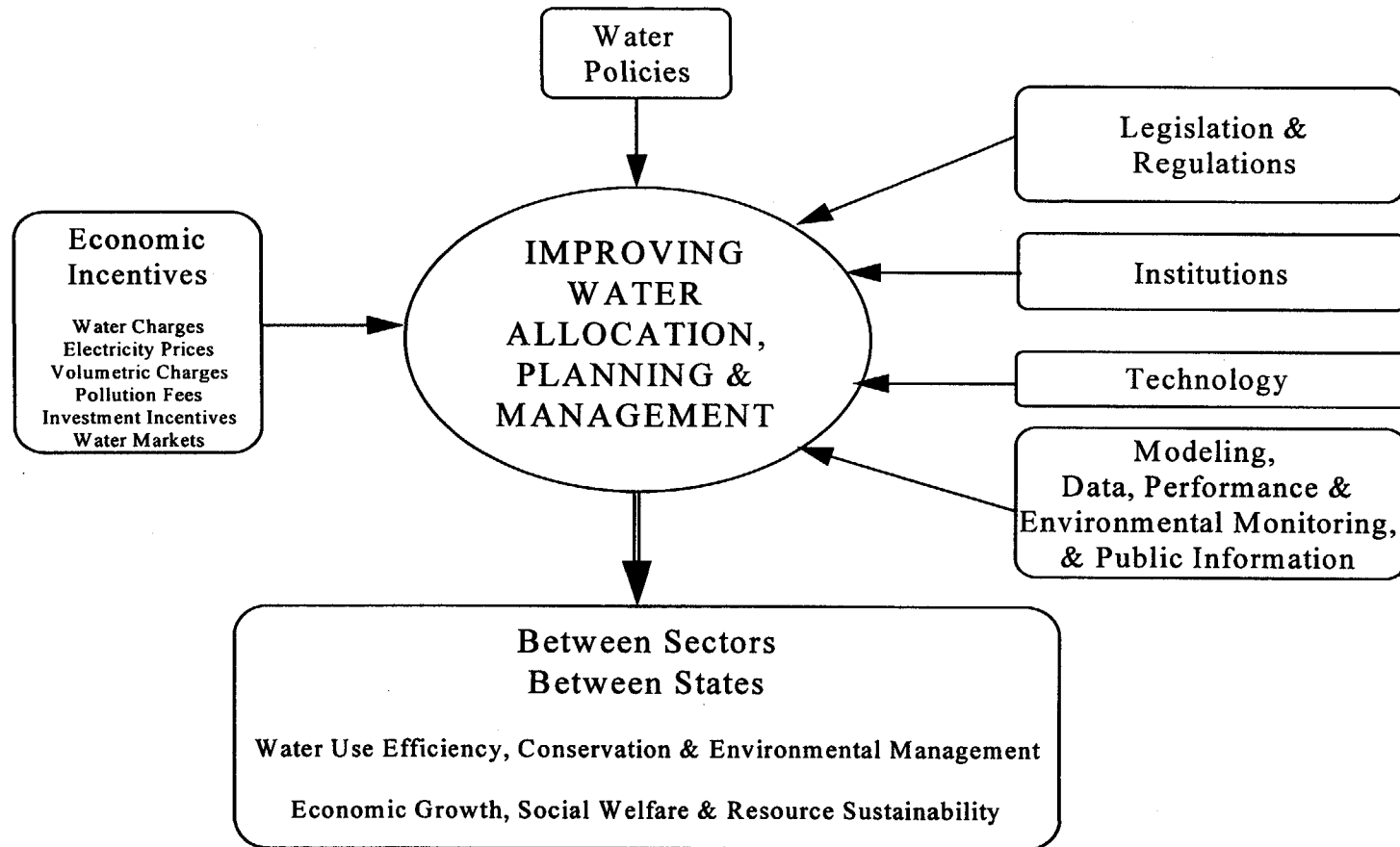
4.02 The options and recommendations presented in this chapter will aim at:

- (a) Improving the Policy Framework;
- (b) Strengthening the Legislative and Regulatory Framework;
- (c) Establishing Government and Non-Government Institutions for Water Resources Management;
- (d) Introducing Economic Incentives for Efficient Water Use;
- (e) Upgrading Technology to Enhance Water Productivity; and
- (f) Improving Modeling, Data, Performance and Environmental Monitoring and Public Information.

Within this framework, several other attention areas will also emerge: (i) the need for public-private sector partnership; (ii) the need for greater decentralization, stakeholder participation and involvement of grassroots organizations; and (iii) the need to place much greater emphasis on demand management. Chapter V will further discuss the enabling environment and the incentive framework for implementing the change process, and make specific recommendations on the timing and strategically most immediate actions to start the reform program.

4.03 The main intervention areas discussed in this chapter are shown in Diagram 1 (“Interacting Areas for Improving Water Resources Management”).

**DIAGRAM 1:
INTERACTING AREAS FOR IMPROVING WATER RESOURCES MANAGEMENT**



A. IMPROVING THE POLICY FRAMEWORK

4.04 Fundamental to improving India's water allocation, planning and management is the establishment of a relevant policy framework at the levels where policy needs to be implemented. The key gap is at the state level where, except for Tamil Nadu, Orissa, and Rajasthan (under preparation), State Water Policies do not exist.⁸³ Thinking through and establishing a coherent policy guide for its water sector is an essential first step for a state to commence the more comprehensive treatment of water that is required. Formulating the policy would provide the opportunity to review all water-related interlinkages, including agriculture, urban and industrial, and environmental. Such a policy statement could also outline the key legislative, institutional, economic and technological actions that the state envisages to improve management of its water resources.

4.05 The existing National Water Policy (NWP) also needs updating. This would likely require longer to formulate than the individual state-level policies above because of the need for dialogue and consensus across states. The most urgent need is for policies at the state-level, where most water decisions are taken and where policies are usually absent. A longer time-frame for revising the NWP would be needed and may enable benefiting from the deliberations at state levels.

4.06 Core features of the State Water Policies and of the revised NWP should include:

- Comprehensive approach to water development on a river basin basis.
- Treatment of surface and groundwater as a unitary resource.
- Multi-sectoral perspectives integrated in all decisions and planning.
- Integration of both quantity and quality-related aspects of water use and development.
- Full integration of environmental and health aspects.
- Integration of pricing and economic incentives.
- Introduction of administrative allocation mechanisms incorporating economic or value-based criteria, as well as promotion of market-oriented approaches,⁸⁴ together with regulatory mechanisms, to water management.
- Greater emphasis on demand management approaches.
- Assured O&M funding and related policies and revenues (water charges) generation.
- Technology improvement aspects, including productivity enhancement, water conservation and water reuse.
- Intended implementation actions, including core reform areas for legislation, institutions, the incentive environment, and technology.
- Participatory approach to water resources management.
- Private sector participation.

⁸³ Preparation of a State Water Policy is a standard part of the preparation process for a WRCP project financed by the World Bank.

⁸⁴ Development of brokered compensated trades and possibly water markets, initially on a pilot basis (refer paras. 4.55 to 4.60).

B. STRENGTHENING THE LEGISLATIVE AND REGULATORY FRAMEWORK

4.07 Revising and strengthening the legislative and regulatory framework will be fundamental to long-term improvement of India's water resources management. The existing legislation provides a useful starting base, but as discussed in paras. 3.06 to 3.13, requires supplementing in a number of key areas. Given that some changes, particularly those involving consensus across states, may take longer to implement than others, an opportunistic approach would likely be required, making the adjustments that are most urgent or can be done easily first. More reform-oriented states or those states where existing legislative inadequacies are particularly constraining are likely to lead the way in state-level legislative reforms. The center can take action to support the state-level legislative reforms and can, simultaneously, enact legislation supporting inter-state cooperation. Again, such central actions should focus on areas where reform is recognized as particularly pressing. Such a "cherry-picking" approach rather than attempting comprehensive, simultaneous change will get a process started and create an environment for enacting more difficult changes later on.

4.08 The areas where legislative change are particularly required are:

- Amending existing state-level legislation to enable implementation of State Water Policies.
- Issuing State Groundwater Acts to regulate groundwater exploitation.
- Enacting or amending central legislation to enable the center to play a more pro-active role in planning and management of water resources from the national perspective, including in establishment of river basin organizations.
- Enacting or amending central legislation to enable better conflict resolution and functioning of Tribunals.
- Modifying the water rights system in order to provide for secure, defensible, and enforceable ownership/usufructuary rights to surface and groundwater.

Reviewing and Amending State-level Legislation

4.09 Given that the primary responsibility for water development and management is at state level and much of the supporting legislation is also under existing state laws or needs to be included in state laws, an evident need is to make necessary legislative changes at the level of each state. Legislation needs are state specific, depending both on the issues and development objectives in each concerned state and the existing status of the current legislative framework. In most states, typical needs for new or revised legislation will be in areas such as: (i) the laws required to implement new or revised institutions and institutional responsibilities for water resources management; (ii) laws relating to strengthening regulation of water resources; (iii) legislation relating to pollution control; (iv) enabling legislation for establishment of water user and multi-sectoral stakeholder

associations and participation of the private sector and civil society;⁸⁵ (v) enabling legislation for new forms of water charges and collection procedures; and (vi) specific legislation regarding water rights and groundwater management. No uniform prescription can be given for the new or amended legislation required in any particular state. Each state should thus undertake a review of its existing legislation in light of its State Water Policy and development objectives for the water sector. On that basis, a set of legislative adjustments should be submitted to the state authorities for consideration and subsequent enactment. The legislation needs to be paralleled by strengthening or creating the institutions required to implement and enforce it (refer para. 4.24).

Groundwater Legislation

4.10 A specific need in all states is the enactment of groundwater legislation to enable better regulation and management of groundwater development and extraction. Although a Model Bill for groundwater regulation has been prepared by the Central Ground Water Board, none of India's states have enacted it wholesale. A few states have enacted specific pieces of legislation, addressing concrete objectives. These are: (i) the Act limited to groundwater in the Chennai metropolitan area and (ii) the Bill limited to protecting drinking water sources in Maharashtra. However, implementation of these laws has been only marginally successful in achieving the stated objectives. The evident political difficulties of the states in implementing a state-wide bill on groundwater regulation points to the need for a more widely acceptable formula. In the "India - Water Resources Management (WRM) Sector Review, Groundwater Regulation and Management Report" (World Bank, 1998d), a variant of this has been proposed, emphasizing the establishment of a state-level enabling framework and a grassroots approach to implementation, and focusing initially on the most critical aquifers. This is likely to be the way forward and the approach should be examined by each state as a basis for preparing the state's own legislation and regulatory framework.

Amending the River Boards Act

4.11 The treatment of water primarily as a "State Subject" significantly weakens the capacity of the center to assist the states in improving water resources management and in resolving inter-state water sharing issues.⁸⁶ No river basin organizations have to date been

⁸⁵ Salman, 1997.

⁸⁶ Although not a recommendation made in this report, some observers have suggested that the Constitution should be amended to include "water resources abstraction, extraction and use" on the Concurrent List. Water would thereby become an item open for the Union Legislature to legislate upon, with resulting bills/acts being adapted and subsequently adopted by states through separate legislative action. It has been argued that such a constitutional amendment would recognize water as having both national and inter-state dimensions for purposes of planning and management across state boundaries as well as being a "State Subject" in terms of specific implementation of development projects and management of state water resources. However, placing water on the Concurrent List would require concurrence of a majority

created under the 1956 River Boards Act despite the widespread view in India that there is great need for improved collaboration between states for inter-state rivers. The problem is that on such inter-state rivers there is usually at least one riparian (usually the upstream state) which has less interest in the establishment of a RBO. The Act presently requires the prior consent of the states. A simple amendment would be to give powers to the Central Government to establish a RBO suo moto. This would be permissible under India's present Constitution as the River Boards Act comes under the "Union List" (Entry 56), which clearly recognizes a role for the center in managing inter-state rivers. Amendment of the Act could be achieved through simple majority in Parliament and would be an important under-pinning step for establishing RBOs. Opinions on this vary in India and there are concerns at state levels that this would give undue power to the center. A variant of the above would be to empower the center to coordinate the creation of an inter-state RBO where at least one state has requested this and after an agreed time period for the states to take action at their levels.⁸⁷

Strengthening the Tribunal Awards System

4.12 The existing Tribunal Award system for resolution of inter-state disputes needs to be substantially streamlined. The following complementary and mutually-reinforcing options should be adopted to ensure both consistency in the quality of decision-making and expediency in the adjudication process:

- Empowering the Central Government (by necessary amendments to the existing Inter-State Water Disputes Act of 1956) to facilitate institution of Tribunals.⁸⁸ Specifically, the Act should be amended with a provision that on receipt of a grievance from any party (state) the center may constitute a Tribunal after one year if the co-basin states have not yet arrived at a negotiated settlement.⁸⁹
- Introducing mandatory time-limits for: (i) the time between request or decision for a Tribunal and its establishment; (ii) the announced decision of a Tribunal; and (iii)

of the states and considerable dialogue, and is unlikely in the short term. Meanwhile, other measures to improve inter-state and center-state interactions on water have been recommended here instead.

⁸⁷ Amending the River Boards Act to give suo moto powers to the center was the subject of considerable debate at the National Workshop, with a number of state representatives opposed to the idea. Part of the reservations may have been due to absence of a clearly defined structure and mandate of the term "RBO" in India. It is recognized that opinions in India on this issue are likely to differ. It would thus be appropriate for state governments and the Central Government to reflect further on this issue.

⁸⁸ It should be noted that at the National Workshop, while there was substantial agreement amongst the state and central government and non-government participants on this issue, a few states had queries or reservations.

⁸⁹ This is consistent with the "Sarkaria Commission Report" (1988) recommendation that the Inter-State Water Disputes Act should be amended to provide suo moto powers to the center to establish Tribunals. The modified recommendation provided here after the National Workshop has the advantage of allowing the states to come to agreement amongst themselves, the Tribunal process thus being a back-up last resort. It is also consistent with Entry 56 of the Constitution where a pro-active role by the center is clearly indicated.

the time period available for a state to present any objections to a Tribunal decision and for response by other parties.

- Creating a statutory authority for the effective implementation of the Award and for managing the river basin whenever a Tribunal Award is made.
- Fixing by law the review of Tribunal Awards at set intervals (say, 50 years). This will help in allaying the states' understandable reluctance to lock themselves in deals they may later regret as circumstances change.
- Establishing basin fact-finding mechanisms, with the participation of the center and of the concerned states. A river basin organization could perform this function.⁹⁰
- Modifying criteria for awarding decision to incorporate economic or value-based considerations.

Water Rights

4.13 A more clearly defined system of usufructuary/ownership rights and a process for the granting by government of these rights needs to be established. For surface water there are two options: (i) abolishing riparian rights of individuals and introducing a system of government-administered water abstraction and use licenses, and (ii) maintaining riparian rights but introducing government-administered licensing requirements. Both options are equal in terms of the complexities associated with their implementation and administration. However, the latter option is more feasible given that it represents a less radical departure from existing legal provisions in maintaining the link between riparian land and surface water rights.⁹¹

4.14 Water rights options for groundwater include, (i) replacing the rule of absolute ownership of groundwater with a statutory system of permits for groundwater prospecting, extraction and use, and (ii) providing the government with stand-by authority to institute a permit system for groundwater extraction and use on a selective basis, limited to the aquifers in need of priority attention. The second option is the approach reflected in the Model Bill for groundwater regulation (June 1996 version), circulated by the Central Government to the states. It is also the approach reflected in the legislation enacted by the States of Maharashtra, Gujarat, Karnataka and by the Union Territory of Pondicherry. The advantage of this option over the first is that it offers flexibility to direct effort and resources where the need is greatest. However, a risk is that it may perpetuate ad hoc reactions to crises unless comprehensive, long-term preventive measures are also introduced.

⁹⁰ The Role of the RBO could be restricted to determining the facts and verifying the supporting data (within a fixed deadline of 12 months). These would only be presented by the parties before the Tribunal, with a view to facilitating its decision on the uncontested facts. Where a Tribunal is involved, the center's presence on the Board of the RBO is also advisable to help guide and orientate the Board's functioning.

⁹¹ This is the approach which was adopted in England and Wales when, starting in 1963, all new riparian abstractions and uses of river water were subjected to licensing requirements.

4.15 For both surface and groundwater rights the following substantive features would be required. First, due regard should be given to existing surface water and groundwater abstractions and uses at the time the government-administered permit requirements are introduced. Appropriate provisions to protect such rights might be obtained from international experience in establishing new water rights systems (refer Boxes A5.1 and A5.2). Second, permits should not be unconditional, but should be made subject to terms and conditions, including quantity and rate of water withdrawal, duration of the right, purpose of water use, manner of use, point of abstraction (or location of well) and point of return of excess flows. Third, the water right should be subject to suspension or cancellation under specific circumstances, with necessary safeguards. Fourth, records should be made and updated of all water rights licences. Finally, water rights should be transferable: the ability to conduct exchanges of water rights for a temporary (leasing) or permanent period of time, is vital for the water rights system to generate incentives for both water conservation and optimal allocation.

4.16 In the Indian context, practical means of initially implementing water rights may be required. Initially, piloting could be done in selected areas, where water is more scarce and the potential for mutual benefits from water trading are evident (refer Boxes A5.4 and A5.6). Also, it may not be practical to commence with individual rights. Instead, licensing could be done for bulk allocations to formal water user groups or other local-level institutions. In turn, the water user groups would further distribute and arbitrate informal water rights amongst their members. The individual's water security will derive from the security of the water rights held by the representative group (e.g., water users association, community or apartment dwellers' association, village panchayat or municipality). Most important, and stressed by Indian planners, the institution of a water rights system would need to be undertaken in a careful manner which recognizes the unique characteristics of different regions—as defined by their hydrological, climatic and socio-economic conditions—and, in particular, contain features that safeguard social welfare and the environment (refer para. 4.58).

Other Central Legislation

4.17 While amendments to the River Boards Act and Inter-State Water Disputes Act are the most important central legislation needs, the need for other legislative adjustments should also be reviewed. It is recommended that a task force be established to review the adequacy of existing central legislation and any further amendments or new legislation that might be required. For instance, further backstopping legislation may be necessary for the handling of various environmental issues.

C. ESTABLISHING GOVERNMENT AND NON-GOVERNMENT INSTITUTIONS FOR WATER RESOURCES MANAGEMENT

4.18 Institutional mechanisms need to be created or strengthened at all levels—state, grassroots, basin and union—to enable implementation of efficient water allocation, planning and management. These institutions should include various forms of private sector involvement, as well as the participation of local-level and non-governmental organizations. As additional responsibilities are shouldered by the non-governmental sector, central and state institutions can modify their role accordingly.

Building Non-Governmental Participation

4.19 Underlying all initiatives should be an orientation to foster the role of stakeholders, civil society and the private sector in decision-making and implementation. Government has an important role to play in water allocation, planning and management, but is only an influencing actor on the primary stakeholders involved. These stakeholders include every household in India as a consumer of water, all of India's farms, commercial entities and industries, and larger community aggregates such as water users associations, villages, associations of industries, etc. Even within government, the state or central-level institutions are only at the apex of an array of more local institutions: panchayats, block and district administrations, municipalities, etc. The higher level administrations, both at state and central levels, are not the directly concerned stakeholders. They are not directly accountable, are too far from the action to be effective at grassroots levels, and do not have the staff or financial capacity to be deeply involved at micro levels. Thus, emphasis should be placed on enhancing the role of the direct stakeholders in water management, planning and allocation.

4.20 Nevertheless, government has a critically important role to play. Government has, to date, held almost exclusive responsibility for all decision-making, investment and management in the water sector. As a result, civil society institutions in the water sector are weakly developed or non-existent. Local government administrations, such as the panchayat (village level) institutions, are also still fragile and require progressive strengthening. Government will need to play a lead role in fostering and catalyzing change to greater civil society and grassroots involvement. Creating this enabling environment for change will be one of government's greatest challenges.

4.21 The government will thus continue to play a core role. It is through government that legislation, the regulatory apparatus, and much of the pricing and incentive environment is created and applied. Government as a neutral party is also needed to resolve some disputes. Government, if well associated with the academic community, researchers and civil society groups, is best able to identify negative externalities and inter-generational issues that need to be incorporated in decision-making. Many environmental or social issues, for instance, have temporal or externality dimensions and can only partly

be accommodated through market mechanisms or interactions between the directly concerned players (refer Box A4.10).

4.22 Building the role of the non-government sector will require energetic actions by government. First, there is a substantial need for better public awareness of water resources issues, and public education and outreach should become a primary function of state and central water resources agencies. Then, there is need to encourage other actors to get together and to form grassroots or larger institutions. This can require massive effort by government and can usually be further enhanced by involvement of leading NGOs and academics. For instance, the recent creation across the state in Andhra Pradesh of WUAs required a vast political mobilization campaign and major training and support by the government agencies. Creation of grassroots-led RBOs in India would also likely require facilitation and training by government or NGOs.

4.23 Paradoxically, there is still urgent need to create and strengthen government institutions, particularly at state levels. This is because in most states, while specialized agencies exist for particular components in the water sector (e.g., irrigation, municipal water supply, rural water supply, hydropower, etc.), there are no such institutions for inter-sectoral coordination and management of water resources (refer paras. 3.16 to 3.17). Without these, the capacity to do the critical activities described above is not present. Thus, the options and recommendations discussed below include both the strengthening of the government apparatus—but in defined areas related to the above objectives—and the encouragement of a greater role for the non-government sector.

Creating a State-level Structure

4.24 The complete absence of state-level institutions for inter-sectoral water resources allocation, planning and management needs to be rectified as a matter of urgency. The initiatives undertaken by Tamil Nadu and Orissa States, assisted under their World Bank-financed Water Resources Consolidation Projects (WRCPs), initiatives in other states,⁹² and various international examples also cited in this report, can be used as models, with

⁹² For instance, Maharashtra has created a “Water Resources Authority” under the chairmanship of the Chief Minister. The authority comprises experts from the different sectors, NGOs, the Chief Secretary and other concerned Secretaries and meets at two to three month intervals. The Member Secretary of the Authority is the Secretary, Water Supply and Sanitation Department. Maharashtra also intends to strengthen the environmental capability and focus of this structure. Substantial actions are also intended by Punjab under its recently issued State Water Policy. A multi-tiered institutional structure is proposed: (i) a “Water Resources Council,” chaired by the Chief Minister; (ii) a “Punjab State Water Resources Committee” with multi-sectoral representation at Secretary levels and chaired by the Chief Secretary; (iii) a “Technical Advisory Committee,” comprising heads of department and other water professionals; and (iv) for handling water issues at decentralized levels, six “Regional Technical Advisory Committees,” including local representatives of user departments, chairmen of local bodies and Zilla Parishads, representatives of regional farmers and WUAs, and regional non-government organizations active in the water sector.

appropriate adaptation to suit the specific circumstances of each state (refer Box A3.7).⁹³ As far as possible, existing initiatives or institutions should be used as a starting point. The first need is to establish a multi-sectoral institution at the level of each state for making decisions and undertaking planning and analysis. This would be through creation of a State Water Resources Board, including technical and environmental capabilities.

- Establish a State Water Resources Board (SWRB). The SWRB would be the state's most senior body for making decisions on water policy, water allocation between sectors, planning of water development programs, and resolution of water resources issues. It would be a formal committee comprising the heads of all relevant government departments and agencies connected with water, supplemented by representatives from water users associations, industry, other stakeholders and academia. It should be chaired by a neutral senior party: for instance, the Chief Minister, Chief Secretary, Finance Secretary or Development Commissioner.⁹⁴ Initial experience also suggests that a specialist working group can be useful for the more technical work of the SWRB. An environmental working group is also useful to provide sufficient focus on environmental issues.
- Establish the SWRB's State Water Planning Organization (SWPO). The SWPO would be the technical secretariat for the SWRB and would comprise full-time professional staff in areas related to multi-sectoral water resources planning and management: hydrologists, basin planners, economists, and sector specialists from irrigation, urban water supply, rural water supply, industry, power, groundwater, agriculture, environment, etc. As far as possible, staffing should be through transfer or secondment of existing staff from the various government departments.⁹⁵ The head of the SWPO would be a senior officer (Additional Secretary rank/equivalent or above) and would also serve as Member Secretary of the SWRB. The SWPO would, as one of its primary functions, prepare comprehensive basin plans for all river basins in the state and a State Water Plan, undertake special studies of particular water resources issues, and prepare environmental management plans by river basin.⁹⁶ Where feasible, an existing institution may be adapted to become the SWPO. For instance, in Tamil Nadu the Institute of Water Studies had responsibilities redefined by Government Order to serve this purpose.

⁹³ Similar initiatives are also underway in Rajasthan State as part of its preparation work for the proposed WRCP in Rajasthan.

⁹⁴ Different options are available for the chairmanship of the SWRB. The likely most operational structure would be that it is chaired at the administrative rather than political level. For instance, in Orissa the SWRB is chaired by the Chief Secretary. As needed, issues or recommendations are brought to the Cabinet (Chief Minister and other Ministers). Alternatively, the SWRB could be chaired by the Chief Minister or other neutral senior Minister (for instance, in Tamil Nadu the State's equivalent of the SWRB—the "Water Resources Council"—is chaired by the Chief Minister). In such situations, a second tier executive committee should also be present in the SWRB, chaired at the Secretary level, in order to ensure regular and frequent meetings of the SWRB.

⁹⁵ There will also be need for some recruitment of additional specialist expertise, particularly in economics, basin modeling and computerization, which can be drawn from universities, consultancies or other organizations.

⁹⁶ An example is the Environmental Management Plan prepared for the Bhavani basin by the Institute of Water Studies, Tamil Nadu.

- Establish environmental management capability in SWRB and SWPO. Special measures will usually be required to establish dedicated capability to handle environmental matters. As discussed above, a special environmental working group should be established under the SWRB. Within the SWPO and at basin levels (see below), an Environmental Unit should also be established. Membership of the environmental working group and staffing of the Environmental Units can generally be found from existing government or academic institutions (e.g., from universities, the SPCB, Environment Department, Department of Health and Family Welfare, Irrigation Department, Groundwater Department, etc.).⁹⁷

4.25 Institutional adjustment is also needed at the states' operational levels. This will generally require institutional adjustment of the main agency responsible for bulk water supply and water resources management, with particular focus on river basin management and a multi-sectoral approach.⁹⁸

- Reorganize and broaden the mandate of the Irrigation Department. The Irrigation Department should be restructured and reorganized from the traditional narrow focus on irrigation infrastructure. The reorganized department would have comprehensive responsibility for overall basin management, including surface and groundwater, bulk water supplies to urban, rural and industrial consumers, irrigation services, and flood and drainage management. This would typically involve the handling of additional specialist functions such as hydrology and water resources data, absorption of staff and responsibilities from other government departments such as groundwater, and, very importantly, reorganization of field staff along river basin lines (or groups of contiguous basins where small) under River Basin Managers. They would also provide key technical inputs to the SWPO and SWRB. The SWRB, however, would be the core institution for multi-sectoral planning and allocation decisions, and care is needed to ensure that even such a broadened irrigation or water resources department does not have undue influence in the SWRB.⁹⁹
- Create river basin organizations (RBOs) at state level. This would be done progressively, commencing with basins where there is particularly obvious need and stakeholder interest. The objective would be to implement integrated basin management at the operational (i.e., basin) level with stakeholder participation.

⁹⁷ The key is that environmental capability needs to be created. The environmental units or cells would be integrated within these institutions and should not be considered as separate entities. All planning, decisions and modeling should integrate environmental considerations as part of the process.

⁹⁸ Typically in India the primary agency is the State Department of Irrigation or Water Resources, but these need adaptation to a broader role.

⁹⁹ Effectively, irrigation departments should become "Departments of Water Resources" (DOWRs), with a basin management role going well beyond the current mandate. This is being implemented under the Tamil Nadu and Orissa, and (forthcoming) Rajasthan WRCPs. An issue requiring care is to ensure that the SWRB and SWPO are not unduly influenced by any one sectoral user. For instance, in both Tamil Nadu and Orissa the SWPOs have both been created through reorganization of existing units within the former public works/irrigation departments. This is proving a useful interim arrangement, but consideration should soon be given to making the SWPOs independent and answerable only to the SWRB. Current thinking in Rajasthan is to create a SWPO with such independence from the outset.

Initiation of these would be through the River Basin Managers. An initial and already considerable task would be to bring together the various governmental stakeholders from the different sectoral users. This should progress as quickly as practical to incorporation of private sector interests (e.g., water users associations, industrialists, NGOs), and where already readily identifiable, such stakeholders should be included from the outset. Over time these RBOs would assume increasing importance.¹⁰⁰

4.26 In implementing the above institutional adjustments (refer paras. 4.24 and 4.25), two areas should be emphasized:

- Training and technical assistance. For all of the above, major training, staff familiarization, and cultural awareness is required. For instance, most staff in state irrigation, urban and rural water supply, power and other water-related departments have almost minimal familiarity with comprehensive basin planning, water resources management, and environmental issues. Careful selection of staff with appropriate specialist backgrounds from different government departments would partially meet these constraints. Linkage through contracts or other arrangements with state universities would also be helpful. Such initiatives would, however, need major training and provision of consultancy assistance to transfer the specialist expertise required. The SWPO and the Environmental Units would also need the full range of equipment, computers and software required.
- Public Awareness and Involvement. This is a central and critically important need. In order to enable acceptance of water allocation, planning and management decisions, the public needs to be well informed. Likewise, the public should be brought into decision-making and information should be transparent and flowing in both directions: from government to civil society and from civil society to government.

Establishing Grassroots Institutions

4.27 A core function of the state-level institutional structure described above should be to develop and foster grassroots institutions for managing and allocating water. These could fill various niches within a river basin: village level (for instance, village water committees under the panchayats, particularly for assuring rural water supply), sub-watershed levels, district levels, and for the whole river basin. As discussed in paras. 3.19 to 3.23, major opportunity exists to establish micro-level institutions, in part building on already established water users associations and through the opportunities created under the Panchayat Raj Acts. It is, further, at this level where most water issues initially arise (e.g., point pollution from an industry, over-exploitation of groundwater by a few village farmers to the detriment of drinking water for the rest of the village), and where the stakeholders can most effectively meet together to find mutually acceptable solutions. Micro-level institutions also form the democratic base for the larger institutions required at

¹⁰⁰ As discussed elsewhere in this report, RBOs can take various forms and degrees of autonomy and executive power. At its simplest, a RBO could be a consultative mechanism (e.g., formal or informal committee) for dialogue between stakeholders.

basin level and in representation in the SWRB. The array of field-based NGOs in most states, as well as other forms of civil society, such as the outreach activities of industries and academic institutions, form an important source of talent that can be channelled to support such initiatives.

4.28 The approach to achieving this is likely to be state specific. In all states, the state institutional structure described above would likely be an important leader of such initiatives. In particular, the basin managers and their field staff could play an important extension role, but should link-up with universities and NGOs. Other key government departments would include the agency responsible for rural water supply and the district commissioners and block level administrations, but interest would be found in many other government departments as well. The restructured Irrigation Department and its basin-organized field staff could commence and coordinate the mobilization effort, which should begin with a broad consultation process with NGOs, stakeholders and other government departments. Initially, a piloting approach would be best, concentrating resources and gaining experience from several localities where stakeholder interest is already high. As with the staff for the new state-level institutions, training and technical support would be required to assist the grassroots-level institutions. Most panchayat institutions, for instance, are still in their infancy, with a still fragile social organization and financial base. An example of a state government-World Bank sponsored initiative to commence building a stakeholder-based RBO is ongoing in Tamil Nadu's Vaigai basin, as described in Box A3.8. The key need is that devolution and decentralization of responsibilities and encouragement of grassroots institutions must be accompanied by sustained efforts and resources towards capacity building in all required areas (training, extension, monitoring, accounting and auditing as needed, technology transfer, assistance with necessary equipment or micro-level financing as required, etc.).

Role of the Private Sector and Civil Society

4.29 The private sector, academics, NGOs and other civil society should be maximally integrated in both government and grassroots institutional initiatives. The private sector itself—industry and commerce—is a key user and stakeholder in the water sector. Industrial GDP now exceeds agricultural GDP and its far faster growth rate will increase its importance over time. It is, thus, important that industrial and commercial representatives are involved in water planning and allocation decisions. Establishing an incentive and regulatory environment to encourage water conservation, recycling and reuse is clearly needed as these water users and polluters become increasingly significant. The private sector can also be an important leader of change and innovation as demonstrated, for instance, by the Indian Water Works Association sponsored by the private sector.¹⁰¹

¹⁰¹ Brook Cowen (1997) provides further discussion on encouraging private sector involvement in the water sector.

4.30 The academic and research community should also be more greatly involved. A number of Indian universities have developed expertise in the water sector: for instance, Anna University and the Indian Institute of Technology in Chennai, the Engineering Staff College of India at Hyderabad, etc. Where, as in practically all states, basin modeling and environmental analysis needs to be enhanced, involving or sub-contracting academic or research centers or consultants would generally achieve higher quality and lower government costs than attempting to create such capacity entirely within the government sector.

4.31 Efforts should also be made to actively integrate groups that have tended to be marginalized, particularly women as they are often the primary stakeholders (refer para. 3.20). Examples of initiatives with women's participation are contained in the India - WRM reports on RWSS, UWSS and Irrigation (World Bank, 1998c, 1998e and 1998f). For both RWSS and UWSS, women are most directly involved. Amongst the leaders of change are NGOs such as the Self Employed Women's Association (SEWA) and Slum and Pavement Dwellers' Association Resource Center (SPARC). For instance, SEWA has campaigned in Gujarat to involve women in all RWSS decision-making and implementation, and for women's associations as a basis for community participation.¹⁰² SPARC's program in Mumbai to assist slumdwellers in gaining access to water supply is operated through women's groups. Swayam Shikshan Prayog and DRDA are amongst other NGOs active with women's groups. In Aunli irrigation command in Orissa, a group of women have formed a WUA as a result of discussions within the village, facilitated by a NGO, the Youth Services Center.¹⁰³ The WUA is headed by a 13 member executive committee comprised entirely of women and including 52 women members (out of a total of approximately 225 members). The executive committee is responsible for making decisions about water sharing and distribution between the users and the various uses of irrigation canal water (including agriculture, washing, bathing and livestock requirements), as well as for monitoring these allocations. Under a GOI-financed program, Mahila Samkhya, women in Banda District, Uttar Pradesh concerned with water supply have formed a registered group which monitors and maintains hand-pumps in the area.

4.32 For most institutional initiatives a combined government-civil society approach may be appropriate. For instance, to implement the Calcutta Environmental Management Strategy, the actors include central and state agencies, district and local governments, NGOs and the private sector (refer Box A3.9). Public involvement and participation should be fostered through public awareness campaigns, two-way flows of information, and capacity building, both at the levels of the government institutions and in civil society groupings.

¹⁰² India - WRM Sector Review, Rural Water Supply and Sanitation Report (World Bank, 1998c).

¹⁰³ This initiative was promoted under the Orissa WRCP and is currently being studied to assess impact and for lessons applicable more generally (Dhar and Oblitas, forthcoming).

Creating Inter-State River Basin Organizations

4.33 Although much can be achieved through the establishment and subsequent functioning of the state-level and grassroots institutions described above, most of India's larger rivers are inter-state, necessitating coordination between states.¹⁰⁴ For these situations, river basin organizations (RBOs) need to be established involving the riparian states concerned. RBOs can take various forms, ranging from informal mechanisms or formal committees to facilitate planning and coordination to more formal structures, including hands-on management (refer footnote 60). Creation of the state-level institutions will provide a capacity for dialogue between the states. The next step should be for the states involved to commence a dialogue on key river basins. This could begin on an ad hoc and informal basis, but should aim for agreement on an institutional structure and a mandate for a RBO. The many examples internationally, and several in India, can be utilized in making decisions on the kind of RBO that would be appropriate for the basin concerned. Various structures and roles are described in Boxes A3.4, A3.5 and A3.6, with a few highlights of different possible forms provided below:

- Basin Planning and Coordination: The *Italian Autoritas di Bacino* (Basin Authorities) are restricted to the formation of basin plans and overseeing their implementation, and membership is exclusively governmental from central and state officials. A largely similar mandate is held by Mexico's Basin Councils, which also serve as fora for negotiation of specific projects and their financing with government.
- Water Allocation, Management of Common Bulk Supplies, Monitoring, and Coordination of Maintenance and Water Quality: India's Upper Yamuna River Board (UYRB) is headed by the Member, Water Planning and Projects, CWC, with members from the co-basin States of Haryana, Uttar Pradesh, Rajasthan, Himachal Pradesh and Delhi. Budget requirements are shared equally by the co-basin states. Decisions by the UYRB—after endorsement by the Upper Yamuna Review Committee, headed by the Union Minister of Water Resources, with Chief Ministers of all co-basin states as members—are final and binding. This is clearly helping to coordinate water resources management on this sub-basin.
- Operations and Maintenance: India's Bhakra-Beas Management Board (BBMB) manages bulk water supplies from the Sutluj, Ravi, Beas and Bhakra Rivers and their distribution between the States of Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir, and the Union Territories of Chandigarh and Delhi. The Board is headed by a Chairman, appointed by GOI, with members from the co-basin states, CWC, CGWB, etc. This plays an important role in the overall management of bulk water supplies and

¹⁰⁴ Options for inter-state rivers in India's federal structure, as discussed in this report, are also broadly similar to typical issues encountered between riparian countries. Several very positive features for basins shared between India and other countries are worth noting. The first is the successful Indus Treaty between India and Pakistan. This provided clarity on usage of Indus waters and permitted non-conflicting investment. The second is the recent treaty (1996) on water sharing between India and Bangladesh regarding the Ganges. Thirdly, discussions have taken place between India and Nepal regarding shared rivers (headstream tributaries of the Ganges river), culminating recently in the "Mahakali Integrated Development Treaty" (February 1996). Further discussion of the Mahakali and Ganges Treaties is provided in Salman and Uprety (1998).

related power generation. State-specific irrigation infrastructure below the common BBMB headworks remains under control of the respective states.

- Whole Basin Management: In France, Spain and the Czech Republic the entire government water resources administration has been patterned along river basin lines and all government functions related to management and development of water resources have been placed under the authority of the basin administrations. The Netherlands has similar institutions patterned along “water systems”. Germany has also created such institutions, but on a selective basis for specific problematic basins. Australia’s Murray-Darling Basin Commission, described in Box A3.5, illustrates the evolution of a RBO and its increasing role in environmental management.
- Self-Funding Basin Organizations: This is increasingly a goal in many countries. The French and Czech water agencies are funded through water charges that they levy on water users and waste discharges. Germany’s river basin entities are funded by membership payments. The Dutch water boards are funded through appropriation of part of property taxes and through polluter taxes (refer Box A2.9).
- Involvement of Users: Mexico’s Basin Councils also involve water users, although membership is still predominantly governmental. In France, the basin agencies (*Agences de l’eau*) are government agencies, but are supplemented by basin committees (*Comites de bassin*), comprising both users and local and central government officials.

4.34 World-wide, the clear trend is increasingly to consider water management along river basin lines and to develop RBOs to ensure harmonious management of water resources. Successful examples in India, such as the BBMB and the UYRB, also demonstrate the benefits to all riparians of having such institutions. Establishing RBOs should be a priority for state leaders and GOI. A situation-specific rather than a blue-print approach is recommended when formulating a proposal for a RBO. The initial structure and mandate of a RBO should preferably be as bold and comprehensive as possible. Nevertheless, even modest initial mandates would represent a beginning in sensitive situations. For instance, in particularly difficult situations, establishing a committee comprising officials from riparian states would start a process and be considerably better than no cooperation at all. Somewhat more formal but still limited roles could also be considered as, for instance, in the case of Italy’s and Mexico’s RBOs and the UYRB. As cooperation between the states develops, structures and mandates could become more comprehensive. International experience has shown that RBOs tend to evolve structurally and functionally over time (for instance, Australia’s Murray-Darling Commission, Box A3.5), and such a natural progression could also be expected in India.

4.35 Flexibility is also recommended regarding the degree of Central Government involvement in RBOs and the extent to which existing legislative provisions are used in establishing RBOs. In the case of the BBMB and UYRB, substantial Central Government involvement is present and has proven beneficial. Exclusively inter-state institutions are, however, also feasible. In establishing a RBO, the 1956 River Boards Act provides a legal mechanism. However, RBOs can also be established without passing through the

provisions under the Act; to date, all existing RBOs in India have been established independent of the Act.¹⁰⁵ Finally, the existence or otherwise of a Tribunal Award or a potential Tribunal Award need have no bearing on the desirability or feasibility of a RBO. Generally, creation of a RBO will actively help achieve resolution of issues through a Tribunal. Experience, both in India and internationally, is that as RBOs develop in effectiveness the need for Tribunals or other forms of litigation diminish.

Adjusting Central Government's Role

4.36 A more pro-active role is recommended for the Central Government: as a catalyst of change in state institutions; by using appropriate instruments during the project financing and approval process; and by promoting public awareness. In order for the Central Government to enhance its effectiveness in these areas, it must itself strengthen its capacity. A first need is to assure better coordination between the many government departments involved with water (refer paras. 3.28 to 3.30). With some restructuring, existing institutions can be used. The present National Water Resources Council (NWRC) and the National Water Board (NWB) provide a senior forum (respectively, Chief Minister and Chief Secretary levels) for center-state dialogue on water issues, but due to their seniority these bodies can only meet infrequently.¹⁰⁶

4.37 The more substantial changes required are to provide NWRC and NWB with permanent technical support. First, a Technical Committee under the NWRC, with representation from all states and key GOI departments and chaired by MOWR, should be created and should meet on a quarterly basis. Second, this should also have a permanent Secretariat or "National Water Planning Organization" (NWPO) with strong expertise in basin planning and modeling. To make use of the existing structures and nucleus of expertise already available, it is recommended that the Water Planning and Project

¹⁰⁵ A case by case approach is recommended given the wide diversity of options available and the individual characteristics and needs of the different basins and states in India. The need for flexibility and a case by case approach applies both to the structure and degree of formality of a RBO and to the degree, if any, of Central Government's involvement. A RBO which only deals with planning and inter-state coordination, rather than playing a larger role, would in itself be useful. States along another river basin may wish to create a RBO with a more complete role in management. Where Central Government is felt to be a useful member in a RBO, it could play a catalyzing intermediary role, helping, as a neutral party, the state actors to get together. The Central Government could also help the states through review of individual state plans for the portions of an inter-state river within each of the states and by providing assistance to the states in harmonizing their individual plans into, effectively, an overall basin plan. For instance, the SWPO of each riparian state could send its plan to NWPO. The NWPO would review each plan, forward comments and suggestions back to each SWPO and, possibly after several iterations, this would result in a harmonized basin development and management plan.

¹⁰⁶ NWRC is chaired by the Prime Minister with the Minister MOWR as Vice-Chairman, Secretary MOWR as Secretary, and the Chief Ministers, heads of the union territories and concerned Union Ministers as members. NWB is chaired by the Secretary MOWR with the Member WP&P of CWC as Member Secretary, and members comprised of Chief Secretaries of all states and union territories and Secretaries of concerned Union Ministries as members.

(WP&P) wing of CWC be adapted and strengthened for this purpose. A nucleus staffing already exists in WP&P and can be strengthened in modeling capabilities and in other sector specializations with secondment from MOWR, CWC, CGWB, NWDA, MOEF, CPCB and other relevant agencies. Additionally, there will be need for recruitment of economists and computer specialists and some consultancy inputs from Indian and international centers of excellence.¹⁰⁷ Third, as with the institutions recommended at state levels (refer para. 4.24), an environmental sub-committee and an environmental cell within the NWPO should also be created to provide sufficient focus on environmental issues.

4.38 A main function of NWPO would be to prepare or assist in the preparation of master plans for inter-state river basins. The SWPOs would prepare basin plans for their parts of the inter-state basins, and the NWPO would assist the states in coordinating and harmonizing their sub-basin plans into overall river basin plans. The thus more operationalized NWRC/NWB could thereby play a more pro-active role in promoting best practices in water resources management and discussing inter-state, national and international issues as they arise. This would also serve to achieve the much needed improved coordination between the different Central Government agencies involved with water. In addition to these changes, largely at MOWR's level, restructuring the present MOWR agencies and MOWR itself should be considered. For instance, the present separation of surface and groundwater under CWC and CGWB merits examination. As a minimum, mechanisms for closer interaction amongst all its agencies should be established. It is also recommended that the function and structure of the National Water Development Agency (NWDA) be examined.

4.39 The center's financing role should also be applied to encourage change. At present, Plan approval is provided only after approval of a development project by the Planning Commission and the MOEF, subsequent to review by an inter-ministerial Technical Advisory Committee coordinated by the CWC. These entities, especially CWC, concern themselves with existing riparian rights and levels of utilization, but a sharper focus could be provided. As with the present mandatory need for environmental assessments when submitting water investment proposals to the center for Plan approval, the following actions by the concerned state should be advised as expected by the center: issuance of a State Water Policy, an Action Plan for water resources management reform, a program to prepare basin plans and a state water plan, and a program to introduce financial incentives for efficient water use. A status report covering all of these action areas should be submitted by the state at the time of submission of an investment proposal. Within a reasonable agreed time limit, actions should be expected and insisted upon by the center. For instance, it would be entirely reasonable for all states in India to have prepared at least a draft State Water Policy and an Action Agenda within the next two years. Similarly, preparation of a basin plan for the portion of a basin within the state's boundaries is only

¹⁰⁷ WP&P has the advantage of already existing and is headed by a senior officer: a "Member" of CWC in the rank of ex-officio Additional Secretary to GOI. As concerns consultancy link-ups, resources from a number of Indian universities could be considered, as well as such centers as CTU, CWPRS and NIH. A number of international agencies and consultancy firms could also provide assistance.

normal professional business and should be insisted upon at the time of any investment proposal. Steps towards creating inter-state RBOs should also be considered expected professional practice from all states.¹⁰⁸

4.40 The existing centrally-sponsored Plan funding mechanism is, however, only partially effective in leveraging change. Overall Plan fund allocations by state are largely pre-determined and non-approval of funds for a particular scheme are thus fungible to other purposes. Accordingly, an additional centrally-financed "Basin Development Fund" could be introduced whereby Plan funds are provided to specific investments in inter-state basins where clear basin agreements have been reached and where a RBO has been established. This would thus specifically reward states which have made progress in inter-state cooperation.

4.41 Awareness creation, capacity building, training and dissemination of best practice is another area where the center can play a supporting role. MOWR and its specialist agencies should mobilize an inter-agency effort to provide a concerted program of technical assistance to the states and civil society. This would include awareness building seminars for senior officials and civil society; study tours for government and non-government representatives to see best practices in selected Indian states and internationally; assistance in specific implementation areas (for instance, as states prepare their State Water Policies and Action Agendas),¹⁰⁹ specialist training for professional cadres in basin modeling, environmental management, hydrology, economics and other relevant topics; and provision of consultancy assistance, computers, and modeling software.

D. INTRODUCING ECONOMIC INCENTIVES FOR EFFICIENT WATER ALLOCATION AND USE

Intra-Sectoral Water Allocation and Pricing

4.42 Efficient inter-sectoral and inter-state allocation in India can be better realized with value-based pricing at the sub-sector level: major change is, therefore, required in the

¹⁰⁸ A set of pro-active but reasonable time-bound requirements should be established. These might, for instance, include: (i) issuance by the state of its draft State Water Policy and Action Agenda within one year; (ii) establishment by the state of a SWRB and SWPO (two year time horizon); (iii) preparation and subsequent approval by the state government of a detailed and time-bound action agenda for establishing financial incentives for efficient water use and conservation, at least covering agricultural water charges, agricultural electricity and polluter fees (two years); (iv) for any specific investment, provision of a River Basin Plan and Basin Environmental Action Plan for at least the state's part of that river basin (three years); and (v) submission of an Action Plan and some start-up actions completed for creation of a river basin organization at the state level (four years). State progress could be monitored annually through an annual status report.

¹⁰⁹ In the National Workshop, a number of states mentioned the likely utility of such advisory assistance as they drafted their State Water Policies.

system of prices and other economic incentives affecting water demand and supply. Although price instruments exist, the levels of existing incentives and the form in which they are applied result in minimal, and in some cases negative, impact on resource usage and provision. Unlike other goods, where scarcity prompts efficiency and conservation, water resources continue to be depleted and misused even under conditions of scarcity. There is urgent need to bridge this “incentive gap”: the gulf between the scarcity value of water and the value underlying the current pattern of water allocation and management.

4.43 Desirable practices such as conjunctive use, water-saving agricultural and industrial technologies, water transfers and water recycling—in other words, water conservation and optimal water utilization both within and between sectors—will emerge only when an individual or decision-making entity (WUA, industry, etc.) perceives a water constraint. For this reason, economic instruments which provide appropriate incentives for both service providers and users should be put in place. Water charges should ideally be based on the full cost of development and supply of water (both capital and O&M costs¹¹⁰). The water price charged to consumers should cover at least O&M costs, with the longer-term goal of covering full capital costs as well. In revising the incentive regime, due account must also be taken of the social and “public good” nature of water. Water is a basic social need and its environmental dimensions go well beyond the values attributed to it by individual users. Pricing will need to protect the interests of the poor and internalize environmental and public health values. Regrettably, current prices neither protect the poor nor the environment (refer paras. 3.34 to 3.43).

4.44 The key areas where sub-sector reform is required are: (i) pricing of water for irrigation; (ii) pricing of rural water supply; (iii) pricing of urban water supply; (iv) groundwater pricing; (v) agricultural pricing and marketing policies; and (vi) financial incentives for pollution control, water reuse and water conservation.

4.45 Irrigation Pricing: As discussed in paras. 3.36 to 3.38, the most pressing need relates to agriculture, responsible for 83 percent of consumptive water use in India. Although the problems are well-recognized in India—for instance, a special study was undertaken and recommendations were made in 1992 by the Committee on Pricing of Irrigation Water¹¹¹—irrigation water charges still remain extremely low, stagnant and not

¹¹⁰ In the National Workshop it was agreed by representatives from state and central governments, NGOs, academics, etc., that chargeable O&M costs should be based on efficient operations and on the basis of the cost of physical works, of maintenance, and the efficient level of staff, and that any O&M charges in excess of this efficient level should be absorbed by the state. However, this mechanism should not be used for keeping the water charges at very low levels as a populist measure.

¹¹¹ The “Report of the Committee on Pricing of Irrigation Water” (GOI, 1992) has recommended not only full cost recovery (i.e., the recovery of full O&M costs plus one percent each of interest and depreciation allowance on capital) but also has indicated the levels to which water rates are to be increased in different states for such a recovery policy. The Committee also recommended an eventual switch over to a volumetric rate structure through a three-stage program of reform: (i) simplification and rationalization of the pricing methods to reflect only area and season; (ii) volumetric wholesaling of water to outlet level water users associations; and (iii) system modifications to technically accommodate the new mode of

volumetric in most of India's states. The following recommendations are based on the "India - WRM Irrigation Report" (World Bank, 1998f), the "Report of the Committee on Pricing of Irrigation Water" (GOI, 1992), the experience of states attempting reforms, and best practice as applicable to India found in other countries:

- A major jump in water charges. There is no avoiding this difficult step. The first essential objective is to raise water charges so that they cover the costs of O&M. As a longer-term objective, water charges should also cover depreciation and interest on capital, but the goal of covering O&M costs will be a sufficiently major target in the short term.¹¹² For most of India's states, the raising of water charges to cover O&M costs will require a one-time or incremental several-fold increase in the currently applied rates.¹¹³
- Accompanying irrigated agriculture productivity improvements. The above essential step is more politically and socially acceptable if accompanied by activities to increase the productivity of irrigated agriculture. This could be achieved through improvements in the performance of the irrigation systems, including rehabilitation and modernization of irrigation infrastructure, coupled with intensification of agricultural extension programs.¹¹⁴
- Accompanying public awareness campaign. The above measures should be preceded and accompanied by a process of consensus building with the political establishment and civil society, followed by a major outreach program to farmers. Acceptability will be far greater if decisions are thoroughly discussed and explained and, in particular, if the benefits from more productive irrigated agriculture are perceived through this process.¹¹⁵

water distribution within the next 5-10 years. The Planning Commission which reviewed the Committee Report recently has approved the levying of water rates per number of waterings as well as the adoption, wherever practicable, of group-centered volumetric water distribution.

¹¹² Required O&M expenditures will be specific to the needs of each irrigation system. Guidance is also provided in the Finance Commission recommendations.

¹¹³ The recommended best approach is to surmount this hurdle in one large increase. An alternative is to announce the overall increase and its application in annual increments over a defined period (3 to 5 years). Thereafter, and also announced up front, water charges should be increased automatically every year based on an established price index.

¹¹⁴ Infrastructural rehabilitation and modernization is being implemented under Haryana and Tamil Nadu WRCPs (in part, under the "Systems Improvement and Farmer Turn-over" (SIFT) Program), and is planned by Rajasthan and Andhra Pradesh. In Orissa this is being accompanied by an agricultural intensification program, and an even more intensive mobilization of agricultural extension is planned for Andhra Pradesh and Rajasthan.

¹¹⁵ A notable recent example of effective involvement of the public has been the irrigation sector reform program under implementation in Andhra Pradesh (AP). AP has tripled water charges, has formed WUAs for all water systems across the state, is substantially increasing maintenance funding to enable effective O&M with participation of the WUAs, and is planning to rehabilitate the irrigation systems. Preceding and accompanying these changes has been a massive public awareness and participation process involving the entire political and government-level apparatus and leadership from the Chief Minister. Because the general public and farmers were thoroughly informed and involved and benefits are expected from these combined measures, the increase in water charges did not become a major political difficulty.

- Switching to volumetric charging to WUAs. Each state should also implement a change over from area-crop based charging to volumetric charging. Volumetric charging will be particularly important as opportunities for different water use levels develop (from diversification of cropping patterns and agricultural technology, new irrigation delivery systems such as dynamic control systems, and at micro levels, drip and sprinkler irrigation). Volumetric charging would likely need to be implemented on a command by command basis as its introduction needs accompanying introduction or improvement of the water delivery system, installation of measuring devices, and arrangements for bulk sales to WUAs. WUAs agreeing to bulk sales could have preferential rates over other farmers. Collection of water charges by WUAs could also be rewarded by a discount.
- Creating a decision-making and price regulating apparatus. It may also be desirable to establish an analytical and decision-making apparatus within the state so that capacity is available to undertake analysis and present recommendations to government. Andhra Pradesh and Orissa States have, for instance, created committees for this purpose. The mandate of the Water Pricing Committee should include not only charges to farmers but also charges for other water services, such as bulk water supply to urban and industrial users and drainage and flood control. A broader mandate would also include water rates in other sectors, such as urban, industry and rural water supply. Better still would be to create a more formal price regulatory apparatus in each state for water pricing, as for instance has been implemented in the U.K. and is being created in India's power sector in Orissa State. This will become essential over time as the private sector, including autonomous irrigation systems managed by farmers and commercial urban water utilities, grows in importance. The regulatory body should be fully independent, and would oversee pricing to ensure fairness as well as financial viability of the sectoral actors involved.

4.46 Rural Water Supply Pricing: The Rajiv Gandhi National Drinking Water Mission and the World Bank have carried out a joint review of rural water supply and sanitation (RWSS) as part of the India - WRM Sector Review (World Bank, 1998c). On the basis of that review, a completely new RWSS strategy has been formulated to rectify the problems arising from the current policy of water subsidization, lack of community involvement, and centralized water management in the rural sector (refer para. 3.41). Related to the pricing front, key elements are turn-over of facilities to local communities, cost sharing of investments by local communities with matching government grants, implementing the principle of full cost recovery on O&M and an annual contribution to a replacement fund. Rural water supply will be managed as an economic as well as social good, recognizing that this is the best way of assuring that its critical social value is actually translated into available and sustainable safe drinking water for rural communities. Underlying the new strategy is full community participation, a demand-driven approach in investment and level and quality of service, and full funding of O&M plus replacement costs by the local communities themselves to ensure that their infrastructure is sustained.

4.47 Urban Water Supply Pricing: Existing difficulties in urban water supply and Sanitation (UWSS) (refer para. 3.42) indicate that cities could benefit from a review of existing tariffs and subsequent implementation of a program to improve incentives for water use and to enhance revenues from domestic consumers. The India - WRM report on UWSS (World Bank, 1998e) includes detailed recommendations on pricing and financial viability.¹¹⁶ An incentive-based strategy is proposed involving delegation of accountability and responsibility to local levels, commercialization of UWSS agencies, and tariff reforms with targeted safeguards for poorer consumers. The recommendations discuss various options for volumetric charging, including practical mechanisms to apply metering generally.¹¹⁷

4.48 Groundwater Pricing: Charging for groundwater is currently only indirectly applied through pricing of diesel and electricity for pumpsets (refer para. 3.39). In the case of the latter, charging is not done volumetrically and is well below costs of provision, and even zero in some states (e.g., Tamil Nadu, Karnataka and Punjab). In addition to enormous fiscal burdens in all states, such policies have contributed to water waste and misuse. Comprehensive energy sector reform programs are now being devised in several Indian states (for instance, under the Power Sector Reform Project in Orissa, and the Haryana Power Sector Restructuring Project, both funded by the World Bank, and for projects under preparation in states such as Rajasthan and Andhra Pradesh). Features of these reform programs relevant to groundwater management include tariffs to cover the cost of energy and the installation of meters.¹¹⁸ As also discussed in the India - WRM report on Groundwater Regulation and Management (World Bank, 1998d), options to make volumetric (i.e., based on power consumed) charging easier in India could include block approaches: selling electricity volumetrically to panchayats and leaving them to arrange distribution and charging amongst their members according to usage. Changes in groundwater pricing would be greatly facilitated if the public were much better informed about the environmental and fiscal issues involved, and the risk of unsustainable agricultural production resulting from overdrawal of groundwater resources.

4.49 Agricultural Pricing and Marketing Policies: As discussed in para. 3.40, various distortions result from India's current central and state agricultural pricing and marketing policies. The first priority is to adjust commodity and input pricing and marketing policies to correct for such distortions. The World Bank studies on oilseeds, sugar, cotton and foodgrains, undertaken in collaboration with GOI, can be used for these purposes.¹¹⁹ One

¹¹⁶ Also refer to Cestti, et. al. (1996).

¹¹⁷ "India - WRM Sector Review, Urban Water Supply and Sanitation Report" (World Bank, 1998e). Refer also to Box A4.6 on Calcutta water pricing, where a surrogate method of near-volumetric charging without meters is discussed, and the examples of urban water supply and sanitation best practice contained in the above report.

¹¹⁸ Recent initiatives in this direction include the GOI-issued ordinance that price of power should reflect full costs of supply plus a 3 percent return. Additionally, there are provisions for the center and states to establish power regulatory authorities to monitor power sector pricing

¹¹⁹ Refer to the following reports in the commodity study series: (i) "The Indian Oilseed Complex: Capturing Market Opportunities" (World Bank, 1997b); (ii) "India's Sugar Industry: Priorities for

important need is the dismantling of price and market-distorting policies and artificial barriers to domestic trade between states and regions to enable less distorted price and market signals to determine cropping patterns, regional specialization, and resultant water use that are more consistent with natural comparative advantage. Along with policy changes, deficiencies and imbalances in market and transport infrastructure would need to be corrected to support a more efficient regional specialization and integrated domestic market. For example, paddy marketing activities, emphasizing private sector initiatives, can be promoted in Eastern India where a relative comparative advantage for water consuming paddy exists. This can be encouraged by moving away from pan-territorial and pan-seasonal pricing and investing in market and transport infrastructure. The current market, trade and infrastructure imbalances between regions in India could, if corrected, have important impact on overall water resources allocation and use. A review by each state of agricultural prices and incentives could also point to practical changes at state levels. It is, thus, also recommended that each state's Water Pricing Committee (refer para. 4.45) should include as part of its mandate a review of state-level subsidies and marketing policies for water-related agricultural outputs and inputs.¹²⁰

4.50 Environmental Incentives: The existing system of subsidies and tax breaks on investments in pollution controlling, water conserving and water recycling technologies and of pollution taxes, should, as discussed in para. 3.43, be thoroughly reviewed and revised. Particular attention needs to be paid to introducing a significant and punitive variable cost on the act of pollution based on a "Polluter Pays Principle". At present, both the center and a number of states have fiscal incentives favoring investment in environmental protection.¹²¹ However, they need significant enhancement to make them effective. For pollution taxes, this would include major adjustment and increases in existing pollution taxes and fines so that they provide a meaningful incentive for controlling pollution, as well as relating pollution taxes to the actual amount and toxicity of effluent produced.¹²² These measures should be accompanied by monitoring, measurement and regulation of pollution. Additionally, revised water charges and the introduction or expansion of other incentives for water recycling and conservation are needed to encourage industries to adopt more "eco-friendly" technologies and production processes. Each state

Reforms" (World Bank, forthcoming 1998a); (iii) "India Cotton and Textile Industries: Reforming to Compete" (World Bank, forthcoming 1998b); and (iv) the ongoing study of foodgrains (World Bank, forthcoming 1998).

¹²⁰ In the National Workshop, some participants commented that the main price and market distortions resulted from central-level policies, and, therefore, that reforms should take place at that level. It is to be noted, however, that state-level distortions are also present as documented in the aforesaid World Bank India commodity studies.

¹²¹ For instance: (i) depreciation allowance of 30 percent on devices and systems installed by industrial units for minimizing pollution; (ii) investment allowance of 35 percent of the actual cost of new machinery or plant to assist in the control of pollution and protection of the environment; and (iii) exemption from tax on capital gains arising from transfer of buildings or lands used for businesses of industries that shift from congested urban areas, if these are used for acquiring or constructing buildings for the purpose of business at a new place.

¹²² As recommended in the National Workshop.

should undertake a review of its environmental pricing for water and introduce a revised set of incentives and disincentives, providing substantial impetus for industries and towns to introduce and sustain environmental and water-conserving technologies. Similarly, GOI should assess the incentives/disincentives currently applied at its level and also introduce an appropriate revised and augmented structure. The more industrialized nations have already gone through the experience of industrial pollution and measures to deal with this problem have been found from which India could benefit. For instance, the Dutch water boards are responsible for water quality management and charge polluters heavily according to their measured level of pollution (Refer Box A2.9).¹²³ The result has been a remarkable turn-around to a clean water environment.

4.51 Protecting the Poor: Implementing pricing reforms must take account of the public good nature of water and its importance as a basic need for all segments of the population and in particular the poor. Most fundamental is the provision at affordable rates of at least the necessary minimum quantities of safe and reliable drinking water to rural and urban consumers. Unfortunately, this philosophy has often been misdirected towards providing subsidies to India's wealthiest citizens. Thus, generally large and wealthy farmers are heavily subsidized to over-pump groundwater, while their neighbors in the same village cannot even access groundwater for drinking purposes. Surface irrigated farmers who have productivity and incomes per hectare several times greater than their less fortunate rain-fed counterparts are favored with cheap water. Wealthier urban consumers often pay less for water than the extreme poor, who, without access to running water, may need to buy from private vendors at much higher unit cost. For the general consumer—farmers, urban and rural households, industries, etc.—current water prices are insignificant relative to their valuation of the benefits derived from water use. The key concern is improving the water service. In all service sectors, tariff increases accompanied by service improvements would enable consumers to be much better off.¹²⁴ Consumers should be actively brought into the decision-making process and allowed to make their choice: continuation of a usually poor service because of inadequate funding by consumers able to pay, or an improved service financed through higher water charges.

4.52 The pricing structure should be such that necessary quantities of safe and reliable drinking water are provided to the poor. The critical need is to isolate and target the segments of the population which really need subsidies for water, and to provide directed assistance specifically to them. This also should be done in a way that minimizes distortions on resource use and consumption. Particular attention should go towards

¹²³ There are many experiences from Europe and other countries from which lessons can also be drawn. England's River Thames, for instance, was an open sewer in the 18th and 19th centuries as a result of urban and industrial pollution. Under the combined impact of institutional and regulatory actions and price disincentives for polluters, the river is now relatively clean, including passage of salmon and other delicate fauna along its watercourse.

¹²⁴ Impacts on consumers of increasing water tariffs are discussed in "India - WRM Sector Review, Irrigation Report" (World Bank, 1998f) and in the two reports in the same series on urban and rural water supply mentioned in the footnote below.

protecting the domestic water supply needs of poor urban and rural households. Various mechanisms to achieve this are discussed in the India - WRM reports on UWSS and RWSS, including the use of multi-tiered pricing based on income and targeted subsidies to consumers or suppliers.¹²⁵ Such measures, as for instance used in Chile, allow appropriate economic incentives to affect the consumption decisions of the majority, and at the same time ensure that social objectives for poorer consumers are met and financial sustainability of the service is maintained.¹²⁶

Inter-Sectoral Economic Allocation Mechanisms

4.53 As discussed in paras. 4.42 and 4.43, efficient inter-sectoral allocation cannot occur if prices fail to reflect the true costs of water provision and the scarcity value of water itself. Hence, “getting the prices right” at the sub-sector level is fundamental to achieving optimal water use not only within, but also between sectors (refer Box A5.5). There are many instances where water pricing in one sector has negatively impacted water availability or quality in another. For instance, in the case of pricing for groundwater pumping, insufficient electricity charges have resulted in indiscriminate agricultural use and, consequently, the drying up and contamination of domestic rural drinking water supplies. Conflicts over water between hydropower and irrigation can also largely be attributed to subsidization of water in the agricultural sector. In combination with revising the pricing regime, reforms must also target allocation mechanisms themselves. Key reform areas are: (i) improving administrative allocation of water by incorporating in decision-making economic or value-based criteria; (ii) developing administrative brokering of compensated trades; and (iii) developing formal water markets, including the establishment of an institutional, legal, regulatory and technological framework. Reforms in these three areas are based on a common rationale; inter-sectoral allocation should incorporate an economic dimension, without overlooking the social aspects, whether it occurs through negotiation or through “automatic” market exchanges. The suitability of one allocation mechanism over the other will depend on circumstance, but in any case the end result should be one of mutual benefits to the parties involved.

4.54 Improving Administrative Allocation of Water: Current allocation and re-allocation of water are done administratively and, typically, on an ad hoc basis (refer para. 3.44). Furthermore, rarely are decisions for water transfer from one sector or user to another influenced by economic or value-based criteria. Such transfers infrequently result in mutual gains or benefits, but instead involve involuntary expropriation without adequate compensation. Administrative allocations should at least include other parallel

¹²⁵ “India - WRM Sector Review, Rural Water Supply and Sanitation Report” and “India - WRM Sector Review, Urban Water Supply and Sanitation Report” (World Bank, 1998c and e, respectively).

¹²⁶ A system of direct subsidies for water is managed by the Central Government of Chile. A budgeted amount of subsidies is allocated among regions and municipalities each year to needy families, according to pre-determined social and economic criteria. The subsidy applies to the first 20 m³ of monthly consumption. The municipalities use the allocated budget to pay the water utility directly (Rivera, 1996).

development actions for those giving up water so that their welfare is also enhanced. They would also require a much stronger knowledge base (hydrological data, sector-wise water accounts and basin modeling) than is currently usually available, as well as information dissemination to all affected parties.¹²⁷

4.55 Developing Brokering of Compensated Trades: A potentially better option would be the brokering between affected parties of more commercial agreements. An industry or municipality could, for instance, be encouraged to negotiate with an agricultural WUA for partial utilization of the WUA's water allocation. A combination of agricultural and non-agricultural services, investments and fees contributed by the industry or municipality might be arranged to mutual advantage. This would be made more feasible if agricultural and irrigation technologies can also be introduced so that agricultural productivity is not impaired. Given the current low pricing of water for all sectors and its much higher economic value, especially for industry, there is substantial room for mutually profitable outcomes. Government or civil society (e.g., NGOs) could play a catalyzing role in such arrangements: for instance, through encouraging consultation and dialogue and facilitating arrangements for beneficial compensation.

4.56 Introducing Water Trades and Markets: Given the reality of the increasing need for water re-allocations, a voluntary trading mechanism could offer even greater flexibility. A limited illustration of the possible gains in India has been observed in Vaigai Basin, Tamil Nadu (refer Box A5.6). At one location in the Vaigai Basin, farmer-groups have privately developed groundwater transfer pipelines and have organized themselves to transfer water some four kilometers to other farmer groups. Both renters and leasers of water are better off. The renters benefit through revenues received greater than the marginal value product of their water while the leasers have used the water to grow high-value horticultural crops and their incomes have also increased substantially. Although such informal bilateral water trades are wide-spread in India,¹²⁸ in common with most other South Asian countries, more formalized and regulated water markets have not developed. This contrasts with the situation in such countries as Chile, the Western U.S.A., and Australia where regulated water markets, based on an explicit water rights system, exist and have reportedly proven to be effective as a means of allocating water resources to their most productive use through a voluntary and automatic mechanism (refer Boxes A5.7 and A5.8).¹²⁹ In Chile, such opportunities have been developed through legislation and institutional support to a common-place transaction. Water rights are fully transferable and independent of land use and ownership, the most common transaction being in the form of renting of water.

¹²⁷ In the National Workshop, specific points made by the participants supporting these recommendations included: (i) sector-wise water allocation should be determined and notified as a water right and publicized to the basin population; (ii) each sector should plan for and utilize water efficiently within its stipulated allocation and be held to this allocation by the "basin authority"; and (iii) the basin authority should maintain sector-wise water accounts and release these for public information.

¹²⁸ As reported by Shah (1993), Palanisami (1994) and Meinzen-Dick (1996).

¹²⁹ Refer also to "India - WRM Sector Review, Groundwater Regulation and Management Report" (Box 3.5, Water Rights Reform: The Cases of Chile and Mexico) and to "India - WRM Sector Review, Irrigation Report" (World Bank, 1998d and f, respectively).

Appropriate lessons need to be drawn from these experiences, keeping India's socio-economic conditions in view.

4.57 Only limited assessments have been done to date on how to apply more formal water markets in the Indian context. Box A5.4 discusses possible creation of a "groundwater management district" and a water market between a farmers' water users association and Chennai's Metrowater to both augment Chennai's water supply and provide attractive remuneration to farmers.¹³⁰ The proposal would involve leasing by farmers of part of their groundwater usage coupled with agricultural technology adjustments to maintain or enhance overall agricultural productivity while using less water. Reflections are also ongoing in Tamil Nadu's Vaigai Basin. The possible options there include creation of a stakeholders' river basin organization and opportunities for renting of water between water users associations with surplus water and Madurai (refer Box A3.8).¹³¹ Particularly instructive would be to review the experience in countries which are in the early stages of piloting or establishing water markets, as for instance in Mexico.

4.58 The Vaigai example above and international experience are worth learning from, but considerable caution is also required. Even in the cases of the most highly developed water markets, as in Chile, these have not replaced, but are instead complementary to comprehensive planning and water resource management.¹³² Further, water markets are not without potential pitfalls, and two issues are of particular concern. First, Indian government planners are rightly concerned about safeguarding against potentially deleterious impacts of water marketing on the welfare of smaller farmers, disadvantaged groups and the landless. Second, protecting the environment is also a concern, in particular, protection against overdrawal of groundwater or over-use of surface supplies (Box A5.3 reviews some of the issues). With this in mind, development of water markets would require a strong supporting and regulatory framework. This would need to include enabling institutions and legislation making rights for surface and groundwater transferable through the leasing or selling of water. Additionally, a grassroots, locally based administration is necessary to ensure equal access and transparency in market operations and to safeguard social welfare and the environment. Physical and technological modifications to enable trading are also essential. These include improved water management, volumetric control and measurement of water, and hydrological monitoring.

4.59 Introducing more formal water markets in India would first require careful reflection, review of experience in other countries, and appropriate adaptation to Indian realities, including features to enable workability in the Indian context. Given these circumstances, careful assessment of the options is essential, and initial experimentation and piloting would be a prudent first step. Features for success would likely include, first, establishment of a grassroots management unit in the locality concerned to monitor and regulate against overdrawal of water and social exploitation by powerful interests and to

¹³⁰ Briscoe, 1996.

¹³¹ Oblitas, Rogers and Harshadeep, 1996.

¹³² It is estimated that in Chile, only 20 percent of water needs were met by water markets in recent years.

provide dispute resolution mechanisms. Second, the management unit should substantially involve stakeholders or should closely interlink with a separate stakeholders' association elected under democratic principles and including by-laws and voting rights to fully integrate women, the poor and disadvantaged groups. Third, water rights may be more easily administered through rights provided to water user groups rather than to individuals, and water transactions should also be handled at the group level. Fourth, technological changes and supporting investment would be required to improve water management, to enable volumetric measurement of water flows and to distribute water according to transacted agreements.¹³³ Finally, an enabling legislative environment would be required. For initial piloting, Government Orders might be sufficient, but eventually, revised legislation would be needed.

4.60 The following shorter-term actions are recommended:

- Study tour to assess international experiences (e.g., Chile, U.S.A., Australia and Mexico), followed by preparation of a strategy note on options that might be available in India or for specific localities.
- Selective piloting of water markets in a few specific locations where the need for a water market has been identified, i.e., where there is already full utilization of water resources (Chennai, Vaigai, Delhi, Hyderabad and water-short districts in Rajasthan), and where strong stakeholder interest is present.
- Monitoring of such pilots, adjustments as needed, and consideration of further replication as appropriate.

Inter-State Economic Allocation Mechanisms

4.61 Although inter-state allocation will need to rely primarily upon development of institutions (inter-state river basin organizations) and supporting enabling legislation, economic criteria should be given due weight in inter-state decisions. These include regional development considerations in evaluating state needs and direct incorporation of economic variables in basin modeling. Further, direct economic incentives could also be applied. For instance, in the case of the interlinked Periyar-Vaigai Basins in, respectively, Kerala and Tamil Nadu, it is likely that the value of water in water-short Tamil Nadu would be much greater than in relatively water abundant Kerala. In situations where a state has available surplus water, a brokered commercial transaction could be of mutual benefit to both states. Water sharing between states can also include broader development considerations than water alone. For instance, integrated development of river basins across states could include a variety of infrastructure (water, roads, power, etc.), thus

¹³³ Examples of such technology in India include Majalgaon Command in Maharashtra where a computer-operated dynamic regulation system is being introduced (refer "India - WRM Sector Review, Irrigation Report" (World Bank, 1998f)).

making water-specific decisions amenable to trade-offs with other developments and enabling mutual gains for all parties.¹³⁴

E. TECHNOLOGICAL IMPROVEMENTS

4.62 Major scope for enhancing effective water supply and improving the productivity per unit of water, with evident positive impact on the environment, is available from technological improvement (refer paras. 3.47 to 3.48). In effect, much more can be done with the same, or even less, water. Current irrigation efficiency is only 30-40 percent. Unaccounted for water (UFW) in domestic water supply schemes is typically 30-50 percent.¹³⁵ Water recycling is infrequent. Even the water that does reach the user is generally unproductively used, especially in agriculture. Huge gains are possible in India from improved technology. Not only are large water savings in all sectors possible, but it is only with improved water control and measurement systems that re-allocation and new pricing systems can be implemented.

4.63 The most important area to tackle is irrigation, responsible for some 83 percent of India's water consumption. Even modest improvements in irrigation efficiency would have large impact on effectively increasing water availability.¹³⁶ A first major gain is available through improving irrigation water management using existing technology. Basic repairs to bring a system to its original design potential or higher productivity (e.g., de-silting, repair of structures, additional hydraulic flow structures, measuring devices, etc.), linked with farmer involvement in irrigation management, can substantially improve the productivity of irrigation systems and expand effectively irrigated area, or can achieve the same results as before using less water, thus releasing water for non-irrigation purposes.¹³⁷ Still higher levels of irrigation efficiency can be achieved through further technical measures such as passive or active control systems. A remote-controlled dynamic regulation system is being introduced in Majalgaon Command in Maharashtra enabling specific water deliveries to different parts of the command, responsive to crop water requirements, and also able to adjust where showers fall in a particular part of the

¹³⁴ This approach is currently being discussed, for instance, between India, Nepal and Bangladesh where mutual gains are assessed feasible through a combination of investments in transportation infrastructure, hydropower, water and other developments. Ongoing support for this is being provided through the World Bank under the "South Asia Regional Development Initiative" (formerly, the "South Asia Development Triangle").

¹³⁵ "India - WRM Sector Review, Urban Water Supply and Sanitation Report" (World Bank, 1998e).

¹³⁶ The key need is to improve the "effective productivity" of water, rather than "irrigation efficiency" per se. Lining of channels would reduce conveyance losses, but such losses can often be beneficial where groundwater recharge is desirable. More important is to ensure that water gets to the root zone of agricultural crops in the right quantities and at the right time. Situations of excess water in head reaches and insufficient water in tail reaches, poor timing of delivery relative to crop needs, inefficient application at field levels, and sub-optimal agricultural technologies are the more important matters to tackle.

¹³⁷ As being undertaken, for instance, in the Minimum Rehabilitation or Systems Improvement and Farmer Turn-over Programs through the World Bank-assisted Water Resources Consolidation Projects (WRCs) in Orissa, Haryana, Tamil Nadu, and in the APERP Irrigation Component in Andhra Pradesh.

command. At the micro level, low pressure drip irrigation or sprinkler irrigation offer substantial gains in efficiency. Such systems are not necessarily just for use of groundwater. For instance, even in the supply-based Warabandi surface irrigation systems of Northwest India, individual farmers or farmer groups could construct small ponds in their fields linked to small overhead tanks to operate drip or sprinkler irrigation for part of their holdings from their surface water allocations.

4.64 Improved irrigation effectiveness from actions such as the above is still only part of the answer. Further substantial gains are possible if the interface between irrigation and agricultural technology is also developed. Beyond irrigation efficiency, improvement in water control generally—the reliability and precise timing and quantities of water delivery—is also important. Agricultural technologies need to be modernized to make maximum use of irrigation supplies. In the not so long-term India must look to the irrigation and agricultural technologies being practiced in water-short countries such as California, Israel and Jordan.

4.65 Various “eco-agriculture” or other eco-friendly technologies also exist. For instance, in West Bengal techniques are being used by local communities to reuse domestic waste water for productive purposes, thus both enhancing productivity and reducing domestic pollution. Domestic waste is used to support fish culture and the effluent from the fish ponds is used again for irrigation (refer Box A6.2). Significant water harvesting technologies are already available for agriculture and have been promoted under various watershed management projects funded by the government, World Bank and other agencies. These include earth bunds, check-dams, terracing and vegetative barriers such as the use of vetiver grass or other plant hedges. Other environmental technology options, covering different sectors, are discussed at Box A6.1. Forging these technological innovations in irrigation techniques and agricultural practices should be vigorously pursued, including active adaptive research and demonstrations, visits to examples of success within India and in other countries, and development of good research and information networks between Indian researchers and innovators and their counterparts in other countries.¹³⁸

4.66 Improving the efficiency of domestic and industrial water supply schemes also offers substantial scope for effectively augmenting supply. Most municipalities could benefit from investment in management techniques to reduce UFW. A leak detection and pipe repairs program is almost invariably needed. Improved monitoring and metering is also usually required. A price environment, possibly supplemented by investment incentives or tax breaks, should be created to provide incentives for industries to conserve water and to undertake water treatment and recycling. For most municipalities and industrial centers, investment in water treatment facilities is usually required to reduce pollution and enable reuse; as practiced, for instance, with India’s Common Effluent

¹³⁸ The proposed World Bank financed Water Resources Research Innovation and Training Project (WRRITP) would include sponsorship of such activities.

Treatment Plants (CETPs), discussed at Box A6.3. Water conservation techniques can also be encouraged. In Saurashtra and Kutch Districts of Gujarat it was traditional practice to have a rainwater collection terrace on the rooftops of houses and to harvest rainwater collected in underground tanks. This traditional practice has been progressively abandoned as communities received subsidized piped water supply. Adjusting the price incentives and making such water harvesting mandatory in building codes might encourage a return to the former desirable practices. Chennai and other cities are quite pro-active in encouraging water harvesting as part of building codes. In Chennai, water harvesting can substantially augment city supplies, whereas rainfall not collected goes into the city drains and immediately to the sea.

F. IMPROVING MODELING, DATA, PERFORMANCE AND ENVIRONMENTAL MONITORING AND PUBLIC INFORMATION

4.67 Achieving improved water resource management also requires a substantial upgrading of the data base and its practical application in basin plans, environmental monitoring, and measurement of performance. As discussed in paras. 3.49 to 3.52, there are critical inadequacies in data measurement and management, poorly developed information systems, duplication of efforts and lack of coordination between different agencies, and difficulties in accessing data especially for non-governmental stakeholders. Professional capabilities in basin modeling are also very limited in most Indian states. Furthermore, the limited basin modeling that is done is seldom made available to the general public. Significantly upgraded performance monitoring is also required for irrigation and domestic water supply schemes as a basis for the technological improvement drive. There is also need for transparency of information and, in particular, for active public dissemination of results and efforts at public education so that the general public can become stakeholders and leaders of change (refer Box A7.2). The center and a number of states are forging initiatives in these directions on which most of the recommendations below are based, but they need broad-basing across all states:

4.68 Preparation of Basin Plans:

- Preparation by each state of comprehensive River Basin Plans for all basins or parts of basins in the state, followed by preparation of an overall State Water Plan.¹³⁹ This would be done by the State Water Planning Organization (SWPO) as its primary objective in the first several years after establishment.¹⁴⁰

¹³⁹ The Basin and State Water Plans would cover all uses of water, including agricultural, RWSS, UWSS, industrial, power (both hydro and thermal), navigation, environmental needs, recreational, ceremonial, etc.

¹⁴⁰ The work being undertaken by Tamil Nadu and Orissa States, under their World Bank assisted Water Resources Consolidation Projects (WRCs), and commencing in Rajasthan and Haryana, could be studied by other interested states.

- Preparation by the SWPO's of Basin Environmental Assessments and environmental assessments of specific environmental issues identified as requiring urgent resolution (e.g., a particularly urgent pollution or health problem, groundwater depletion, etc.).¹⁴¹
- As opportunities arise, basin plans and environmental assessments should also be done on an inter-state basis, through inter-state cooperation and possible supplementary assistance from the center. The work of each SWPO on the part of the basin in its respective state could be readily combined for this purpose.
- A concerted training program, including transfer of modeling software, provision of computers, selective provision of other facilities (e.g., satellite imagery) is required. The training program currently provided by the MOWR's Central Training Unit (CTU) at Pune, also supported by The World Bank,¹⁴² should be further expanded and the center and states should identify a network of other central and state training institutes including universities also to provide specialist training. Such efforts should also be back-stopped through twinning arrangements with other international centers of excellence.¹⁴³
- The above drive to improve basin modeling capabilities should also be facilitated by taking a few basins for particularly intensive study, including introduction of state of the art modeling skills. For instance, the World Bank is providing assistance to Tamil Nadu's Institute of Water Studies (IWS) in developing for the Vaigai Basin an interactive basin planning model (refer Box A7.3).¹⁴⁴
- Basin modeling should be an inter-active process with a high degree of stakeholder involvement.¹⁴⁵ This approach is also being piloted for the Vaigai Basin in a joint exercise with IWS and Tamil Nadu's Madurai basin manager where a stakeholder committee is commencing establishment with a view to its progressive development, through the interaction and discussion process between stakeholders, into a RBO (refer Box A3.8).¹⁴⁶

¹⁴¹ Environmental and other needs should also be integrated into each of the basin models and incorporated as specific modules in the basin modeling exercise. Modeling exercises should include, for instance, the minimum flow requirements for environmental and navigational needs, assimilation requirements for treated effluent, sustenance of fisheries and aquatic life, maintenance of biodiversity and special social requirements, and the impact of dumping of solid waste and effluent emanating from municipal areas, industries and hospitals.

¹⁴² Funds have been provided under the World Bank's Institutional Development Fund grant for purchase of computers and software, hire of specialist consultants from India and overseas, and study tours to centers of technical excellence and have helped to significantly build up CTU's capabilities.

¹⁴³ For instance, India has already established links with Hydraulics Research, Wallingford, U.K.; Delft University and Delft Hydraulics, Netherlands.

¹⁴⁴ The Vaigai model is called THANNI, meaning "water" in Tamil and an acronym for "The Holistic Analysis of Natural Network Information." Principal contributors to the development of the model have been N. R. Harshadeep, P. Rogers, S. Rajagopal, E. V. Jagannathan and G. Subramanian (World Bank/Harvard University/IWS, Government of Tamil Nadu).

¹⁴⁵ In identifying stakeholders, careful attention should be paid to incorporating all multi-sectoral uses of water; for instance, navigation requirements have often been neglected. In the Vaigai basin participatory modeling exercise, an unexpected and significant stakeholder turned out to be thousands of washermen.

¹⁴⁶ Oblitas, Rogers and Harshadeep, 1996.

4.69 Improving Hydrological Data: The World Bank/Netherlands-assisted Hydrology Project, operating in eight states of peninsular India,¹⁴⁷ is already making an energetic start in this direction. The points below, already underway, could also be considered by other Indian states.

- The existing network of measuring stations for surface and groundwater, including water quality, should be expanded. This would require assessment and rationalization in each state and river basin of the existing combined network of such stations from the different agencies involved (state agencies, CWC, CGWB, CPCB, IMD, etc.)
- Each state should establish a State Water Resources Data Center (SWRDC). This would assemble all data on surface water, groundwater, meteorology and water quality from all collecting sources (government and private) in the state, based on river basins or a part thereof lying within the state. The SWRDC would collect, collate, analyze and store hydrological data in state data banks. Additionally, the SWRDC should promote the formation of Hydrologic Data Users Groups (HDUGs) to bring together users of data. Retrieval and ready dissemination of all data would be provided to HDUGs¹⁴⁸ by a Geographic Information System (GIS) based on river basins or sub-basins.¹⁴⁹
- A National Water Resources Data Center (NWRDC), again combining ground and surface water, including water quality and meteorological data, is being established. The SWRDCs should fully network with the NWRDC and both the NWRDC and the SWRDCs should provide data to HDUGs at all levels, based on river basins, sub-basins, or a part thereof.¹⁵⁰

4.70 Establishing Performance Monitoring Systems:

- For all surface irrigation and domestic water supply schemes, relevant measurement and monitoring indicators of performance (including environmental impact) should be established and followed. This would underpin the drive to improve productivity and efficiency.
- Periodic reports on water quality and quantity (refer para. 4.69), performance indicators and environmental aspects (refer para. 4.71) should be issued on a regular basis and all such information should be made accessible on the internet and on CD-ROM.¹⁵¹

¹⁴⁷ Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu.

¹⁴⁸ To cover costs, affordable fees for provision of data would generally be desirable. Where quality data is readily available in user-friendly form, most users are fully prepared to pay for such data. The key current constraint is that data is not readily available.

¹⁴⁹ Implementation is commencing under the World Bank/Netherlands-assisted Hydrology Project in peninsular states and in the World Bank-assisted WRCP states. These initiatives also include establishment of Data User Committees, including non-government representatives, to orient data collection and dissemination to the practical needs of the stakeholders.

¹⁵⁰ Establishment of the NWRDC is also supported under the Hydrology Project. Discussion has also taken place in India about a possible National Water Information Bill to set out the rules for ready access to water information.

¹⁵¹ It was also recommended in the National Workshop that the Central Pollution Control Board and State Pollution Control Boards should issue periodic reports on the water quality of rivers and aquifers, which should be published and formally sent to state governments, municipalities, industries and other interested parties.

4.71 Improving Environmental Monitoring and Management:

- Environmental monitoring could be improved through establishment of performance indicators for environmental aspects of water development and management.
- The improved hydrological data measurement and collation described in para. 4.69 should be further supplemented by collection, analysis and publication of environmental and ecological data.
- In all water projects, provisions should be made for preparation of Environmental Management Plans (EMPs) and a budget provided under the project for the EMP.
- Procedures for environmental clearance of projects should be made quick and transparent.
- Industrial pollution should be assessed by pollution load (i.e., by the actual toxicity and amount of effluent) rather than by assumption according to the category of industry and the presence or otherwise of effluent treatment plants.
- The performance of Common Effluent Treatment Plants (CETPs) should be evaluated and the findings incorporated in future investment and management decisions for pollution control.
- Pollution of water resources from non-point sources (e.g., fertilizers and pesticides) should be monitored and research, regulation and public education undertaken to minimize such pollution.
- Mechanisms should be developed for monitoring and resolving problems arising out of inter-state transfer of polluted water.
- Special attention is needed for environmental assessment and protection of lakes, estuaries and wetlands.

4.72 Achieving Transparency and Public Information and Participation:

- In all of the above areas, data and analysis should be fully transparent and made available to HDUGs and the general public. In the cases of basin planning, environmental management planning, and in monitoring and implementing technological improvements, stakeholders should be brought in as active participants in the analysis and recommendations. Examples of such initiatives include the participatory basin planning exercise commencing in the Vaigai Basin and the irrigation technology improvements underway with WUAs in Andhra Pradesh and Orissa.
- Public awareness and participation will generally require substantial changes in the way government agencies have traditionally conducted business. Full transparency and ready availability of information is essential. There is need for an active “outreach” process where various mechanisms are used to encourage involvement of the public and better understanding of water sector issues. The media (radio, television, newspapers, including in local languages), seminars, workshops, political gatherings and other mechanisms should all be used. It is important, both for the quality of knowledge and for the participatory process that knowledge flows in all directions, including from civil society to government. In order to implement the major change agenda discussed in this report, a strongly participatory approach is needed. This will be fostered through the “awakening” of perceptions and empowerment of stakeholders.

In this process, particular attention should be paid to communications with and active involvement of traditionally more marginal or less vocal groups, such as women, the poor and other minority groupings.¹⁵²

¹⁵² It is noteworthy that the need for public awareness and participation was one of the strongest thematic messages recommended by both government and non-government participants in the National Workshop.

V. STRATEGY AND ACTION PLAN

5.01 There is clear need for improving the nation's inter-sectoral water allocation, planning and management. Severe water constraints—quantitative and qualitative—are now present in most of India's river basins and will grow cumulatively over time. However, India's water constraints are more a matter of managing its resources than of absolute scarcity, per se. To its credit, India has made major advances in the development of its water resources. However, a number of other countries with less water are doing more with the resources that they have. Given India's huge and growing population and ambitious social welfare and economic growth aspirations, the management of its fragile and finite water resources, and the associated major reform program required, must aim for the best, rather than marginal change.

5.02 A long-term vision needs to be in constant focus as the reforms are implemented. Because India is starting from a largely "greenfield" situation as regards water resources management, especially at state and river basin levels, the change process must recognize the realities from which change must commence. Many of this report's recommendations are thus "start-up" in nature, comprising primarily the short and medium-term agenda. This, however, is not the end of the line. India should keep in its sights the best examples of success from around the world and within its own borders, a number of which have been provided in this report. This should help to guide the short and medium-term actions by India and the progressive implementation of further change.

5.03 Such best practices, themselves evolving, should be kept under constant review by India's planners and policy-makers. As soon as possible, management of water resources in India will have to be on a river basin basis, including a sophisticated management apparatus, incorporating all sectoral users and stakeholders and crossing state boundaries. The recommended actions start this process, but success stories such as the Murray-Darling Basin in Australia, including major emphasis on public awareness and stakeholder participation, illuminate the further actions required. The development of water policies, legislation and regulatory structures in India can draw lessons from the structures successfully in place in Europe and the U.S.A., even if a phased approach is required to get there. Pricing and other market allocation mechanisms need to evolve as quickly as possible to meaningful instruments guiding resource allocation and usage practices. Examples are the tariff structures used by best practice water utilities (e.g., Singapore, EMOS in Santiago, Chile, and initiatives underway in Buenos Aires, Argentina), agricultural pricing policies that better guide resource use, water marketing arrangements found in the Western U.S.A. and Chile, and pricing as an environmental control mechanism in the Netherlands. A major drive is required to improve technology for increased productivity of water in all sectors, with lessons for agriculture from countries such as Israel, Jordan and California. Hydrological data and modeling capabilities must reach the same level of sophistication as found in the U.S.A. and Europe; the needs in India are even more pressing than in these countries. The eventual institutional structure in

India will likely be a major transformation from its present form and the initial restructurings in the reform process: for instance, evolution to commercialized water services as found in the U.K., U.S.A. and Chile, and government agencies eventually restricted to policy, planning and regulatory activities as found in the U.K. and evolving in a number of other countries. India's long-term sights must necessarily be far-reaching. The Reform Agenda discussed in this report will enable an energetic start in these directions.

A. THE REFORM AGENDA

5.04 The key need is to **develop a new "enabling environment"** that will provide for better water resources management in India. There is no simple or uni-dimensional solution to these issues. There are, first, a myriad of actors involved: each and every household in India, every private business, and the various social, administrative and political aggregations (i.e., villages, socio-economic strata within villages, municipalities, districts and states). Further, immediate needs and incentives can be quite different from the long-term needs where sustainability and environmental management are crucially important.

5.05 Initially, the leadership in creating the enabling environment will need to come primarily from government, in consultation and working with industry, water user groups, NGOs and other civil society representatives. Government is currently the primary, and in many cases the exclusive, decision-maker in the water sector. Change will thus need to be initiated by the government sector, but this should be seen as a short-term need given government's present near-monopoly role. The objective over time should be to increasingly involve the non-government sector and grassroots organizations in water allocation, planning and management. This will need progressively building up, but a start can be made immediately through encouraging active involvement of academics, NGOs, water users groups and industry representatives. Particular attention should be given to fostering involvement of traditionally marginalized groups which have a large stake in water resources issues, such as women and the poor.

5.06 The key element in the enabling environment will be to **establish an "incentive framework"** that influences the individual actors: households, farmers and firms. In the end, such influence will be felt through the direct impact of financial incentives or regulatory actions actually enforced. These translate the policy, legislation, institutional and technical capabilities into impact at the level of the individual. The incentive framework must also provide the right directions for the higher organizational aggregates—incentives for change at the level of: state governments and their various water-related departments, river basin organizations, the different Central Government agencies, and grassroots organizations. For these, policies, legislation, institutional structures and interlinkages, approval processes and financial leverage, also come into play.

5.07 Additionally, the incentive framework needs to be broadened to a more client-driven and decentralized environment. The present government monopoly is far removed from the actual stakeholders. It discriminates against local-level solutions found and implemented by stakeholders and local communities. It leaves out the intellectual talents and energies of civil society, from the communities themselves, and from academics, NGOs and industry. It further perpetuates a supply-driven approach, rather than a demand-driven and needs-oriented approach in addition to supply-side solutions. Thus, water allocation, planning and management should be progressively moved in two general directions:

- A **public-private sector partnership** should be built which would include the private sector, civil society groupings, academics, NGOs, industry and other entities such as irrigation or village water supply users associations.
- The presently highly centralized decision-making and implementation should as far as possible move towards **decentralization, stakeholder participation and involvement of grassroots organizations.**

These orientations have been built into the various detailed recommendations made in this report. Fundamental to the change process will be the creation of public awareness, transparency of information and two-way flows of information, and maximal participation in decision-making and implementation by civil society and the various stakeholders involved. Further, as the change process progresses, these orientations are likely to become more important over time, and additional opportunities should be taken as they occur. Once these two directions are underway, they will build on themselves and act as drivers for further change.

5.08 A third important orientation is that solutions to water allocation, planning and management issues need to maximally exploit **demand management**. Traditionally, the response to problems has been sought through reliance on exploiting additional water sources. However, particularly as such sources are now scarce, a balance must now be found between making the best use of existing resources and harnessing new supplies. Many of the report's recommendations relate to the increased orientation on demand management: technology improvements (achieving higher productivity, water reuse, water conservation, etc.); economic incentives to encourage higher water use efficiency and reduce pollution; regulations; comprehensive basin modeling for optimal water planning and to facilitate dialogue between stakeholders; and public information and education.

5.09 Achieving improved water resources allocation, planning and management will require a multi-faceted approach. Just as water is not uni-dimensional, its improved management requires a **comprehensive approach, using in combination a number of mechanisms, in the fields of: (i) policy, (ii) legislation and regulations, (iii) institutions, (iv) economic incentives, (v) technology and (vi) data, analysis and public information.** All reform areas require attention. Economic and regulatory actions cannot be applied in a vacuum. Policy is needed to provide direction. Legislation underpins

regulation and many price instruments. Institutions are needed in order to have capacity to undertake any of the reform areas. Technical capacity and understanding must underpin all actions, and be a basis for planning and investment decisions. Of these, economic incentives are likely to be the most effective and should be given particular prominence in the reform agenda.

5.10 Action will thus be needed on a variety of fronts:

- Improving the Policy Framework;
- Strengthening the Legislative and Regulatory Framework;
- Establishing Government and Non-Government Institutions;
- Introducing Economic Incentives;
- Technological Improvements; and
- Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information.

The detailed recommendations contained in Chapter IV are encapsulated in more summary form in paras. 5.11 to 5.16 below.

5.11 **Improving the Policy Framework:** Each state should prepare a State Water Policy responsive to its needs and in line with the principles discussed in the National Water Policy and recommendations provided in Chapter IV. An Action Agenda should also be prepared and discussed within the state, outlining the specific actions intended. These are the most immediate needs as the absence of a policy and action framework at state levels means there is no basis on which to commence reforms. The National Water Policy should also be updated.

5.12 **Strengthening the Legislative and Regulatory Framework:** At state levels, a considerable body of legislation needs review and revision and, in some areas, creation:

- Amending legislation to enable: creation of the new water allocation and sharing institutions; strengthened regulatory powers, pollution control measures, establishment of multi-sectoral water stakeholder associations, participation of private sector and civil society, and new forms of water tariffs, including volumetric charging;
- Establishing groundwater legislation and a regulatory framework for groundwater management; and
- Assessing options for defining and making transferable surface and groundwater rights.

At central and inter-state levels, the first priority should be to amend the River Boards Act. The Act should be amended to give powers to the Central Government to initiate establishment of RBOs. RBOs could take many different forms, ranging from fairly informal structures, to begin with, facilitating dialogue and planning between states, to more formal institutions with executive powers. A second need is to adjust the Inter-State Water Disputes Act to substantially streamline Tribunal Award procedures within a mandatory time-frame. The adjustments to the Act should include provisions that: (i) the

center can establish a Tribunal one year after receipt of a grievance from a riparian state if agreement is not reached between concerned riparian states, and (ii) following a Tribunal decision, a mechanism for effective implementation and monitoring of the Award is established.

5.13 Establishing Government and Non-Government Institutions: Institutional mechanisms need to be created or strengthened, in particular at state, grassroots and basin levels:

- **Creating State-level Institutions:** The critical gap at state levels needs to be filled through: (i) establishing a multi-sectoral state-level institution comprised of a State Water Resources Board (SWRB) and its State Water Planning Organization (SWPO), including provisions for environmental capability; (ii) re-organizing the state bulk water supply agency (usually the Irrigation Department) along river basin lines and adjusting its mandate to include a broader role in water resources management; and (iii) creating river basin organizations (RBOs) for basins or portions of basins within the state.
- **Establishing Grassroots Institutions:** Development of grassroots institutions should be fostered, including capacity building, to implement local-level resource management initiatives.
- **Creating Inter-State River Basin Organizations (RBOs):** For all inter-state basins, riparian states should seek to form RBOs as a matter of priority. This should be constantly and strongly pursued and encouraged, including provision of incentives, by the center. These can take a wide variety of forms as discussed in Chapter IV.
- **Strengthening Central Institutions:** The Central Government apparatus, in particular MOWR, needs to be more sharply focused to enable it to play a more pro-active role. The National Water Resources Council (NWRC) and the National Water Board (NWB) need to be strengthened with an operational level Technical Committee and a permanent professional Secretariat or National Water Planning Organization (NWPO). Also, MOWR and its member agencies (e.g., CWC, CGWB and NWDA) should establish mechanisms for closer interaction.
- **Adjusting Central Government's Role:** The center's role should include fostering public participation and change through information and public awareness, and capacity building for local and state-level institutions. For state governments, it would provide financial incentives, appropriate instruments and facilitation of state initiatives and capacity building through: (i) approval of central-assistance Plan funds for water investments contingent on state progress in water resources management reform; (ii) financing through a River Basin Development Fund of multi-state basin developments where a RBO and basin plan exist; and (iii) technical assistance support to states for their reform programs.
- **Building Non-Governmental Participation:** This orientation should underlie all initiatives. Initially, given government's present monopoly role, the lead in this process will have to come substantially from government. Civil society, academia, NGOs, industrialists and water user groups should be brought into decision-making and institutions as quickly as possible. Particular attention should be given to fostering

involvement of traditionally marginalized groups which have a large stake in water resources issues, such as women and the poor. As non-governmental participation is developed through public awareness and capacity building, and additional responsibilities are shouldered, the center and state institutions can modify their role accordingly.

5.14 Introducing Economic Incentives: The incentive environment needs to be greatly enhanced through:

- **Intra-Sectoral:** (i) establish meaningful water prices for irrigation, urban and rural water supply and sanitation, reflecting the cost of providing service and the scarcity value of water and charged volumetrically; (ii) increase agricultural power tariffs and charge volumetrically; (iii) tackle distortions in agricultural commodity and input prices and domestic marketing policies; and (iv) establish pollution taxes and other incentives for environmental and health management.
- **Inter-Sectoral:** Develop economically-based water re-allocation systems by: (i) introducing economic analysis and compensation packages in administrative re-allocations; (ii) developing brokering of compensated trades; and (iii) piloting and developing formal water markets with appropriate regulatory mechanisms.
- **Inter-State:** Encourage commercial water transactions between states, or agreed multi-component (including non-water investments) basin development plans for inter-state river basins enabling mutually beneficial gains.

5.15 Technological Improvements: Implement a major drive in all sectors to: (i) increase water use efficiency; (ii) improve productivity of end use; (iii) employ water conservation, water treatment and water recycling and reuse technologies; and (iv) enable transfer and reuse between sectors.

5.16 Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information: Develop technical capabilities and public information to: (i) prepare river basin plans, state water plans and environmental management plans; (ii) strengthen hydrological measurement networks and institutions; (iii) establish performance and environmental monitoring systems for water provision services in all sectors; (iv) involve stakeholders in all water planning and allocation decision-making; and (v) provide public information and involve stakeholders in all water planning and allocation decision-making.

B. ACTION PLAN FOR IMPLEMENTING THE REFORM AGENDA

5.17 The Action Plan for implementing the Reform Agenda is at Matrix 2.

5.18 As discussed in para. 5.05, particularly at the beginning of the reform process, the primary direction for change must come from government itself, though involving civil society in its initiatives. Actions in Matrix 2 are thus categorized by the two main government actors: the state governments and the Central Government. These are the

main decision-making entities, but their respective roles are distinct. Of these, the primary actors will need to be the state governments. Most decision-making and actions occur at state levels and even for inter-state water sharing and management, actions by the individual states and cooperation between them are essential for success. The center, nevertheless, has a crucial role to play as a provider of guidance, funding and financial leverage, back-stopping legislation and dispute resolution mechanisms, and in fostering public awareness. A major focus of the Action Plan will be to maximally involve local government and civil society, including all stakeholders, NGOs, industry and the academic community.

5.19 The Action Plan at Matrix 2 presents desired actions as a guide for undertaking change at state and central levels. Particularly at state levels, there will be need to take into account the specific circumstances of the state concerned. No uniform prescription or blueprint will be appropriate for all circumstances. A reform agenda as bold and comprehensive as possible would be best. However, progressive changes would still be moves in the right direction. A strategic, but also opportunistic, approach will often be needed, tackling first those issues considered most important and susceptible to change.

C. GETTING STARTED

5.20 The Action Plan at Matrix 2 includes a suggested time-frame for its implementation. Some actions are particularly critical at the beginning, as they provide a foundation for other subsequent steps. This section provides guidance on the likely most important start-up actions, at state levels and at the center (refer Diagram 2—"Getting Started").

State-level Actions

5.21 Establishing a Policy and Action Agenda: The first need in each state will be to set out a policy framework and Action Agenda. To this effect, an Interim Water Resources Task Team should be established quickly to assess the situation in the state and to draft two guiding documents establishing an agenda for change:¹⁵³

- Prepare a draft State Water Policy: A short conceptual document, providing an overview, key issues, and the future vision for improving management of the state's water resources.
- Prepare an Action Agenda: A note detailing the specific short and medium-term actions intended.

¹⁵³ The state-level Task Team would be temporary in nature. Once an institutional capability has been established by the state (i.e., the SWRB/SWPO), the Task Team would no longer be needed. Similarly, at central level, the interim Task Team (refer para. 5.23) would be phased out as the Technical Committee and NWPO are established.

5.22 These documents should be reviewed extensively within the state government, including at political levels. They should also involve consultation through workshops, the media, and other procedures with civil society and major constituencies. Although the order of subsequent actions will vary by state, in most cases, the following actions are short-term needs:

- Establish Institutional Capability: Although the task team above will be sufficient for the focused intellectual input required for drafting a State Water Policy and Action Agenda, permanent capability—the SWRB and its SWPO—is required for steering and implementing further actions.
- Create Public Awareness: Implementation of the change process will require better understanding of the issues by the general public. A multi-media campaign should be launched and sustained over time to create awareness and understanding of the changes required, and concerned civil society should be integrated in the decision-making process.
- Review and Establish Economic Incentives and Mechanisms: A review should be made of existing incentives for water use and conservation. The review should focus on areas particularly in need of change and where change can be introduced quickly. Generally, the more immediate and short-term changes would be in the following areas: (i) adjust (almost always increase) water charges in all sectors; (ii) raise agricultural power tariffs and switch to metered charging; (iii) prepare and phase in volumetric charging of water; (iv) correct commodity price and market imbalances distorting regional water use; and (v) introduce financial incentives for pollution control and water reuse and conservation.
- Initial Review of State Water Legislation: A review should be undertaken of existing legislation and its adequacy relative to the objectives under the State Water Policy. Key areas requiring change or new legislation should be identified and this legislation subsequently prepared.
- Launch Initiatives for Inter-State Basins: Possibilities will vary depending on the present degree of cooperation between the concerned riparian States. In all cases, some steps towards further cooperation are possible and should be identified and undertaken. The short to medium-term objective should be to establish RBOs.
- Introduce Technological Improvements: A quick review should be undertaken in all sectors of opportunities for enhancing productivity, water use efficiency, and water recycling and reuse.
- Improve Modeling, Data, Performance and Environmental Monitoring, and Public Information: Identify the state-specific actions needed and implement.

Central-level Actions

5.23 For the Central Government, actions in the short term should be to help create awareness of the issues amongst civil society and government. At the level of the states, it would provide technical assistance and create financial instruments encouraging change. At the central level, it would make targeted changes in the institutional structure and

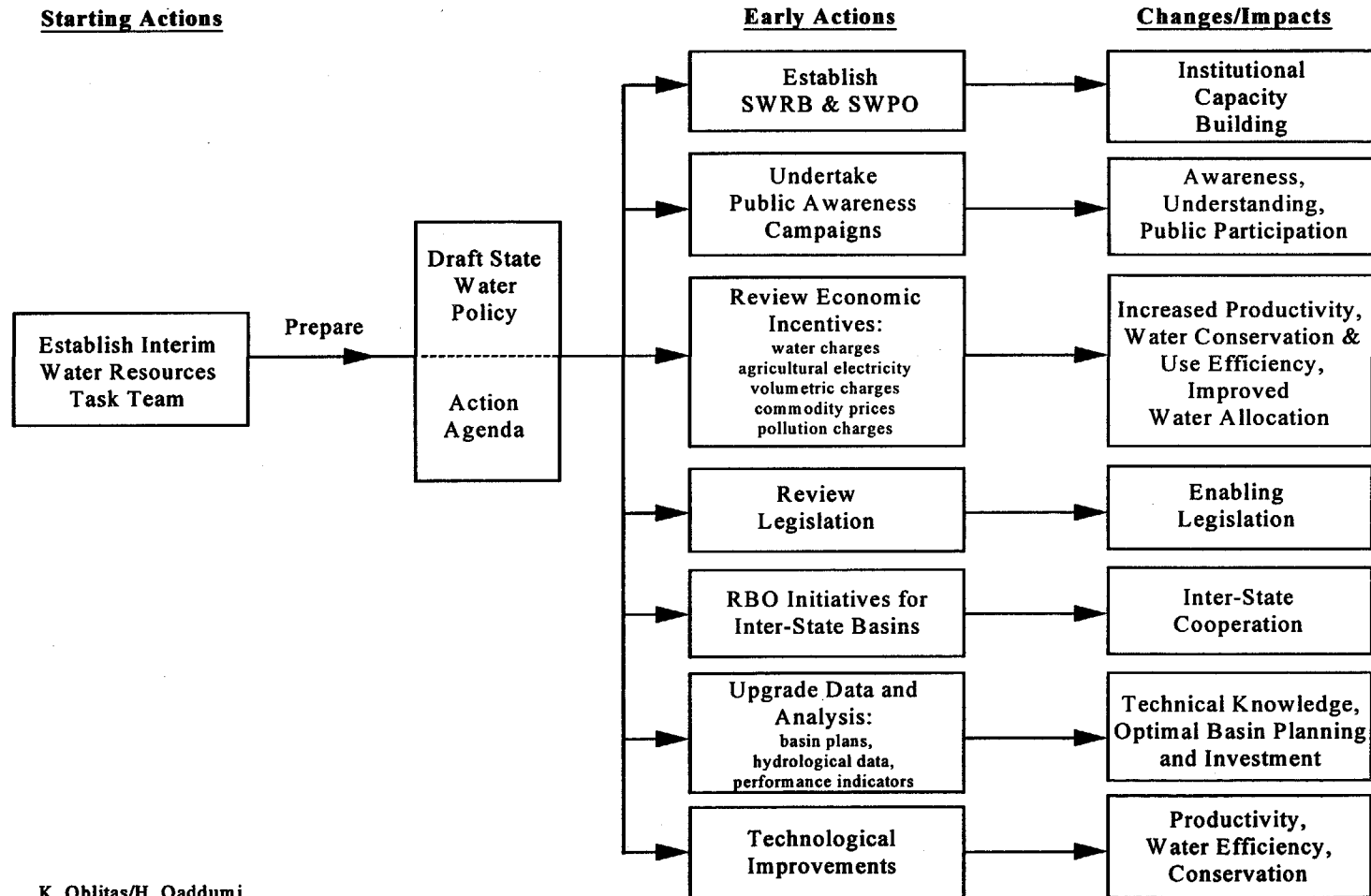
legislative provisions. To get these actions underway, a cross-ministerial Interim Water Resources Task Team should be established to prepare a short-term Action Agenda for Central Government's role. The following actions will need to be at the forefront:

- Public Awareness: A vigorous program to this effect should be launched, including use of the media, literature, workshops and study tours.
- Guidance and Capacity Building: This will require multi-disciplinary capabilities, and an advisory role ranging from the general and conceptual to highly specific advisory capability to help states devise and implement specific actions (e.g., a particular piece of legislation, how to introduce volumetric charging, features for establishing a SWRB or RBO, etc.). The center should also help train and build capacity of local-level institutions.
- Funding for State Initiatives: A funding provision should be provided for ready access by states to finance initiatives at the state or basin level.¹⁵⁴ This could be through a "centrally-sponsored scheme" or other grant-providing mechanism.
- Applying Approvals Leverage: Develop and apply in the Plan-approvals process a system for monitoring state progress in water resources management reform.
- River Basin Development Funding: Provide centrally-sponsored-scheme Plan funding for multi-state river basin development where RBOs and basin plans exist.
- Reviewing Existing Legislation and Procedures: Amendments of the River Boards Act and the Inter-State Water Disputes Act should be a priority for the MOWR/National Parliament.
- Improving Central Institutions: The short-term need is to establish or strengthen capacity to handle the areas above, including making the NWRC more operational.

¹⁵⁴ For instance, the costs (consultancy, training, equipment, study tours, etc.) related to establishing new state institutions (SWRB/SWPO), introducing volumetric charging, monitoring and regulatory apparatus for establishing pollution fees, undertaking basin plans, improving hydrological data, etc.

IMPROVING INTER-SECTORAL WATER ALLOCATION, PLANNING AND MANAGEMENT

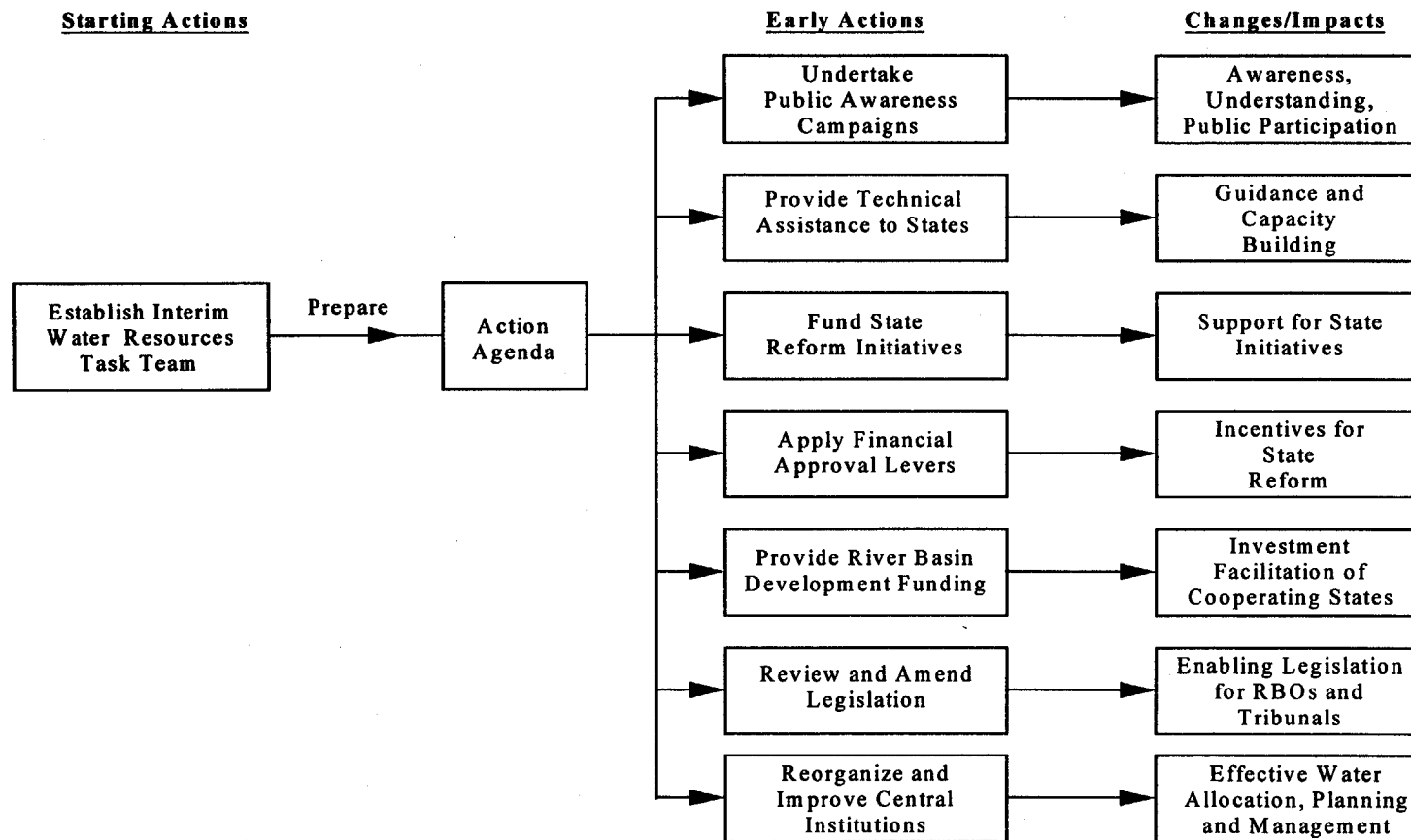
DIAGRAM 2A: GETTING STARTED -- STATE ACTIONS



K. Oblitas/H. Qaddumi

IMPROVING INTER-SECTORAL WATER ALLOCATION, PLANNING AND MANAGEMENT

DIAGRAM 2B: GETTING STARTED -- CENTRAL GOVERNMENT ACTIONS



K. Oblitas/H. Qaddumi

MATRIX 2

ACTION PLAN FOR THE STATES AND CENTRAL GOVERNMENT

STATE LEVEL ACTIONS			
I. Improving Policy Framework			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
<p>Formulate State Water Policies and Action Agenda</p> <p>State Water Policy should include the following:</p> <ul style="list-style-type: none"> • comprehensive approach on a river basin basis • treatment of surface and groundwater as unitary resource • multi-sectoral perspective • integration of quantity and quality-related aspects • full integration of environmental and health aspects • integration of pricing and economic incentives • introduction of administrative allocation mechanisms incorporating economic or value-based criteria, as well as promotion of market-oriented approaches, together with regulatory mechanisms, to water management • much greater emphasis on demand management approaches • assured O&M funding and related policies and revenues (water charges) generation • technological improvement aspects, including productivity enhancement, water conservation and water reuse • intended implementation actions, including core reform areas for legislation, institutions, the incentive environment and technology • participatory approach to water resources management • private sector participation 	<p>Establish <u>Interim Water Resources Task Team</u></p> <p>Prepare a draft <u>State Water Policy</u></p> <ul style="list-style-type: none"> • overview of state's water resources situation, key issues, future vision and objectives • broad intentions for current and future development of state's water resources. <p>Prepare an <u>Action Agenda</u></p> <ul style="list-style-type: none"> • specific short-term actions for improving water resource management • appended to State Water Policy or a separate note 	<p>Chief Minister or Chief Secretary</p> <p>Interim Water Resources Task Team</p> <p>Interim Water Resources Task Team</p>	<p>immediate</p> <p>immediate</p> <p>immediate</p>

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS			
II. Strengthening Legislative and Regulatory Framework			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Amend and Create Legislation Enabling legislation will typically be needed for the following: <ul style="list-style-type: none"> • state water policies • implementation of new or revised institutions and institutional responsibilities • regulation of water resources • pollution control • establishment of water users associations, participation of private sector and civil society • new forms of water charges and collection procedures • surface and groundwater rights and management 	Undertake overall review of existing legislation	SWRB	short term
	Amend or create necessary legislation	SWRB/state government	medium term
Establish Groundwater Legislation	Enact appropriate and widely acceptable legislation for groundwater management (refer "India - WRM Groundwater Regulation and Management Report" (World Bank, 1998d))	SWRB/state government	medium term
Define Transferable Surface and Groundwater Rights	Assess options for defining and making transferable surface and groundwater rights <ul style="list-style-type: none"> • surface water: maintenance of riparian rights coupled with introduction of government administered licensing of transferable water rights • groundwater: institution of government-administered permit system for selective groundwater extraction and use, including provision for transferability (as recommended in 1996 Model Bill for groundwater) 	SWRB/state government	medium term
	Introduce government-administered licensing of transferable water rights <ul style="list-style-type: none"> • provide transferable bulk water rights to water user groups on pilot basis in selected areas • include protective provisions for existing uses; terms and conditions on use; provisions for necessary suspension or cancellation of rights with compensation; recording of licenses 	SWRB, bulk water supply agency & Basin Managers	medium to long term

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS			
III. Establishing Government and Non-Government Institutions			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
<p>Establish a Multi-Sectoral State-level Institution</p> <ul style="list-style-type: none"> apex body at the level of the state, responsible for comprehensive water planning, allocation and analysis 	<p>Create a <u>State Water Resources Board (SWRB)</u></p> <ul style="list-style-type: none"> core and most senior level state institution for multi-sectoral planning and allocation decisions, including water policy, inter-sectoral water allocation, planning of water development programs, and resolution of water resources issues formal committee, comprised of heads of relevant government departments and agencies connected with water, supplemented by representatives from water user groups, industry, academia and other stakeholders chaired by a neutral senior party (e.g., Chief Minister, Chief Secretary, Finance Secretary or Development Commissioner) 	<p>Chief Minister or Chief Secretary</p>	<p>immediate</p>
	<p>Create SWRB's <u>State Water Planning Organization (SWPO)</u></p> <ul style="list-style-type: none"> technical secretariat for SWRB full time professional staffing in areas related to multi-sectoral water resources planning and management senior officer head (Additional Secretary rank/equivalent or above) to also serve as Member Secretary of SWRB responsible for preparing basin plans for all river basins in the state and a State Water Plan, undertaking studies of water-related issues, preparing environmental management plans by river basin 	<p>SWRB</p>	<p>immediate</p>
	<p>Establish Environmental Capability</p> <ul style="list-style-type: none"> create an Environmental Working Group in SWRB create Environmental Unit within SWPO and at basin levels 	<p>SWRB, SWPO & Basin Managers</p>	<p>short term</p>
<p>Reorganize and Broaden Mandate of State Bulk Water Supply Agency (e.g., Irrigation Department)</p> <ul style="list-style-type: none"> responsible for overall basin management, including surface and groundwater, bulk water supplies to urban, rural and industrial consumers, irrigation and drainage services, and flood management 	<p>Reorganize along river basin lines and adjust mandate to include a broader role in water resources and overall basin management</p> <ul style="list-style-type: none"> re-organize field staff along river basin lines take on additional specialist functions such as hydrology and water resources data absorb staff and responsibilities from other governmental departments such as groundwater 	<p>Chief Secretary & Secretary of Irrigation Department or State bulk water supply agency</p>	<p>short term</p>

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS

III. Establishing Government and Non-Government Institutions (continued)

Reform Recommendations	Components of Reform	Responsibility	Time Frame
<p>Create River Basin Organizations (RBOs) at state level</p> <ul style="list-style-type: none"> responsible for implementing integrated basin management at the operational (basin) level incorporating all governmental and multi-sectoral stakeholders and including private sector interests 	<p>Initiate establishment process</p> <ul style="list-style-type: none"> in acutely water scarce river basins with high stakeholder interest bringing together various stakeholders, including government and private sector interests (water user groups, industrialists, NGOs, etc.) 	Basin Managers	short to medium term
	<p>Encourage RBO's further gradual development to assume a role of increasing importance</p>	SWRB & Basin Managers	medium term & continuous
<p>Create Inter-State River Basin Organizations (RBOs)</p> <ul style="list-style-type: none"> various possible forms—both informal and formal—ranging from basin planning and coordination, to water allocation and management of common bulk supplies, to monitoring and maintenance of water quality, and to general operations and hands-on management flexibility regarding the degree of Central Government involvement and use of legislative provisions in establishment 	<p>Initiate establishment process</p> <ul style="list-style-type: none"> begin dialogue, even if only on an ad hoc and informal basis, on key river basins with an aim for agreement on an institutional structure and mandate for RBO adopt a situation specific approach, evolutionary with respect to structural forms and scope of responsibilities 	Riparian States (Chief Ministers, Chief Secretaries, SWRB & Basin Managers)	short to medium term
<p>Promote Training and Technical Assistance in State-level Institutions</p>	<p>Transfer specialist expertise through careful selection of staff, contractual arrangements with private sector and consultancy assistance</p>	SWRB & SWPO	short term
	<p>Transfer technology (computers, software, etc.), particularly to SWPO and Environmental Units</p>	SWPO	short term
<p>Develop and Foster Grassroots Institutions</p>	<p>Commence mobilization effort through consultation with NGOs and stakeholders on a pilot basis in select areas</p>	Basin Managers supported by SWRB/SWPO	short term
	<p>Provide training and financial and technical support for capacity building to existing local-level institutions</p>		medium term & continuous
<p>Promote Public Awareness and Integrate the Private Sector</p>	<p>Involve academics, NGOs, industry, water user groups and other civil society maximally in decision-making, with particular emphasis on outreach to traditionally marginalized groups such as women and the poor</p>	SWRB, SWPO & Basin Managers	immediate & continuous
	<p>Inform and involve the public through media campaigns, seminars, workshops, publicity, education programs, etc.</p>	SWRB, SWPO & Basin Managers	immediate & continuous

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS

IV. Introducing Economic Incentives

Reform Recommendations	Components of Reform	Responsibility	Time Frame
Intra-Sectoral Allocation and Pricing			
<p>Establish Water Prices</p> <p>These should be accompanied by:</p> <ul style="list-style-type: none"> public awareness campaigns, including outreach programs to water consumers transparent information to water users on water charges, the necessary costs of effective O&M, actual expenditures, the size of existing subsidies, environmental costs, etc. system improvements, including increasing financial allocation to maintenance works, rehabilitation and modernization of distribution systems; additionally support agricultural improvements through agricultural intensification programs 	<p>Create a Water Pricing Committee (WPC)</p> <ul style="list-style-type: none"> to undertake analysis and present recommendations to government responsible for determining water rates in all sectors <p>Increase irrigation prices and charge volumetrically</p> <ul style="list-style-type: none"> implement major jump in water charges, with the goal of covering at least efficient operations and maintenance (O&M) costs in the short-term switch from area-crop based charging to volumetric charging and bulk sales to water users associations (WUAs) <p>Increase urban water prices (both domestic and industry) and introduce volumetric charges</p> <p>Increase rural water supply prices</p>	<p>Chief Secretary & SWRB</p> <p>WPC & Irrigation agency</p> <p>WPC & municipalities</p> <p>WPC & RWSS agency</p>	<p>immediate</p> <p>short term</p> <p>short term</p> <p>short term</p>
<p>Establish Groundwater Pricing</p> <p>These should be accompanied by:</p> <ul style="list-style-type: none"> transparent information to pumpset owners and the general public on actual costs of power provision, the size of existing subsidies, environmental costs, etc. 	<p>Increase or introduce power tariffs</p> <p>Introduce volumetric charges (i.e., based on power consumption)</p>	<p>WPC &/or state electricity agency(ies)</p> <p>state electricity agency(ies)</p>	<p>immediate</p> <p>short to medium term</p>
<p>Tackle Distortions in Agricultural Commodity and Input Prices and Domestic Marketing Policies Created at State Levels</p>	<p>Undertake review of subsidies and marketing policies for water-related agricultural inputs and outputs</p>	<p>WPC</p>	<p>medium term</p>

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS

IV. Introducing Economic Incentives (continued)

Reform Recommendations	Components of Reform	Responsibility	Time Frame
Intra-Sectoral Allocation and Pricing (continued)			
<p>Establish Incentives for Pollution Control and Water Conservation</p> <ul style="list-style-type: none"> • Financial disincentives/penalties for water pollution • Financial incentives for pollution control, water conservation and recycling 	<p>Review and revise existing state taxes and fines relating to pollution</p> <p>Introduce pollution taxes and effluent charges for actual amount of pollution emitted based on “Polluter Pays Principle”</p> <p>Introduce or review and revise existing state incentives for investment in environmental protection and water recycling and conservation</p>	<p>WPC, SWRB & Pollution Control Board</p> <p>Pollution Control Board</p> <p>SWRB, WPC & Pollution Control Board</p>	<p>immediate</p> <p>short term</p> <p>short to medium term</p>
<p>Install Measures to Guard Social Well-being</p>	<p>Create a pricing structure such that necessary quantities of safe and reliable drinking water are provided to the poor</p> <ul style="list-style-type: none"> • through multi-tiered (increasing block) rate structures • through direct subsidies (i.e., not relating to water use) for <i>targeted</i> consumers and /or service providers <p>Rehabilitate and modernize irrigation and drainage systems and undertake agricultural extension to enhance agricultural productivity and incomes</p>	<p>WPC & state water supply agencies</p> <p>state irrigation agency and agriculture department</p>	<p>short term</p> <p>short to medium term</p>

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS			
IV. Introducing Economic Incentives (continued)			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Inter-Sectoral Allocation			
Improve Administrative Allocation of Water	Introduce economic analysis and compensation packages in administrative allocations	SWRB & SWPO	short to medium term
	Develop knowledge base (hydrological data and basin modeling) and disseminate information to all affected parties	SWRDC, SWPO & Basin Managers	short to medium term
Develop Brokering of Compensated Trades	Assess where mutually profitable/beneficial outcomes exist and play a catalyzing role in negotiating such arrangements	SWPO & Basin Managers	medium term
	Develop knowledge base and disseminate information to all affected parties	SWRDC, SWPO & Basin Managers	short to medium term
Study and Pilot Water Markets	Undertake study tours, including users and all water using sectors, to assess international experience	SWPO, irrigation agency and other agencies	short term
	Introduce water markets on a pilot basis, restricted to select areas with evident need and high stakeholder interest, and restricted in scope to formal groups of water users <ul style="list-style-type: none"> • Establish local management unit to facilitate trades, monitor and regulate, and to provide dispute resolution mechanism • Monitor and make adjustments as needed for replication 	Basin Managers, concerned agencies & NGOs	medium to long term
	Introduce regulations to guard environmental and social welfare	Basin Managers and concerned agencies	concurrently with above
	Establish institutional, legal (clearly defined and transferable bulk/sectoral water rights), administrative and technological mechanisms to enable development of formal water markets	state government, SWRB & Basin Managers	concurrently with above

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS			
IV. Introducing Economic Incentives (continued)			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Inter-State Allocation Mechanisms			
Improve Inter-State Allocation of Water	Introduce economic analysis in administrative allocations	state govts with GOI	short term
	Develop knowledge base (hydrological data and basin modeling) and disseminate information to all affected parties	SWRBs, SWRDCs & SWPOs (& inter-state RBOs where existing)	medium term
Develop Multi-Component (including non-water investments) Basin Development Plans	Give due weight to economic criteria in decision-making in order identify potential mutual benefits from integrated development of inter-state river basins	state govts & GOI (& RBOs where existing)	short to medium term
	Develop analytical base to support decision-making, including basin modeling incorporating economic variables	SWPOs (& RBOs where existing)	medium term
V. Technological Improvements			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Increase Water Use Efficiency and Improve Productivity of End Use in all Sectors	Rehabilitate and modernize surface irrigation schemes	irrigation department,	short to medium term
	Undertake leak detection and repairs for domestic water supply schemes and improve monitoring and metering	UWSS & RWSS agencies	short to medium term
Improve Agricultural Technology	Encourage the adoption of technology innovations to maximize productivity (on-farm water management, agronomic practices, drip irrigation, diversification, eco-agriculture technologies, watershed management)	agriculture departments, WALMIs & universities	short to medium term
Encourage Water Conservation, Recycling, Reuse and Treatment	Encourage effluent treatment, water conservation programs and water harvesting	all agencies	medium term

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS			
VI. Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Prepare River Basin Plans and Environmental Assessments, supported by Modeling	Prepare comprehensive <u>River Basin Plans</u> for all basins or parts of basins in the state	SWPO (& RBOs where existing)	short to medium term
	Prepare a <u>State Water Plan</u>	SWPO	medium term
	Prepare <u>Basin Environmental Assessments</u> and <u>Environmental Assessments</u> of specific environmental issues	SWPO (&RBOs where existing)	short to medium term
	Improve basin modeling capability <ul style="list-style-type: none"> • implement training program including transfer of modeling software, provision of computers, selective provision of other facilities (e.g. satellite imagery) • identify training institutes including universities and seek supplementary assistance through twinning arrangements • select a few basins for particularly intensive study • encourage an inter-active process with high degree of stakeholder involvement 	SWRB, SWPO, universities, Basin Managers & NGOs	immediate to short term
Improve Hydrological Data	Establish a <u>State Water Resources Data Center (SWRDC)</u> <ul style="list-style-type: none"> • to assemble and monitor all quantity and quality-related data from collecting sources in the state, based on river basins or a part thereof lying within the state • to develop Geographic Information System (GIS) • to disseminate data to all <i>bona fide</i> users on a periodic and regular basis, including making it accessible on internet and CD-ROM 	SWRB, then SWRDC	short to medium term
	Expand and improve data measurement <ul style="list-style-type: none"> • assess in each state and river basin existing network of measuring stations • expand existing network of measuring stations for surface and groundwater, including water quality 	SWRDC & SWPO	medium to long term

Matrix 2 (cont.). Action Plan for the States and Central Government

STATE LEVEL ACTIONS

VI. Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information (continued)

Reform Recommendations	Components of Reform	Responsibility	Time Frame
Establish Performance Monitoring	Establish relevant measurement and monitoring indicators of performance for irrigation, urban water supply and sanitation, and rural water supply and sanitation	SWRB, SWPO & state agencies (irrigation, UWSS, RWSS, etc.)	short term
	Issue on a regular and periodic basis reports on performance indicators and make information accessible on internet and on CD-ROM	SWPO & state water agencies	short to medium term
Improve Environmental Monitoring and Management	Establish measurement and monitoring indicators of environmental aspects of water development and management	SWPO, SWRDC, SPCB & others	short term
	Collect, analyze and issue on a regular and periodic basis environmental and ecological data and performance indicators and make information accessible on internet and CD-ROM	SWPO & SPCB	short to medium term
Data Transparency, Public Information and Public Involvement	Make data transparent and provide mechanisms for ready access by stakeholders and the public to all information and analysis	SWPO, SWRDC, & Basin Managers	immediate start
	Provide "outreach" to public through media, seminars, workshops, political gatherings, and information bulletins to inform and involve the general public in basin planning, environmental issues, and productivity improvements	SWRB, SWPO, Basin Managers & state agencies	immediate start
	Actively enlist participation of traditionally more marginal or less vocal groups, such as women, the poor and other minority groupings	Basin Managers, state agencies & SWRB	immediate start

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS			
I. Improving Policy Framework			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
<p>Formulate Action Agenda</p> <p>National Water Policy should include the following:</p> <ul style="list-style-type: none"> • comprehensive approach on a river basin basis • treatment of surface and groundwater as unitary resource • multi-sectoral perspective • integration of quantity and quality-related aspects • integration of environmental and health aspects • integration of pricing and economic incentives • introduction of administrative allocation mechanisms incorporating economic or value-based criteria, as well as promotion of market-oriented approaches, together with regulatory mechanisms, to water management • much greater emphasis on demand management approaches • O&M funding and related policies and revenues (water charges) generation • technology improvement aspects, including productivity enhancements, water conservation and water reuse • intended implementation actions, including core reform areas for legislation, institutions, the incentive environment and technology • participatory approach to water resources management • private sector participation 	<p>Establish cross-ministerial <u>Interim Water Resources Task Team</u></p> <p>Prepare an <u>Action Agenda</u></p> <ul style="list-style-type: none"> • note articulating specific short-term actions at central level for improving water resource management <p>Update <u>National Water Policy</u></p>	<p>MOWR/NWB</p> <p>Interim Water Resources Task Team</p> <p>MOWR (consult NWB & NWRC)</p>	<p>immediate</p> <p>immediate to short term</p> <p>short to medium term</p>

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS			
II. Strengthening Legislative and Regulatory Framework			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Strengthen Legislative Framework	Establish <u>Task Force</u> to assess possible reforms in: <ul style="list-style-type: none"> • River Boards Act and Inter-State Water Disputes Act • surface and groundwater rights • other enabling legislation 	MOWR	immediate to short term
Facilitate Establishment of River Basin Organizations	Amend River Boards Act to give powers to the Central Government to enable the establishment of a RBO	MOWR	short term
Improve Performance of Tribunal Awards System	Enhance effectiveness of Tribunal by: <ul style="list-style-type: none"> • amending Inter-State Water Disputes Act to enable Central Government to institute a Tribunal within one year of a state's request if the concerned riparian states have not reached agreement • establishing mandatory time limits for creation of Tribunal, award decision, and state response/rebuttal • fixing by law the review of Tribunal Awards at set intervals • providing for the establishment of a mechanism for mandatory implementation and monitoring of the Award decision 	MOWR	short term

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS			
III. Establishing Government and Non-Government Institutions			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
<p><u>Strengthen the National Water Resources Council</u></p> <p>In order to more effectively:</p> <ul style="list-style-type: none"> • coordinate activities amongst various Central Government agencies involved in water • promote best practices in water resources management • discuss inter-state and international water issues 	<p><u>Create a Technical Committee</u> under NWB</p> <ul style="list-style-type: none"> • with representation from all states and key GOI departments • chaired by Ministry of Water Resources • meeting on a quarterly basis 	MOWR	short term
	<p><u>Create a National Water Planning Organization (NWPO)</u></p> <ul style="list-style-type: none"> • Secretariat of Technical Committee of NWB • adapt CWC's WP&P wing for this purpose • staffing on secondment from MOWR, CWC, CGWB, NWDA, MOEF, CPCB and other relevant agencies and some additional disciplines 	MOWR/CWC	short term
	<p><u>Create an Environmental Sub-Committee and an Environmental Cell</u> within NWPO</p>	MOWR/MOEF & NWPO	short term
<p><u>Restructure Ministry of Water Resources (MOWR)</u></p>	<p>Create a mechanism for closer interaction between MOWR and its agencies (CWC, CGWB, NWDA)</p>	MOWR	short term
<p><u>Use Approvals Process to Encourage Reforms at State Levels</u></p>	<p>Review process for Plan funding and approval of state project proposals to include monitoring of water allocation, planning and management reforms at state levels. Monitoring to include state progress with:</p> <ul style="list-style-type: none"> • establishment of State Water Policy and Action Agenda • establishment of SWRB and SWPO • establishment of financial incentives for water use productivity and environmental management • preparation of intra-state River Basin Action Plan and Basin Environmental Action Plan • actions towards creation of an intra-state RBO • status of dialogue with other riparian states for inter-state basins • degree of initiatives taken by the state to cooperate with other riparian states and to move towards/establish an inter-state RBO 	CWC/MOWR & Planning Commission	short term
<p><u>Provide Financial Assistance for RBOs</u></p>	<p>Provide river basin development funding for investment in river basins where riparian states have:</p> <ul style="list-style-type: none"> • a non-contested agreement between riparian states • a jointly issued River Basin Plan for the full basin • some form of inter-state RBO 	Planning Commission/ MOWR & Ministry of Finance	medium term

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS			
III. Establishing Government and Non-Government Institutions (continued)			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Provide Training and Technical Assistance to State and Local-level Institutions	Build capacity through: <ul style="list-style-type: none"> • awareness creation (e.g. seminars, workshops) • providing advisory support • disseminating best practices (e.g., study tours) • providing specialist training, provision of computers, software, etc. 	MOWR & its specialist agencies	immediate start
IV. Introducing Economic Incentives			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Improve Environmental Incentives	Assess and introduce augmented incentives/disincentives for pollution control, water conservation, water recycling and reuse	NWPO, MOEF & CPCB	short to medium term
Tackle Agricultural Pricing and Marketing Policies	Dismantle artificial trade barriers between states and regions and unify commodity pricing policies throughout India	GOI	medium term
	Correct market and infrastructure imbalances	GOI	medium term
Provide Funding for State Initiatives	Develop a centrally-sponsored scheme or grant-providing mechanism to support state-level initiatives, including: <ul style="list-style-type: none"> • introducing volumetric charging • establishing enforceable pollution fees • brokering compensated trades • piloting or developing water markets 	MOWR, Planning Commission & Ministry of Finance	short to medium term

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS

V. Technological Improvements

Reform Recommendations	Components of Reform	Responsibility	Time Frame
Undertake a Sustained Drive to Encourage Technological Improvement	Provide technical support, including financing of state initiatives to introduce improved technology to: (i) enhance productivity of irrigation systems and (ii) improve related agricultural technology	MOWR & Ministry of Agriculture	short term
	Improve efficiency of domestic water supply schemes, including water treatment and water conservation practices	MOUAE & RGNDWM	short to medium term

VI. Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information

Reform Recommendations	Components of Reform	Responsibility	Time Frame
Improve Hydrological Measurement, Data Systems and Data Analysis	Strengthen the <u>National Water Resources Data Center (NWRDC)</u> <ul style="list-style-type: none"> • to assemble and monitor all quantity and quality-related data from collecting sources, based on river basins, sub-basins or a part thereof, and to disseminate data to <i>bona fide</i> users • to develop National Geographic Information System (GIS) • to disseminate data to all <i>bona fide</i> users on a periodic and regular basis, including making it accessible on internet and CD-ROM • fully networked with SWRDCs 	CWC & CGWB (supported by CPCB, IMD & SWRDCs)	short to medium term
	Expand and improve data measurement <ul style="list-style-type: none"> • assess and expand existing network of measuring stations for surface and groundwater, including water quality 	CWC, CGWB & CPCB	medium term

Matrix 2 (cont.). Action Plan for the States and Central Government

CENTRAL LEVEL ACTIONS			
VI. Improving Modeling, Data, Performance and Environmental Monitoring, and Public Information (continued)			
Reform Recommendations	Components of Reform	Responsibility	Time Frame
Improve Basin Modeling Capability	Implement training program including transfer of modeling software, provision of computers, selective provision of other facilities (e.g. satellite imagery)	NWPO, CTU, CWPRS, IHH & universities	short to medium term
	Expand training program provided by MOWR's Central Training Unit (CTU) at Pune and identify a network of other training institutes	NWPO & CTU	short to medium term
	Develop twinning arrangements with international centers of excellence	NWPO	short to medium term
Establish Performance and Environmental Monitoring Criteria	Develop and Apply Performance and Environmental Monitoring Criteria for Evaluation of State Performance and Evaluation of Individual Investments	NWPO, MOEF & CPCB	short to medium term
Foster Public Participation	Provide "outreach" to public through media, seminars, workshops, political gatherings, and information bulletins to inform and involve the general public	MOWR & agencies	short term
	Actively enlist participation of traditionally more marginal or less vocal groups, such as women, the poor and other minority groupings	MOWR & agencies	short term

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