DRAFT

ARAL SEA BASIN PROGRAM
TECHNICAL PAPER SERIES

Developing a Regional Water Management Strategy:
Issues and Work Plan

❖

Prepared by
Program Group 1 (Project 1.1) in cooperation with the
ICWC and the World Bank
for
the EC of ICAS

May 1, 1996

DEVELOPING A REGIONAL WATER MANAGEMENT STRATEGY: ISSUES AND WORK PLAN

EXECUTIVE SUMMARY

1. Water is a strategic resource playing a vital role in the economic and social life of arid Central Asia. Over the last 35 years, intensive cotton farming and onesided agricultural development has diverted so much water from the two rivers which feed the Aral Sea that its shore line has in some places retreated by more than 120 km. Vision of abandoned and derelict fishing boats in a landscape of salt and crusted sand first drew the world's attention to the human and ecological crisis facing the Aral Sea and its shore region. But degradation due to the nonsustainable use of water and related land resources extends far beyond the Sea. Over the last few decades, the upper Basin (flow formation zone) has lost about 50% of its forest cover. Soil erosion has intensified, not only reducing agricultural productivity but also silting storage reservoirs. The massive discharges of drainage water from irrigated land into rivers have resulted in a drastic increase of water salinity. Soil salinization and waterlogging is a serious problem throughout the Basin. This is all directly linked to a decline in human health and agricultural productivity in the Basin.

2. Taking into account the new political, economic, and social realities, and recognizing the severity of environmental concerns, the heads of state of Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan met in January 1994, and approved an Action Plan for the improvement of environmental situation in the Basin and for its social and economic development over the next three to five years. The regional water management strategy is a centerpiece of the Action Plan.

3. The principal objective of the regional water management strategy in the Aral Sea Basin is to identify the means and mechanisms for combining the development goals and interests of each Basin state with long-term water resources and environmental management objectives. In this context, there

are two predominant issues. The first is population growth. By 2010, the population of the Basin is expected to be close to 50 million, compared with about 37 million in 1994 and only 16 million in 1960. Second, about 92% of total water use in the Basin serves an irrigated area of about 7.9 million hectares. This ranks as one of the world's largest irrigation systems; this is double that of Egypt and half of the vast Indus system in Pakistan. Given this large infrastructure and the Basin's economic dependence on agriculture, the fundamental goal of Project 1.1 is to determine a way to achieve sustainable agricultural development while also alleviating the area's substantial environmental challenges.

4. This report is a summary of preparatory work to develop a common strategy for rational allocation, sustainable use and protection of water resources in the Aral Sea Basin shared by Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. The work has been financed by a grant from the Global Environmental Facility (GEF) administered by the Executive Committee of the Interstate Council for the Aral Sea (EC of ICAS) with the assistance of the World Bank. It has been undertaken in close cooperation with the European Union (through its TACIS WARMAP project), the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP).

5. The work began in early 1995 and so far has concentrated on establishing the basic provisions for development of a regional water strategy. A hallmark in the preparatory stage was the establishment of an interstate Program Group and 10 working groups that produced reports identifying key national concerns for water management and summarizing national positions concerning a regional water strategy. This arrangement was meant to include many of the key "stakeholders" from the very beginning of strategy formulation in order to create the sense of commitment and "ownership" that is of basic importance for strategy implementation. The process of bringing national and regional goals closer together has been further strengthened by a region-wide circulation and review of these reports.

6. Since the Basin states became independent in 1991, their economies have been marked by serious declines in GDP and living standards. While water sector no longer receives sufficient support from the state budgets, neither have new sources and methods of financing been mobilized. If financing shortfalls continue, degradation of water management infrastructure built in the past may reach irreversible dimensions. But water management needs must compete with several other priority areas for human and financial resources. It is important to recognize that, during the next five to seven years of a transition toward market-oriented economies, institutional and financial constraints will continue to be severe. Any short and medium-term action program must take these constraints into account.

7. There are many ways to view the problems of water resources in the Aral Sea Basin. In this report some of the major economic and social, water and land, environmental and institutional issues are discussed. This thematic perspective has been augmented by the national priorities identified in the preparatory stage of Project 1.1 by

national experts from each of the Basin states. By integrating identified thematic issues and national priorities, eight major regional issues emerge that will call for special attention in the next stage of work on the regional water management strategy. These are:

- The new political, economic and social setting;
- Information improvements;
- Managing transboundary water re-
- sources;
- Increasing water use efficiency (water conservation);
- Water quality control;
- Salinity management;
- Environmental concerns; and
- Improving implementation capability.

8. As for **the new political, economic and social setting**, one of the fundamental issues in the Aral Sea Basin is that, for almost 70 years, the Basin was located in one federal state; since the Basin states became independent, regional interdependence taken on a new meaning. Instead of federal coordination from outside the region, the newly independent countries themselves must coordinate regional issues. The difference between the past and present (and the future) extend, however, beyond economic and technical matters. The entire system of human incentives, attitudes and motivation is changing; new institutional arrangements are emerging that have little to do with those known in the past. The issue emphasizes the need for capacity-building, human resources development and participatory decision-making in environmentally-sound water and land resources management. Inputs from all agencies cooperating under the Aral Sea Program (UNDP, UNEP, EC TACIS, US AID and others) will be important to address adequately this fundamental issue.

9. Transboundary water resources can be efficiently managed only if there is a common **information system** on all important variables - and if the system is open to all parties who share the resources. A Basin-wide information system, built on national "nodes", is needed to share information on water, land, and environmental resources and their use. In the next stage of work on development of a regional water strategy, full use will be made of the WARMIS, an information system for water and land resources in the Aral Sea Basin being developed by the EC TACIS WARMAP project. Close cooperation with the Aral Sea Program 2 (Management Information System) is foreseen.

10. A new system of national and interstate rights concerning the use and protection of water is needed for **managing transboundary water resources**. The new system should include transparent procedures for sharing costs, benefits, and risks among the riparian states. An economic mechanism to be used for managing transboundary waters is to be developed and agreed upon by the Basin states. It should not, however, require a rapid modification of the interstate allocation procedures presently in force. Only gradually should economic incentives, in combination with self-monitoring and self-control approaches, gain priority over the procedures inherited from the past. To improve management of transboundary resources, national experts have outlined several priority interstate agreements to be drafted and negotiated on the next stage of work on the regional water management strategy. For

better implementation of interstate water allocations, in the next stage of the project about 10 water flow and water quality automatic monitoring stations will be installed at strategic locations (interstate boundaries) on the Amu Darya and Syr Darya. Close cooperation with the Aral Sea Project 1.2 (Improving Efficiency and Operation of Dams), 1.3 (Stability of Dams and Reservoirs), and Program 7 (Operational Water Resources Management) is foreseen.

11. All Basin states recognize that **conservation and more efficient use of water** are imperative, especially in relation to irrigated farming. It should be recognized, however, that increasing water use efficiency only makes sense if all riparian states participate. Moreover, water conservation on either a national or interstate level has its own financial implications. Who will pay and who will benefit? A gradual transition from a system of "norms and quotas" to "demand management" using economic and financial incentives is unavoidable, especially in view of land tenure changes. It is estimated that about 20% of water currently used for irrigation can be saved for other purposes. The introduction of new institutional arrangements, like Water User Associations, will be important in this respect. The program of water conservation, to be outlined in the next stage of the project, involves structural and non-structural measures. The results of pilot projects program will be of special significance in this respect.

12. More efficient utilization of water in each of its uses is the highest priority requirement to overcome **deterioration of water quality** in the Basin. This is especially true for irrigation farming where highly mineralized drainage water constitutes up to 45% of irrigation water applied. In properly designed and operated systems, the drainage water should be on the order of 15% to 20% of irrigation water applied. In the future, a Basin-wide agreed system of water quality standards will be developed. At the same time, water quality standards should be set up for specific reaches of the major rivers. Introduction of the "polluter pays" principle will also be important, at both national and interstate levels. Close cooperation with the Aral Sea Program 3 (Water Quality Management) is foreseen.

13. **Water and soil salinity** are ever-present and interdependent problems in the arid Aral Sea Basin. Soil salinization is accelerated by mobilization of deep brackish and saline groundwater. A key decision that needs to be taken is where salt is to be stored in the Basin's environment. Once again, more efficient utilization of water in irrigated agriculture is a key requirement for resolving this issue. Redesign and reconstruction of some irrigation and drainage systems will be important in this respect, though the extent of reconstruction activities will have to be decided on the basis of a careful site-specific analysis of economic viability of the reconstruction investments. The standard of drainage service necessary to support irrigated agriculture in the variety of settings that occur in the Basin must be determined. The results of investigations carried out under the Aral Sea Program 3, especially 3.1b (Agricultural Water Quality), will be of special importance in this respect.

14. The Aral Shore Zone (the Disaster Zone) is the area bearing the brunt of **environmental crisis** affecting the Basin.

This zone experiences both the direct impacts of the desiccation of the Aral Sea and the cumulative negative effects of upstream water resource utilization. But there are a great number of environmental problems in other parts of the basin. For example, at the source of the rivers, in the upstream flow-formation zone, environmental problems such as soil erosion, mud-slides and mining waste are particularly acute and difficult to deal with. To improve the situation, adoption of common environmental criteria related to land and water use and better management practices in agriculture will be of key importance. Close collaboration with the Aral Sea Program 4 (Environmental Studies) is foreseen.

15. One of the pervasive major weaknesses of past water resources planning in the Aral Sea Basin has been **ineffective implementation** of schemes and programs. Failures in implementation stemmed from a series of distortions including inadequate funding and lack of incentives for good operation and maintenance, and little or no involvement of affected local people in project planning and implementation. This is why, in formulating a regional water management strategy, particular attention will be given to how the strategy will be implemented. To this effect, a number of measures will be taken including the adoption of legal and other normative acts, a clear identification of national and interstate institutions responsible for implementation of the strategy, and work plans that emphasize "stakeholder" participation and regional representation. Several organizational improvements at both interstate and national levels are to be developed further in the next stage of project implementation.

Next Steps

16. The next stage of investigations for the development of the regional water management strategy in the Aral Sea Basin is a continuation of efforts initiated in the preparatory phase of Project 1.1. The report identifies in modular form investigations to be conducted at the regional level and work to be done by each of the Basin countries; finalizing terms of reference for each activity will be done in the beginning of the next stage of the project. Interaction between regional and national investigation is imperative, recognizing that the Basin states are sovereign and at the same time joined in one water system comprising the basins of the Amu Darya, Syr Darya, and Aral Sea.

17. At the regional level, the first need is to finalize terms of reference of all regional and national activities, including organizational preparations and communication arrangements. Next, it is necessary to develop and agree on **common methodologies**, approaches, criteria, and procedures to ensure compatible results from regional and national investigations. The second and third groups of regional investigations compose **regional assessments**, ranging from socio-economic development projections to the evaluation of a possible impact of global climatic change, and **special studies** such as the identification of water demands of the Aral Sea. Finally, the fourth category of work to be done at the regional level is development of short, medium, and long-term **action programs**.

18. In parallel with regional assessments and investigations, each Basin country will undertake a series of **national investigations**.

The fifteen items proposed in the work plan range from analysis of national socio-economic issues to an assessment of national programs for water conservation. Development of good channels of communication between the national teams, as well as close cooperative links between national teams and units responsible for regional investigations (including synthesis of study results), is imperative.

19. Implementation of the next stage of the project is scheduled for a period of approximately two years. Several **inputs** are expected from other projects of the Aral Sea Basin Program, although the time of their availability is not yet fully ascertained. The analytical tools, techniques and mathematical models developed under Project 1.1 for integrated analysis of factors affecting water management decisions in the Basin will need reliable inputs; the regional information system (water, land, environment) and the pilot projects program are of particular importance in this respect.

20. It is envisaged that the following **outputs** will result from Project 1.1 activities: (i) a set of agreed short, medium and long-term action programs supporting sustainable development and management of water and related land resources over next 20-25 years; (ii) identification of diverse water resources in the Basin available for use; (iii) water consumption "norms" (standards) mutually agreed upon by the riparian states; (iv) a Basin-wide water conservation program, including a common system of regulations and economic incentives; (v) a set of mathematical models for planning and operational management of Basin's water and related land resources; (vi) a set of legal documents, agreements, normatives and regulations (interstate and national), proposed as mechanisms for strategy implementation; (vii) a system of pilot projects (which later will be used for promoting extension services); (viii) recommendations and pre-feasibility studies for engineering projects (water management infrastructure); and (ix) recommendations for institutional improvements at national and interstate levels.

21. The estimated **total cost** of stage 2 of Project 1.1 is $6,945,000, including $3,685,000 for regional work and $3,260,000 for national investigations. This budget includes a substantial portion for local specialists, a modest amount for office equipment (computing facilities) and about 10 water flow and water quality monitoring stations to be installed on the state borders. A complete budget is presented in Section 8 of the report.

22. The success of the next stage of work on the regional water management strategy will to a large extent depend on the proper **organization** of this large, multinational effort. The complexities involved must be fully recognized. It is expected that the Executive Committee of ICAS will continue to be responsible for the overall coordination of work. Responsibilities for regional investigations will be assigned by ICAS, based on competitive bidding. As for national investigations, lead institutions responsible for within country organization of each nation's work should be agreed by the respective governments.

23. The assistance of international consultants must be organized in a way that is compatible with the local organization, at both

regional and national levels. Beside short-term consultants, the report proposes establishment of a **core team** of local and foreign experts (according to the actual needs) working together for the entire duration of the Project. The core team would be responsible for coordination and integration of the results of national and regional investigations. This type of arrangement is needed to ensure that the strategy documents are prepared in a timely and consistent manner.

TABLE OF CONTENTS

1

Aral Sea Program Project 1.1

1. Water is a strategic resource playing a vital role in the economic and social life of arid Central Asia. Over the last 35 years, intensive cotton farming has diverted so much water from the two rivers which feed the Aral Sea that its shore line has retreated by more than 120 km in some places. Abandoned and derelict fishing boats in a landscape of salt and crusted sand first drew the world's attention to the human and ecological crisis facing the Aral Sea and its shore region. But degradation due to the nonsustainable use of water and related land resources - nonsustainable agriculture - extends far beyond the Sea and its shores. Over the last few decades, the upper Basin (flow formation zone) has lost about 50% of its forest cover. Soil erosion has intensified, not only reducing agricultural productivity but also silting storage reservoirs. The massive discharges of drainage water from irrigated land into rivers have resulted in a drastic increase of water salinity. Soil salinization and waterlogging is a serious problem throughout the Basin. These effects are directly linked to a decline in human health and agricultural productivity in the Basin.

2. This report is a summary of preparatory work to develop a common strategy for rational allocation, sustainable use and protection of water resources in five states of the Aral Sea Basin. The work has been part of Project 1.1 of the Aral Sea Program, and has been financed by a grant from the Global Environment Facility (GEF) administered by the Executive Committee of the Interstate Council for the Aral Sea (ICAS). It has been undertaken in close cooperation with the European Union (through its TACIS WARMAP project), the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP).

3. The work so far has concentrated on establishing a common factual base and conceptual framework for development of a regional water management strategy. This initial stage, which has lasted about ten months, has produced reports on water-related issues in each of the five Aral Sea Basin states as well as five thematic reports and a summary regional report. The five national reports have been prepared in recognition that each state is sovereign and will evaluate regional

water strategy in the light of its own interests and priorities. These reports identify key national concerns for water management and summarize national positions concerning regional strategy. The summary regional report, "Basic Provisions for Development of a Regional Water Management Strategy in the Aral Sea Basin", reviews each country's perspective on the national and regional issues, identifies differences and similarities, discusses the possible ways of addressing the major issues, elaborates some of the common methodological approaches, and presents a program for the next stage of work. The process of bringing national and regional goals closer together has been initiated by region-wide circulation and review of the reports. All reports have been prepared in Russian and submitted to ICAS for approval (the English translation of national reports and summary regional report is underway). They present a great deal of data and offer a good picture of water sector developments in the period 1990-94. This is important because the present situation in the Basin is in many respects different from what it was in 1990 at the breakup of the former USSR.

4. A major accomplishment of Project 1.1 thus far has been the intensification of inter-state contacts and consensus-building on regional issues. Representatives of the Aral Sea Basin countries, with cooperation and support from outside sources, have taken these steps, which constitute an important development in building and enhancing region-wide capacity for water resources management. In the preparatory stage of the project, several inconsistencies have been identified in the ways individual Basin states approach the same issues. For example, each Basin state uses different "norms" for assessing water requirements; some technical issues are approached in a different ways; legal requirements are sometimes interpreted in different ways. Unification of methods and approaches across the Basin will be one of the prime tasks of the next stage of work on the regional strategy. The results of joint strategy development in any situation may not always be "optimal" but in the Aral Sea Basin the project will seek to expand the "win-win" space in the riparian states and in the region as a whole. The commitment of the Aral Sea Basin heads of state and the supporting national and regional institutions has begun a process that will contribute to the long-run economic well-being of each country by yielding agreements on steps to better use and conserve scarce water resources.

5 The next stage of work will be formulating a regional water management strategy. This will include finalizing terms of reference for strategy formulation, agreeing on common methodologies, improving national and regional water and land assessments (in cooperation with the WARMAP project and other donor initiatives), formulating and evaluating options for water management, and recommending courses of action that can be implemented given all the constraints. It is estimated that this stage of work will require approximately $ 6.945 million dollars over 24 months to develop a regional water strategy that will be supported by all the states of the Aral Sea Basin. The proposed work program is presented in the final section of this report.

6. The grave environmental problems of the Basin prompted the government of the former USSR to take some steps to assist in water management already in 1986. These measures were only begin and did not succeed easing the difficulties faced by the region, however. In 1991, five of the Basin states became independent. The governments of these states recognized immediately the need to establish water allocation principles for the new situation, and in 1992 they signed a water treaty establishing the Interstate Commission for Water Coordination (ICWC). The treaty decided to

continue allocation patterns and procedures developed in the 1980s for the Amu Darya and Syr Darya basins within the framework of the respective water master plans (the so called "schemes). In addition, in 1994 the presidents of Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan founded the ICAS, a body of 25 high-level representatives from the five states. ICAS meets twice a year to review policy issues. The ICAS Executive Committee (EC), together with the ICWC and the ICAS Commission for Sustainable Development, are responsible for implementing policies and programs. In addition, the heads of state founded the International Fund for the Aral Sea (IFAS) to coordinate and administer financing for the Aral Sea Program from the five states and from donors.

7. In January 1994, the presidents of the five ICAS countries met in Nukus, Uzbekistan, where they agreed on an Aral Sea Program comprising seven specific programs (plus a supplementary program for capacity building) with several projects under each program (a total of 20 projects). The action plan that was signed by the heads of state commissioned Program 1

> to develop a common strategy of water distribution, rational water use and protection of water resources in the Aral Sea Basin, and to prepare interstate legislative documents regulating issues of common water use and water protection against pollution, with due regard for the region's socio-economic development.

8. The principal objective of the regional water management strategy in the Aral Sea Basin is to identify the means and mechanisms of combining development goals and interests of each Basin state with the long-term water resources and environmental management objectives. Water must be developed, preserved, and maintained for present and future generations. The strategy follows the provisions of the International Water Law on equitable, reasonable, and mutually advantageous use of water resources. It is also based on the principles of cooperation in the international river basins, as proclaimed by the Helsinki and Dublin declarations, which provide for:

- The right of each Basin state to an equitable and reasonable share in mutually advantageous water utilization;
- The sovereignty of each state over its national resources and its share in transboundary water resources;
- The principle of "no significant harm", which prevents any activity that may result in the deterioration of shared resources.

9. The regional water management strategy will:

- Move toward comprehensive management of water and related land resources, highlighting environmental protection and control at both national and interstate levels;

- Establish a mechanism for coordinated water resources management by the Basin states;
- Move toward integrated, intersectoral water resources management;
- Identify potential conflicts between interstate, intersectoral and local interests and the possible ways to manage and resolve them;
- Focus on the stewardship of natural resources, orienting all actions towards sustainable economic development;
- Establish an information management system to be used in the decision-making processes at all relevant scales and levels.

Constraining the strategy are the special conditions of the arid zone characteristic of most of the Basin's area, as well as the general scarcity of water resources.

10. The regional water management strategy shall define and initiate implementation of a set of short-term (year 2000), medium-term (year 2010) and long-term (about 25-30 years) action programs, establishing potential for better management of water resources in the Basin through:

- Capacity building, including human development;
- Improving organizational structures;
- Providing a legislative and regulatory framework;
- Developing analytical tools and techniques for planning and operational decision-making;
- Introducing economic mechanisms and incentives;
- Technological improvements;
- Maintaining and developing the engineering infrastructure of water management, including irrigation and drainage facilities;
- Securing adequate financial arrangements and support for implementation of the strategy and the action plans.

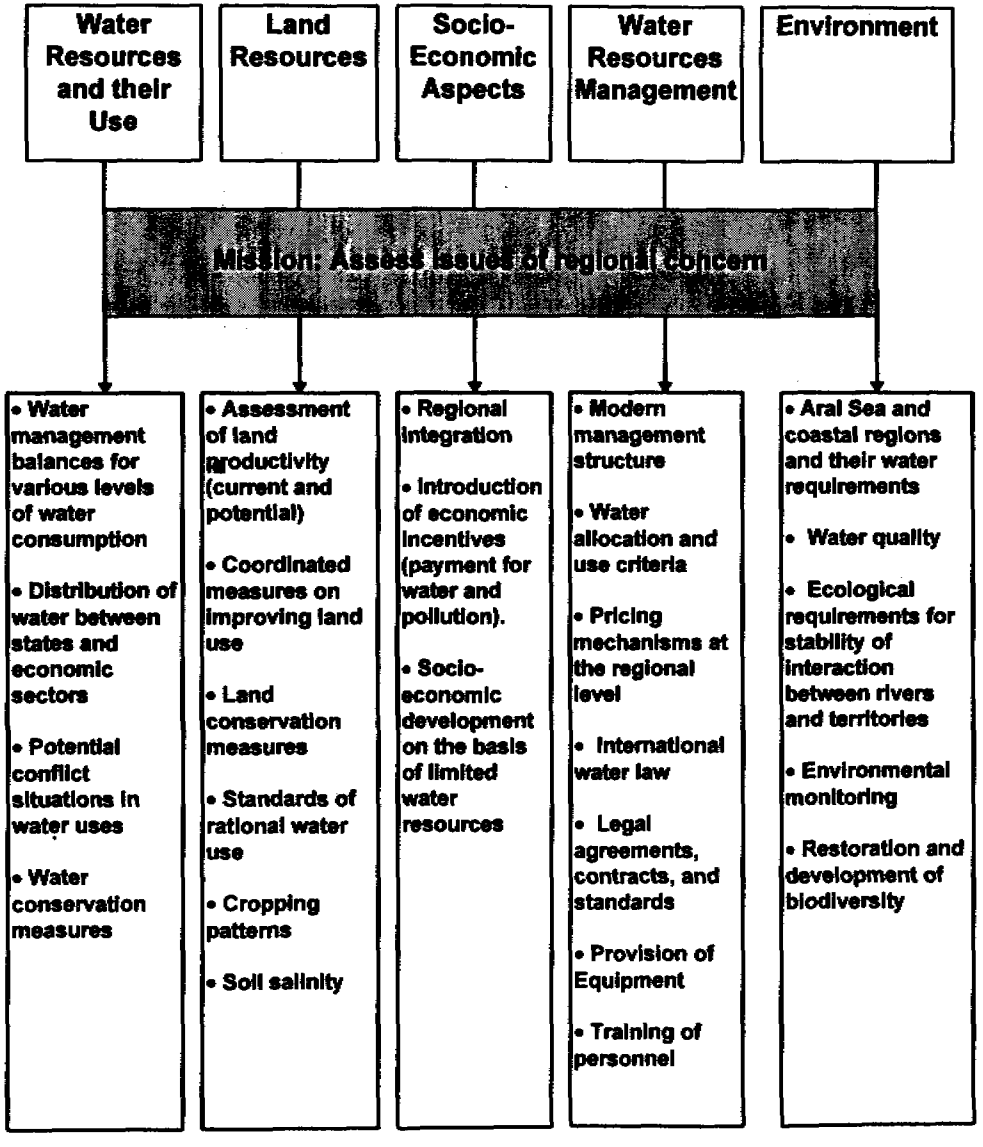
12. A hallmark in the preparatory stage was the establishment of Program Group 1 (PG1) and the 10 working groups that produced the national and regional reports. This arrangement was meant to include many of the key "stakeholders" from the very beginning of strategy formulation in order to gather information, to clarify the goals of national policies, and to create the sense of commitment

and "ownership" that is of basic importance for implementation of the strategy. Although this process is not always easy, especially in international basins, experience has shown that it is the only way to avoid the risk of a large gulf between the design and the implementation of the strategy. Summaries of responsibilities of the working groups and the activities and accomplishments under Project 1.1 follow on the next two pages. A list of the members of PG1 is presented in the appendix.

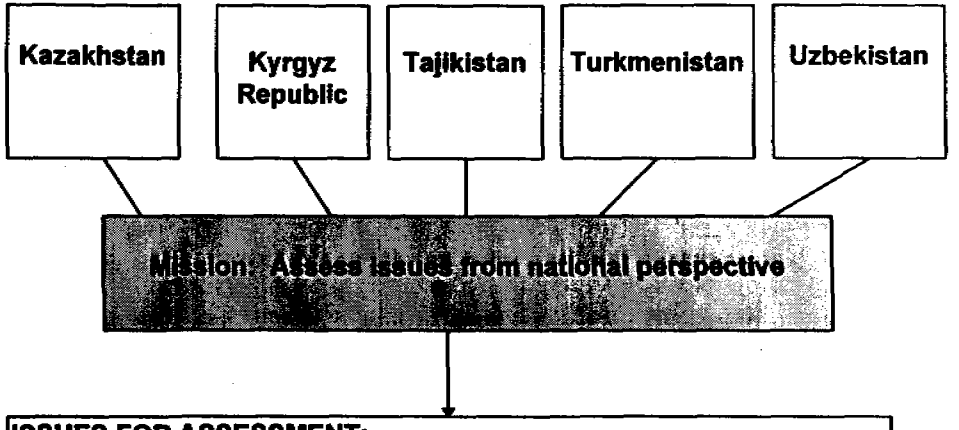
13. This document summarizes the major findings of the preparatory stage, with particular attention to the national priorities and concerns and also to the proposed work plan for formulating a regional water management strategy. Its draft was translated into Russian and reviewed by the members of the Program Group (PG1). Beside the national and regional reports, this summary also uses other sources of information relevant to the problems at hand. The report is intended for a wide audience, including the donor community. Section II briefly covers the economic and social setting in the Aral Sea Basin, focusing especially on agriculture (the largest water consumer) in the context of economy of each Basin state. Section III presents a basic picture of water and land use in the basin, while Section IV reviews major environmental problems. Section V discusses institutional arrangements. Section VI summarizes the main issues from both national and regional perspectives. Based on the investigations already carried out for the regional water strategy and for other projects of the Aral Sea Program, Section VII identifies some of the ways in which the main national and regional issues could be addressed. Finally, Section VIII presents the proposed work plan for the next stage of developing a water management strategy for the Aral Sea Basin.

MAIN TASKS OF PROJECT 1.1 WORKING GROUPS

REGIONAL GROUPS



NATIONAL GROUPS



ISSUES FOR ASSESSMENT:

- **Available national water resources**
- **Alternatives for socio-economic development and water demand by various economic sectors**
- **Potential for limiting water use and water conservation**
- **Potential productivity of irrigated land**
- **Economic mechanisms for water management at a national level**
- **National legislation on water, land resources and environment.**

Major Events And Accomplishments Under Aral Sea Program 1.1
Preparations for Developing a Regional Water Management Strategy

Date and Location	*Event and Accomplishments*
1994	
November	Establishment of Program Group 1 (PG1) and approval of its members by the Interstate Council for the Aral Sea (ICAS).
1995	
February 7-10 Tashkent, Uzbekistan	*First PG1 Workshop, Launch of Project 1.1* • Agreement on the objectives and general directives for PG1 work • Election of regional coordinator • Establishment of 10 working groups (5 national, 5 regional/thematic) • Commencement of process of integrating and coordinating sources of assistance
March 28-30 Tshimkent, Kazakhstan	*Second PG1 Workshop* • Approval of terms of reference for 10 working groups • Agreement on division of Basin water resources into local and transboundary water
June	General directives of work presented to ICWC • Comments and suggestions on work received • ICWC endorsement of draft methodological assumptions
July 12-13 Saryagach, Kazakhstan	*Third PG1 Workshop* • Progress evaluation and adjustment of schedules • Agreement on outline of regional report
July 17-10 Tashkent, Uzbekistan	*Seminar* "Application of Mathematical Modeling Techniques for Development of Water Resources Management Strategy" • Discussion of a strategic planning model and other computerized approaches to assist developing a regional water management strategy.
September Tashkent, Uzbekistan	*PG1 Meeting* • Progress evaluation and adjustment of schedules
October 25 Tashkent, Uzbekistan Provisions for	*PG1 Working Group Leaders Meeting* • Submission of national reports to Executive Committee of ICAS • Nomination of editorial committee to prepare summary regional report "Basic Development of a Regional Water Management Strategy in the Aral Sea Basin.
November	• National reports circulated among all working groups for comments and suggestions
December	• Completion of summary regional report • Commencement of translation of summary report and national reports into English
1996	
January	• Final version (in Russian) of summary report submitted to Executive Committee of ICAS
February	• Beginning of preparation of concise English-language summary report (this document)

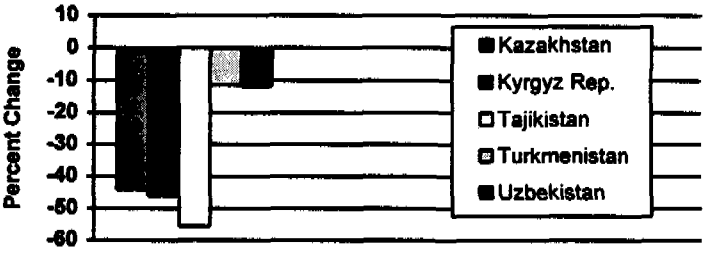
2

Economic and Social Setting

14. This section briefly presents the economic and social situation in Central Asia, first from an overall perspective and then for each state. It focuses especially on the agricultural sector, which uses 92% of the water in the Aral Sea Basin (Section III indicates specific land-use patterns and their relation to water use). Finally, the section discusses the implications of some macro-economic and social developments for management of water and land in the Basin.

15. The complicated social and economic situation in the Aral Sea Basin is dominated by three factors: the legacy of the past, the new political independence of each state, and the varying degrees of movement toward market-oriented economies. The past was marked by economic inefficiencies, legislation without adequate enforcement, and a number of ineffective institutional arrangements. Independence has brought the prospect of greater national self-sufficiency and governance, while at the same time contributing to a decline in economic integration among the former republics of the USSR. Numerous customs barriers, obstacles to funds transfer, rupture of procurement and supply contracts, and a sharp rise in transportation tariffs have all been features of the region in the last few years. Since these states became independent, their economies have been marked by high rates of inflation, credit shortages, and declines in GDP (Figure 1) and in living

Figure 1. Change in GDP for Five Central Asian States, 1994 vs 1990

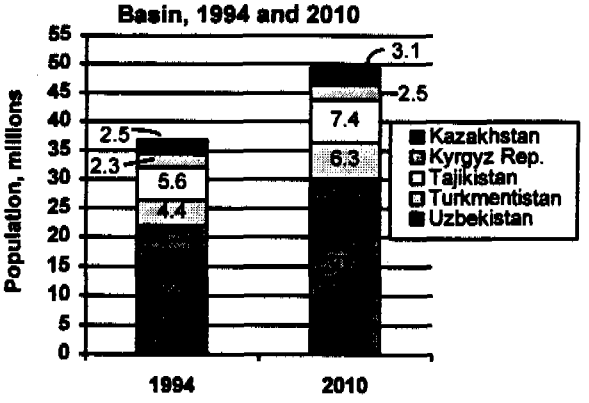


standards. Although the economic situation has been worsening, the region on the whole has reportedly high levels of literacy, education, and technical expertise.

16. Agriculture, including forestry and livestock , is the largest sector in the Basin, providing a substantial part of the region's export earnings; its percentage of GDP varies among the states, contributing between 23% and 34% in each state (World Bank 1994, 1995).[1] It is also a major employer, ranging from 24% of the 1993 labor force in Uzbekistan to 45% in Tajikistan. About 60% of the population in the Central Asian states is rural. It is primarily the expansion of irrigated area during the last 35 years that has led to the massive withdrawals of river water and the resulting dessication of the Aral Sea.

17. Population growth is a major issue in the social and economic structure of each state. In the 1960s and 1970s, the average annual population growth rate in all of these countries was above 2.7% (with a high of close to 3.4% in Turkmenistan). Between 1990 and 1994, however, the average annual population growth rates dropped to 0.4% in Kazakhstan, 0.9% in the Kyrgyz Republic, 1.9% in Tajikistan, 1.6% in Turkmenistan, and 2.2% in Uzbekistan. A major element in the decline of the population growth rates has been out-migration, coupled with a simultaneous drop in the birth rate because of the deteriorating socio-economic situation. National projections of population growth for the Aral Sea Basin assume annual growth rates of between 1.3% and 3.9%. By 2010, the population of the Basin is expected to be close to 50 million, compared with about 37 million in 1994. Population growth is a major consideration in national agricultural plans, several of which call for expansion of irrigated land to provide adequate food.

Figure 2. Estimated Population of the Aral Sea Basin, 1994 and 2010



[1] While GDP figures for Tajikistan are not indicated in either source, statistics in World Bank 1994 (p. 547) indicate that agriculture accounted for some 43% of net material product in 1991, although this is reported to have fallen to about 5% by 1993.

National Profiles

18. Kazakhstan. With a land area of 2,717,300 km^2, Kazakhstan is the second largest of the former Soviet Republics. About 2.6 million of Kazakhstan's roughly 17 million inhabitants live in the Aral Sea Basin. Like all of the Central Asian countries, Kazakhstan has suffered a contraction of its economy since the breakup of the former USSR. By several measures national output or GDP has fallen over 40% from 1990. By 1994, the volume of capital investment was approximately one-third of what it was in 1990, just before the breakup of the Soviet Union. While agriculture is probably the largest current contributor to output (and certainly the largest employer), Kazakhstan is richly endowed with oil, gas, and minerals, particularly iron ore. In 1990 the main components of GDP were agriculture and forestry (30.4 %), industry (including mining) (32.3%), and services (35.4%) (World Bank 1995). In 1993, some 44% of those employed were in the agricultural sector, while 21% were in industry, and 36% were in services. The major agricultural products are wheat, maize, livestock, cotton, and wool. For the future, Kazakhstan places emphasis on development of its mineral wealth and processing capabilities (including the chemical industry), and on improving transportation, particularly railways and shipping. Agricultural production will focus on grain, meat, and cotton production and export.

19. Kyrgyz Republic. The Kyrgyz Republic is a mountainous, landlocked state of 198,500 km^2. About 7 % of its land is arable, and about 40% of mountainous terrain is used as pasture (World Bank 1995, p. 49). About half of the population of 4.6 million lives in the Aral Sea Basin. The Kyrgyz Republic also has had a severe contraction of its economy ; GDP has fallen by some 46% since 1990, accompanied by a halving of capital investment. Approximately 35% of the Kyrgyz Republic's GDP in 1994 was from agriculture, 28% from industry and 37% from services (World Bank 1995). The employment structure is roughly similar, with Kyrgyz statistics for 1993 assigning about 38% of total employment to agriculture, 23% to industry, and 39% to services. Sheep and cattle ranches and agroprocessing are the dominant activities in the agricultural sector. With limited natural resources--mostly coal, quicksilver, and non-ferrous metals, the Kyrgyz Republic is taking measures to strengthen its machine-building, power and food industries.

20. Tajikistan. All of Tajikistan's 5.6 million people live within the Aral Sea Basin in a territory of 143,100 km^2. Tajikistan has also suffered declines in GDP each year since independence, with a cumulative 50% decline in GDP since 1990. Political instability has played a large role in this decline. A new currency and the launch of a five-year economic plan that includes reform measures was a major feature of 1995. Tajik statistics indicate that agriculture employed about 45% of the labor force in 1993, although outside estimates of agriculture and forestry's contribution to net material product in that year indicate that only about 5% of net material product came from agriculture and forestry (World Bank 1994). The economic emphasis in Tajikistan is being placed on hydro-power development, on the aluminum-smelting industries, and on the production of cotton and fruit.

21. Turkmenistan. Turkmenistan has a population of about 4.5 million, all of whom live in the Aral Sea Basin. It has an area of 488,100 km^2, of which 90% is in the Kara Kum desert. With substantial developed energy resources and exports, primarily of natural gas and oil,

Turkmenistan's economy has suffered relatively less than those of the other Central Asian states, with an estimated GDP decline since 1980 of about 12% (a high population growth rate has meant that GDP per capita, has fallen some 17% since 1990). Despite the energy reserves, the economy is still predominantly agricultural. This sector accounted for an estimated average 46% of net material product over the last three years (World Bank 1995) and for about 44% of employment. Cotton, grains, fruits and vegetables are the major crops. For the future, Turkmenistan looks forward to exporting its natural resources. The nation also wishes to concentrate on cotton and livestock for export.

22. Uzbekistan. Uzbekistan, with an area of 448,840 km2 and a population of about 22 million is located entirely within the Aral Sea Basin. Exports of agricultural goods, energy, and minerals have helped to hold the decline of GDP in Uzbekistan to approximately 11% since 1990. Uzbekistan has natural gas resources to export; gas condensate and oil reserves are large enough for the country to be self-sufficient. Gold, tungsten, and manganese are abundant. About 36% of 1993 GDP was generated by agriculture, however, 33% by industry, and about 31% by mining, construction, and services. This last sector employed about 45% of the work force in 1993, with about 30 % devoted to industry and 24% to agriculture. Uzbekistan is the region's leading producer and exporter of cotton, which accounts for some 40% of the gross value of agricultural production. Uzbekistan also produces the region's largest share of fruits and vegetables. Uzbekistan has emphasized providing for its food needs in recent national planning, and has emphasized self-sufficiency in wheat and certain other foodstuffs in its agriculture.

Regional Economic and Social Factors

23. Despite the attempts of all countries to regulate the process of gradual reform, transition to market-oriented economies has contributed to a general production decline and to a decline in capital investment. Inflation has severely eroded local incomes. Farms and farmers have particularly suffered from increase in input prices that have yet to be matched by corresponding increases in output prices. A major problem with the macroeconomic situation is the shortage of financing, which especially affects needs that require long-term investment such as water management, land reclamation, and reconstruction of irrigated land. The solution of many social, economic, and ecological problems in the Aral Sea Basin is closely connected to changes in the economic structure and policies of Central Asian states.

24. Economic integration and intensification of reciprocal contacts and cooperation among the Central Asian states are important issues. In 1994, the presidents of Kazakhstan, the Kyrgyz Republic and Uzbekistan signed an Agreement on the Establishment of a Single Economic Area, and there have been a few other similar initiatives in the region. In April 1995, the heads of the three states signed a program of economic integration which among other things emphasizes measures to eliminate customs duties on interstate trade and to establish single freight rates; it also envisions freedom of transport. All initiatives toward economic integration and close cooperation of the Basin states are of great significance for the development and implementation of the regional water management strategy.

25. In every state of Central Asia, overall agricultural productivity has declined substantially since 1990. For example, compared with 1990, the volume of output per hectare of irrigated land (in comparable prices) has fallen some 41% in Kazakhstan's part of the Aral Sea basin, by 34% in the Kyrgyz Republic, by 35% in Tajikistan (cotton output has fallen two times), and by 10% in Uzbekistan, the region's largest producer of agricultural goods. In Uzbekistan, however, the value of agricultural production in 1991-1995 was roughly the same as in 1985-1990 (in constant prices). Furthermore, in 1995, the gross agricultural output of Uzbekistan increased by 2.3 percent at constant prices, for the first time since 1990. Among crops, the largest increase was recorded in wheat production, which amounted to 2.3 million tons and had expanded by 69 percent as compared with 1994. Nevertheless, Uzbekistan did not achieve self-sufficiency in production of grains in 1995 (as the government expected) because the actual level of grain production was about 22% lower than projected. For Turkmenistan there is no comparable data, although it is known that crop yields have dropped by between 12% and 50%.

26. Contributing to declining production and productivity have been reduction of state support for agriculture; credit and fund shortages; a reduction of the amount of agricultural inputs such as chemical fertilizers, pesticides, machines, inefficient use of inputs; and the weakness of the emerging private sector. Privatization has different features and different rates of progress in the various countries, but the constitutions of each country specify that land belongs to the state. Measures for land tenure, including assignable and hereditary leases, are being considered or implemented in all of the countries. As a result of tightening of macroeconomic policies, remaining state orders on grains, cotton and some industrial products, indirect control over a wide range of prices, and state interference in the activities of individual production enterprises, the financial position of most collective farms deteriorated substantially in the years 1991-94. This process is still continuing.

27. In the national reports prepared under Project 1.1., each of the Basin states has stated an objective of producing enough food for its own growing populations. Considering the need for water in all sectors of the economy, however, as well as ecological requirements for water, it is clear that further economic and social development should proceed by decreasing water consumed by irrigated farming. This might be accomplished either by investments to increase irrigation efficiency or by revision of goals for food production and expansion of irrigated agriculture. The goal of feeding the growing population in the Basin could perhaps be better met by strengthening regional cooperation in food production rather than by stressing national food self-sufficiency.

28. Also in the realm of overall policy, the national reports underline that substantial state support will be required for water resources. An analysis of 34 countries around the world carried out by experts from the region has shown that typically, state budgets finance all water resource development works, rehabilitation, reconstruction of drainage, and more than 50% of operational costs. In Italy, Germany, France, and Japan, only 5%-20% of water management costs are covered directly by water users. It is not sufficiently recognized, however, that these are some of the economically most developed countries. They are characterized by a number of economic distortions that, simply, they can afford to tolerate. The relevance of these examples to the Aral Sea Basin situation is debatable. Still, although the states of the Basin presently face serious budget difficulties, it is hard to see how the agricultural sector, or the economy as a whole, can develop and

progress without a substantial state commitment to invest in water resources management and to subsidize, at least to some extent, operational expenses. Moreover, the social and economic costs of *not* investing in water management may be very high in the long run.

Major Issues

29. In the practice of the former USSR, capital and most of the operational expenses of the water sector were covered by central budgets, either federal or republican (although financing was not always adequate). All the related institutional and financing arrangements were designed accordingly. Although the situation is changing gradually, new sources and methods of financing have not yet been developed. Now, when central budgets are limited due to the economic difficulties of the Basin states, the water sector does not receive automatic support from the state budgets. This reduces the potential of the sector substantially, both in material and human resources terms. Only because the system had substantial built-in reserves is the situation not as bad as it could be. If financing shortfalls continue, however, all reserves will finally be exhausted and sector degradation may reach irreversible dimensions.

30. It is understood that water management concerns must compete with other priority areas for human and financial resources; some important water investments may need to be deferred in order to allow the economic situation to stabilize. However, timely action on some water issues may ultimately assist the stabilization process and benefit the Basin as a whole. It is therefore vital that water decisions be made on the basis of rational priorities rather than in an ad-hoc manner. This is especially important given institutional, human resources, and financial constraints, which will continue to be severe in the next five to ten years, while the Basin economies recover to their 1990 levels.

31. The high degree of economic and political uncertainty in the region compounds the already difficult task of developing common water resources management policies and strategies. National agricultural and other policies that are fundamentally important to water resources management are still under preparation. Regional institutions - such as the Sustainable Development Commission of ICAS - which could substantially contribute to the development of the socio-economic plans underpinning water strategy, are not yet fully effective. The continuing political commitment of the heads of state of the Basin countries as well as the assistance and cooperation of international and local organizations are essential to formulation and implementation of national and regional water strategies.

3

Water and Land Resources

32. This section focuses primarily on the availability and use of water in the Aral Sea Basin. Most of the available water is the surface flow of the Amu Darya and the Syr Darya systems. Because about 92% of the available water in the Basin is used for irrigated agriculture, land use and related problems are also discussed. Any future water and land use strategy in the Basin should aim to protect these resources for sustainable socio-economic development with the important principle of treating the Aral Sea and its coastal regions as specific water users.

33. The available water resources of the Aral Sea Basin are listed briefly below, both naturally occurring resources (surface flow and groundwater) and manmade resources (flow regulation from reservoirs and water re-use). For the purpose of defining regional water management strategy, most important is the classification of available water into local national and transboundary resources. Only the transboundary resources will be subject to interstate agreements. In accordance with the 1992 Helsinki Convention, it has been recommended under Project 1.1 that the states of the region accept the following definitions of local national and transboundary waters.

Local national waters include:

- The flow of rivers which are contained entirely within the boundaries of a single state and which are not connected to transboundary waters,
- Groundwater located on the territory of one state and not connected to transboundary surface waters or groundwater,
- Return water (primarily collector-drainage water) discharged within the boundary of a single state which does not flow into or otherwise affect transboundary waters.

Transboundary waters include:

- Rivers or their tributaries formed on the territories of two or more states, or crossing boundaries between two or more states, or flowing through two or more states; also related lakes or manmade reservoirs built to manage the transboundary waters.
- Groundwater aquifers situated on the territory of two or more states, or connected with the transboundary surface waters.
- Return water (primarily collector-drainage water) or water resources that have formed on the territory of two or more states, which flow into or otherwise affect quality or quantity of transboundary water.

Reports of the national working groups under Project 1.1 indicate that the division of the Basin's water into local and transboundary resources needs further investigation; clear-cut division criteria are needed. This clarification is especially important for surface water. The present imperfections of the division into local and transboundary waters can be illustrated by the fact that the sum of national estimates of the volume of water available in the two major river basins considerably exceeds regional estimates based on the same hydrological data. About 30% of the groundwater in the Basin is considered to be transnational. Better assessment of the volume, quality, and variability of transnational waters is of fundamental importance for all future interstate negotiations concerning water sharing and use.

34. The availability and reconciliation of data are important to any basic assessment of water resources in the Aral Sea Basin. Although the hydrometeorological services of each country in the region have a tradition of cooperation, the frequency of measurement and the number of working observation stations have lately been reduced to such an extent that the amount of data and the quality of any resultant resources assessment is falling. The number of hydrometeorological stations in the flow formation zone (upstream part of the Basin) has fallen by 16% between 1988 and 1995 for the Amu Darya, and by 28% for the Syr Darya (Figure 3). Tajikistan reports that no more than 15% of its hydro-meteorological stations are still operational. The network of observation stations is insufficient in other respects as well. For example, the causes of significant water losses from the river channels in their transit reaches are unknown, although the losses approximate 10 km^3 annually. And there is no observation network at all for drainage collectors. This lack of reliable data underlines the importance of Aral Sea Program 2 on information improvements. This report has relied on historical data, on estimates prepared by regional and national working groups of Project 1.1, and on data provided by the WARMAP project.

Figure 3. Hydrometeorological Stations in the Aral Sea Basin, 1988 vs. 1994

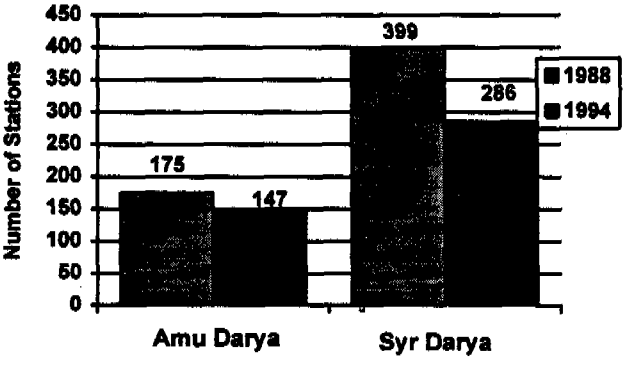


Table 1. Water Balance in the Aral Sea Basin, km3

	1990 Actual	1994 Actual			1994 Calculated	2010 Calculated
	Total Aral Sea Basin	Amudarya River Basin	Syrdarya River Basin	Total Aral Sea Basin	Total Aral Sea Basin	Total Aral Sea Basin
RESOURCES						
Surface water resources	112.7	80.3	41.2	121.5	121.5	115.6
Groundwater recharge	11.6	6.2	7.8	14.0	14.0	18.0
Return water	41.2	31.3	14.6	45.9	45.9	31.4
Inter-basin transfer	1.0	-	1.0	1.0	1.0	1.0
Total Resources	**166.5**	**117.8**	**64.6**	**182.4**	**182.4**	**166.0**
USES						
Unaccounted losses from river channels	9.8	7.0	3.2	10.2	10.2	10.0
Surface flow losses due to groundwater withdrawal	7.0	4.2	3.3	7.5	7.5	10.6
Unused discharge of vertical drainage water	2.2	1.6	1.0	2.6	2.6	4.0
Transfer to other basins	1.0	1.0	-	1.0	1.0	1.0
Summary withdrawal by all economic sectors	117.5	66.0	45.7	111.7	151.8	125.2
Diversion of return waters to Aral Sea and natural depressions	14.5	13.6	2.8	16.4	16.4	9.5
Water withdrawal by Afganistan	2.0	2.0	-	2.0	2.0	5.0
Discharge into Aral Sea by main streams	12.3	19.0	7.8	26.8	26.8	19.0
Total uses	**166.3**	**114.4**	**63.8**	**178.2**	**218.5**	**184.3**
BALANCE	**+0.2**	**+3.4**	**+0.8**	**+4.2**	**-36.1**	**-18.3**

35. In spite of the difficulty of collecting and standardizing data, the preparatory phase of Project 1.1 has produced several water balances for the Aral Sea Basin, including the **actual** balances for 1990 (a dry year) and 1994 (a wet year), and some **calculated** balances for the years 1994 and 2010 (see Table 1). To present the overall water situation in the Basin, the balance for 1994, based on actual data, is discussed below.

Water Availability

36. Although the **surface water resources** in 1994 were some 121.5 km^3 in the Basin (see Table 1), the mean annual surface water flows in the Amu Darya and Syr Darya Basins together is 115.6 km^3, comprising 78.5 km^3 from the Amu Darya and 37.1 km^3 from the Syr Darya. The range of year-to-year variability of river flows is significant, as shown for various probabilities in figures 4 and 5. Tajikistan and the Kyrgyz Republic together are the source of about 75% of the total surface resources in the Basin, while together they use only about 10% of these resources (figure 6). Afghan tributaries contribute about 8% of the flow in the Amu Darya, or about 5% of the Basin total. Political instability in that country has so far discouraged an invitation to join the Aral Sea Program.

Figure 4. Annual Surface Flow of the Amu Darya at Various Probabilites

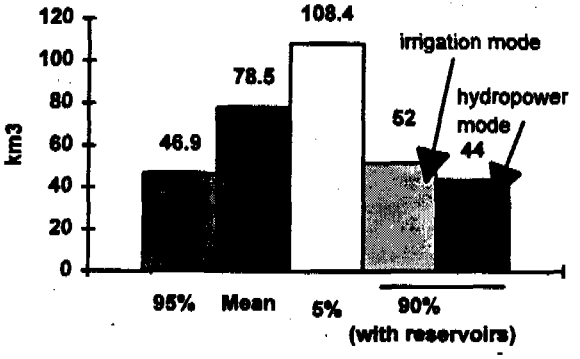


Figure 5. Annual Surface Flow of the Syr Darya at Various Probabilities

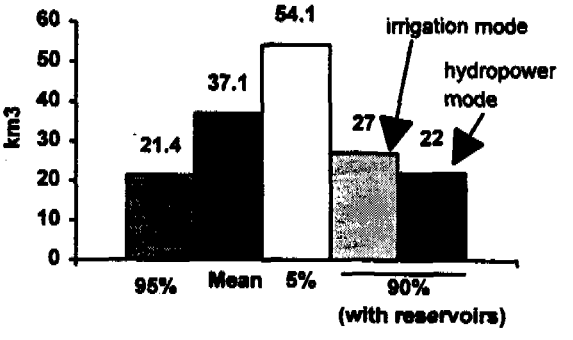
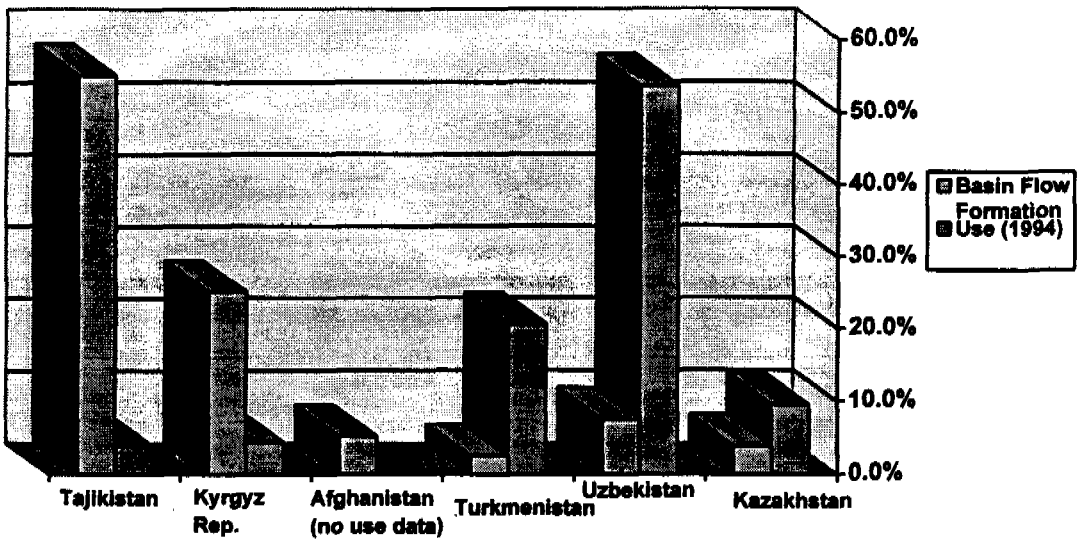


Figure 6. Percent of Flow Formation and 1994 Use for Six Aral Sea Basin States



37. The Aral Sea Basin has more than 80 **storage reservoirs** with a capacity of over 10 million m^3 each. The aggregate capacity of these reservoirs exceeds 60 km^3, of which about 44 km^3 is usable (about 17 km^3 in the Amu Darya Basin and 27 km^3 in the Syr Darya Basin). The total capacity of the Syr Darya reservoirs is about 0.73 of the mean annual flow, while the Amu Darya capacity is 0.21. Thus, several of the Syr Darya reservoirs are large enough to provide year-to-year stabilization of river flows, while the Amu Darya reservoirs provide control to a much lesser extent.

38. Although all large storage reservoirs were originally designed to serve the dual objectives of **irrigation and hydropower generation**, the principal importance of irrigation was unquestionable in the past. Reservoirs were operated so as to store as much water as possible in the winter and spring seasons -- discharging water for salt leaching purposes only -- and to release water during the summer vegetation season to serve crop irrigation. Hydropower was generated more or less as a side effect of irrigation water releases. Since independence, the situation has changed, and the upstream states where most of the large reservoirs are located (the Kyrgyz Republic, Tajikistan) are more and more interested in maximizing production of electricity, especially during the cold winter season. This is fully understandable, considering that hydropower is almost the only energy source of the upstream states. The conflict of interest between the upstream states which are best served by winter releases of water and downstream states best served by summer releases is now addressed in an ad hoc manner, through bilateral or multilateral negotiations involving compensation of the upstream states, in the form of coal, natural gas or electricity supplies, by the downstream states. The agreement reached in early 1996 by the governments of the

Kyrgyz Republic, Uzbekistan and Kazakhstan, concerning the use of the upstream Syr Darya (Naryn) storage reservoirs for both electricity generation and irrigation water supply, provides the most recent example in this respect. The issue, which is of immediate importance for the regional water management strategy, is addressed by Project 1.2. of the Aral Sea Program.

39. At present, **hydropower** provides 27% of the energy consumed in the Basin (with substantial cross border investment this figure could rise as high as 71%). The hydropower mode of reservoir operations has reduced the availability of water during the growing season in the middle and lower river reaches (especially in the Syr Darya Basin), while raising flow losses in the non-growing season (see figures 4 and 5). This trend in reservoir use mandates a reassessment of guaranteed yield from reservoirs in dry years, an especially important issue for interstate water allocation. Moreover, the usable capacity of some reservoirs (for example, the Nurek Reservoir on the Vakhsh River in Tajikistan) has been reduced by up to 30% because of silting; this compounds the difficulties of flow regulation and interstate allocation. Maintenance of reservoir capacities is being examined under Aral Sea Project 1.3.

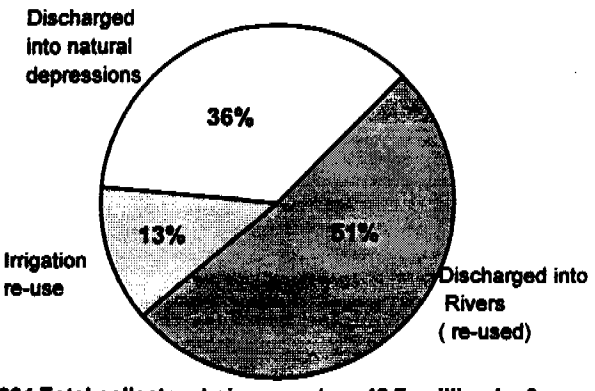
40. Despite the relatively high availability of flow in the 1994 balance, **deterioration of surface water quality** is a problem throughout the Basin. The large volume of collector-drainage water discharged into the rivers has resulted in a drastic increase in the rate of water mineralization. For example, in the lower Syr Darya the mean water salinity has increased in the last 40 years from 0.63 g/l to 1.62 g/l. Occasional concentrations of salt up to 3 g/l are common. In general, water salinity increases along the rivers, reaching the highest values in the lower reaches. Sulphates, chlorides, and sodium ions are prevalent in drainage water, as well as pesticides, nitrogen, and phosphate compounds. The concentration of these substances in drainage water exceeds the maximum permissible concentration for domestic use by between five and ten times. Surface waters also receive a substantial volume of untreated wastewater from cities and industries. The deterioration of surface water quality has had a severe effect on the health of local populations, and the supply of good-quality drinking water is a problem, particularly in the deltas of the Amu Darya and Syr Darya.

41. Based on the national reports, renewable **groundwater resources** in the Aral Sea Basin total about 34 km^3 annually, while confirmed resources are about 12.5 km^3 . Reportedly some 14.0 km^3 were used in 1994 (less than 1 km3 in Uzbekistan). Groundwater withdrawals are approaching the volume of proved reserves in the Kyrgyz Republic, Tajikistan, and Turkmenistan. The interaction between surface and groundwater should be considered carefully in planning and management of both resources. Conjunctive management of surface and groundwater in the Basin could increase the efficiency of water utilization by allowing storage of excess water in wet years and groundwater withdrawal in dry years. The **quality of groundwater** is generally poor, although the data are insufficient for thorough analysis. Generally, the quality is better in the upstream parts of the Basin. For example, in the Kyrgyz Republic, 100% of the groundwater withdrawn for domestic use

meets national quality standards for such use. In Kazakhstan, however, only about 45% of the groundwater withdrawn for domestic use meets national quality standards.

42. Return water reuse is significant in the Aral Sea Basin. Return water of 45.8 km^3 in 1994 is the sum of **drainage water** collected from irrigation (42.7 km^3) and wastewater discharged by industrial enterprises and municipalities (3.1 km^3). The use of collector-drainage water is shown in figure 7. Some 51% is returned to the rivers, while 13% is re-used for irrigation. A large volume of the collector-drainage water (about 36% or 16.3 km^3) is totally lost; it is discharged into natural depressions and evaporates. The extent of water re-use in individual states of the Basin (that is, irrigation water re-use and drainage water discharged into rivers) is difficult to estimate, since collector drainage water discharged in one state is usually transported downstream with the river flows and used for irrigation in downstream state.

Figure 7. Uses of Collector-Drainage Water In the Aral Sea Basin, 1990-94 average



1994 Total collector-drainage water: 42.7 million km3

Water Uses and Unproductive Losses

43. Of a total **water use** of approximately 111.7 km^3 in 1994, about 91.6% was for irrigated agriculture, 3.6% for domestic and household purposes, 1.9% for industry, 1.6% for rural water supply, 0.8% for fisheries, and 1% for other uses. The important role of irrigated agriculture in the water use pattern and in the economies of states makes consideration of irrigation and land use patterns essential to a regional water resources management strategy.

44. Increasing **efficiency of water use** in irrigation could save vast amounts of water in the Basin. In this respect, it should be recognized that during the last ten years, especially in 1990-1994, irrigation water use decreased seriously due to the initiatives of the interstate organizations (1980 - 18,200 m^3/ha/year; 1990 - 14,600 m^3/ha/year; 1994 - 13,000 m^3/ha/year; 1995 - 12,200 m^3/ha/year). This decrease was achieved by limiting water use only. Because of the shortage of funds, limiting water use was not accompanied by necessary technological improvements. The average irrigation standards per hectare during the growing season in Central Asia vary between 3,800 and 11,200 m^3/ha. Actual water consumption, however, varies between 4,500 m^3/ha/year and 20,600 m^3/ha/year, which in combination with system efficiencies of 0.56-0.63 makes necessary revision of current water limits adopted for specific zones of the Basin. There is a wide variation in the methods used by Basin states to set standard irrigation application rates ("norms") and to estimate

irrigation efficiency; harmonizing these methods should be a major goal of coordinated Basin water management. While a number of relatively simple non-investment water conservation measures could improve efficiencies substantially, there is little possibility that large-scale water savings or land improvement will occur without a substantial investment in irrigation infrastructure and technology.

45. As for the approximately 6% of total water withdrawals that are directed to **municipal and industrial use**, the levels of domestic water supply and sanitation have not been assessed adequately in the national reports. The 1990 figures from other sources indicate that in southern Kazakhstan, less than 40% of the population had a central water supply. In the Kyrgyz Republic taken as a whole, this figure was 57%, and for Tajikistan 60%. In Uzbekistan, some 84% of the urban population and 50% of the rural population are supplied with water from central sources. Although the Soviet Union set standards for water consumption at an average daily requirement of 600 l/person in cities and 150 l/person in rural areas, actual consumption during 1994 varied from 46 l/day in Naryn oblast (province) in the Kyrgyz Republic to 1,000 l/day in Tashkent city (Uzbekistan).

46. Considering the high economic efficiency of **non-consumptive water use** (fisheries, navigation, and recreation), development of this area could be beneficial. The volume of fish output in the region could be increased several times by stocking reservoirs and rivers and by building small artificial hatcheries. For example, in the Turdakul and Hauzhan reservoirs in Uzbekistan, fish production is as high as 60 kg/ha and 40 kg/ha respectively, while in the rest of the region it is only 3-7 kg/ha. If a potential yield of 100 kg/ha were realized, an additional 200,000 tons of fish could be produced each year using water at the rate of about 3 km^3/year.

47. The first category of **unproductive water use** in the basin is water loss, whether by evaporation or filtration from river channels, by loss due to groundwater withdrawal, or by loss of drainage water. A considerable volume of water is lost in riverbeds , especially in certain sections of the two main rivers and an important tributary, the Naryn. Observations of high water losses are generally not supported by climatic and hydrological factors. This problem needs more thorough study, as proposed in the second stage of this project. Among unproductive uses, are diversions of return water into the Aral Sea and into natural depressions. These amount to 16.4 km^3 as noted in paragraph 42.

48. The final use of water in the Basin mentioned in Table 1 is **discharge into the Aral Sea.** This amounted to about 31.5 km^3 in 1994, a huge increase of flow into the Sea over the relative trickles in the late 1980s; in 1990, this figure was 12.3 km^3.

Water Balances

49. As shown in Table 1, a comparison of the *actual* and *calculated* balances for 1994. indicate that to supply all the existing irrigation systems at a level compatible with the

present "norms" of specific water use per hectare, a total volume of 151.8 km3 instead of 111.7 km3 would have been required. Assuming water inflow to the Aral Sea at the same level as was actually recorded in 1994, the *calculated* balance for 1994 shows a water deficit in the Basin of 40.6 km3.

50. In Table 1, the *actual* 1994 water balance (relatively wet year) is contrasted with the *actual* 1990 balance (dry year) to produce an overall picture of developments in the four years since independence. Total resources in 1990 were reported at 166.5 km^3 vs. 182.9 km^3 in 1994. Water withdrawals were about 6.4 km^3 lower in 1994 than in 1990 (see also Table 2). Most interesting in this regard was a 2% decrease in water use in Turkmenistan which occurred in spite of despite a 31% increase in irrigated area (Table 3). This massive expansion of irrigated area was carried out within the framework of the governmental "Grain" program, initiated to increase country's self-sufficiency in grain production. Expansion of the irrigated area has been carried out within the country's water allocation established by the ICWC. This was achieved by a partial switch from cotton to grain crops. It must be noted that expansion was implemented in a technically unsatisfactory way, e.g. without drainage facilities, and the grain yields obtained were considerably lower than expected. Uzbekistan also reduced its water consumption by some 7% with a slight increase in irrigated area. The Kyrgyz Republic reduced water consumption slightly in all economic sectors, while Kazakhstan reduced irrigation water use and increased water used for other purposes.

Table 2. Water Use by Five Aral Sea Basin States, 1990 and 1994 (km^3)

Country	1990	1994	Change	Change %
Kazakhstan	11.9	10.9	-1.0	-8.4
Kyrgyz Rep.	5.2	5.1	-0.1	-0.02
Tajikistan	13.3	13.3	0.0	0.0
Turkmenistan	24.4	23.8	-0.6	-2.4
Uzbekistan	63.3	58.6	-4.7	-7.4
Total	118.1	111.7	-6.4	-5.4

Note: There is a slight discrepancy between the 118.1 total water use for 1990 given in these figures and the 117.5 km^3 total use reported in the 1990 regional water balance.

Table 3. Irrigated Area in Five Aral Sea Basin States, 1990 and 1994 (thousand ha)

Country	1990	1994	Change	Change %
Kazakhstan	781.8	786.22	4.4	0.6
Kyrgyz Rep.	423.7	429.9	6.2	1.4
Tajikistan	709.1	719.2	10.1	1.4
Turkmenistan	1,329.3	1,744.1	414.8	31.2
Uzbekistan	4,222.0	4,286.0	64.0	1.5
Total	7,465.9	7,965.4	499.5	6.6

51. Another important difference between 1990 and 1994 is the volume of water discharged into the Aral Sea. In 1990 this was only 12.3 km^3; in 1994, it was 31.5 km^3. It is irrigation use that remains fairly constant; it is the Aral Sea that receives far less water in dry

years. The relatively wet period in the first years of independence has masked the continuing overuse of surface waters; the Sea has been treated as a residual, rather than an active, user of water.

52. In addition to 1990 and 1994 balances, Table 1 presents *calculated* prospective balance for 2010. Regarding future water demands, Table 1 shows that even under the lower demand scenario (agreed recently at the ICWC meeting, however, without indication of the associated costs), the shortage of water in the Basin is in the order of 18.3 km3/year (assuming Aral Sea inflow at the level of 19 km3/year, which cannot sustain the Sea even at the present level). All estimates of available resources and future water demands will be subject to further investigation in the next stage of work on the regional strategy.

Irrigation and Drainage

53. In the Aral Sea Basin, out of the total land resources of about 155 million hectares some 33 million hectares are considered suitable for irrigation while about 7.9 million hectares are actually irrigated. Rain-fed agriculture occupies about 54 million hectares (mostly pastures and hay). This area includes some 2 million hectares of arable land but its productivity is no more than one-tenth of the productivity of irrigated land. At the moment, the rain-fed area plays a small role in the total agricultural production in the Aral Sea Basin, but increasing productivity of the rain-fed farming is an important goal. Cotton still dominates irrigated agriculture, although between 1990 and 1994 its share of irrigated agriculture decreased from 45% to 37.1%. In the same period, the area under cereals (grain) increased from 11.6% to 26.1%. Fodder crops in 1994 occupied only 23,3% of the total irrigated area, compared to 27,4% in 1990. For a wide variety of reasons, including the high cost of inputs (especially gasoline and chemical fertilizers) and disrupted markets, the levels of both yields and production of major crops (cotton, cereals, maize) in irrigated farming have decreased by 5% to 40% in every country since 1990. In the transition period towards a market economy, the agricultural sector in most of the Basin's countries is no longer supported by the respective state budgets. The insufficient attention paid to agriculture has also led to the increase of soil salinization and waterlogging.

54. By the end of 1994, the overall length of main and inter-farm irrigation networks in the Basin was 47,748 km. Of this, about 28% have anti-filtration linings. About 77% of farm intakes are equipped with flow gauges. The efficiency of inter-farm irrigation networks is considered fairly good, approximating 0.82 in 1993/94, although for Tajikistan the figure is 0.62. On-farm irrigation networks total 268,480 km; about 21% of this length has anti-filtration lining. The remaining on-farm canal length has unlined earth beds. The average weighted efficiency of on-farm irrigation networks is 0.73, ranging from 0.70 in older irrigated areas to 0.82 - 0.90 for newly developed land. The most widely used methods of irrigation in the Basin are furrow irrigation (70% of the area), strip irrigation (25% of the area) and basin irrigation (4% of the area). These methods are readily applied in the face of varying environmental and economic conditions and relatively simple in design and use

given the occasional low water availability in some irrigation sources in the region. During 1986-90, about 12% of the total irrigated area was equipped with pipes, siphons and other installations increasing the efficiency of water use. Due to the overall difficulties of the Basin's agriculture, the area equipped by such installations is now less than 1% of the total irrigated area. This is most unfortunate, because past investigations carried out by the national experts have shown that such installations, together with land leveling to +/- 5%, may save up to 500-1,000 m^3/ha of water per vegetation season. Sprinkler and drip irrigation occupy less than 1% of the total irrigated area. In the Aral Sea Basin, air is generally too dry for any large-scale sprinkling operations and drip irrigation, though very attractive in the upstream parts of the Basin, is currently too expensive.

55. Out of the total net irrigated area of 7.9 million ha in the Aral Sea Basin, over 5 million ha requires man-made drainage, but only about 4.7 million ha has such drainage. At the end of 1990, the total length of collector-and-drainage networks was about 174,500 km, Of this total length, roughly 89% is on farms, with 11% on inter-farm networks. Closed horizontal drainage is used for about 1.3 million ha, mostly on newly irrigated lands. There are about 8,500 tube-wells providing vertical drainage to an area of about 790,000 ha. Drainage improvements initiated in the 1970s and 1980s have been largely discontinued because of a shortage of funds and lack of appropriate materials. This is most unfortunate, because underground horizontal drainage and vertical drainage tube-wells require much less water for soil leaching than conventional open drainage canals. In recent years, funds required for maintenance and repairs of drainage network have been drastically reduced. Moreover, since 1985, a growing water shortage, lower water quality, and the decay of enterprises responsible for the drainage system have resulted in secondary soil salinization.

56. The two **major land quality problems** in the Basin are soil salinity and waterlogging caused by high groundwater levels. The area with high groundwater levels (less than 2 meters below the surface) increased in years 1990-94 from 25% to 31% of the total irrigated land. In the same period, the area of moderately and strongly-saline land (where crop yields are reduced by 20% to 50%) increased from 23% to 28% of the total irrigated land. Waterlogging is especially serious in Kazakhstan and Turkmenistan, where between 1990-94 it increased from 12% to 37% and from 51% to 67% of irrigated areas in the respective countries (Aral Sea Basin). The extent of the problem varies; in the upper reaches of the Amu Darya and Syr Darya less than 10% of the land has average or strong salinity, while downstream in Karakalpakstan about 95% of the land is saline. Soil salinity is of course closely tied to drainage conditions (see paragraph 61).

57. The ongoing Agricultural Water Quality Project 3.1b indicates that **soil salinization** is accelerated in large tracts of the irrigated area by inflow of deep brackish and saline groundwater. This is caused by the regional and local groundwater flow patterns triggered by introduction of irrigation practices. Irrigation has increased the groundwater recharge by hundreds of times in comparison with the natural conditions and, together with deep drainage facilities, has induced a new groundwater flow pattern mobilizing deep highly saline groundwater deposits. This phenomena is most severe in the middle reaches of Amu Darya

and Syr Darya, where drainage water outflowing several large irrigation schemes has a salinity contents five to ten times higher than that of irrigation water (normally, two to three times salinity increase would be expected under equilibrium conditions). The problems related to mobilization of deep saline groundwaters cannot be solved by modification or expansion of the drainage system alone. Reduction of the volume of subsurface drainage water by increasing the efficiency of water use is equally important.

Major Issues

58. The **information** with which to assess the availability and quality of water, the use and quality of land, agricultural productivity, irrigation needs, and other key factors in water management is inadequate. The division into local and transboundary waters is not clear; water losses in the Basin are not well understood, and the methods for calculating productivity and water use vary widely. The WARMAP project is collecting data on the oblast, water management region and irrigation system levels, and Project 1.1 will continue to work with this project closely in the course of strategy formulation. Better assessment of resources and uses is a basic condition for all debates concerning water sharing among the riparian states. An adequate system that takes into account methods of collecting and sharing necessary information in the Basin would be crucial for successful management (Aral Sea Program 2).

59. Even with the current imperfect information, it is clear that there is **not enough water in the Basin to meet the demands of all the states.** With the exception of Kazakhstan, every country in the region plans to expand irrigated agriculture by the year 2010, by a total for the Basin of over 1 million hectares. The countries of the region seem to recognize the problem of water shortages by frequently raising the issue of importing at least 20 km^3 from outside the Aral Sea Basin. The difficulties of importing this vast amount of water are well known. The basic alternatives appear to be either conserving water in a variety of ways or revising national social and economic goals and policies (or both).

60. **Water conservation** generally means on the one hand reducing losses and on the other conserving as much from use as possible. The countries of the region estimate that overall, 12.7 km^3--18 km^3 can be saved in the Basin. This level is substantial, but it would come at a cost. The Kazakh report, for example, indicates that saving 1 km^3 of water may cost about $1 billion. Based on this, for example, Uzbekistan's estimate of potential water savings of up to 3 km^3 per annum would cost $3 billion. It is clear that this amount of money would be a substantial burden on any national budget in the region. Therefore, countries and regional organizations must carefully set priorities for water conservation, rather than covering a wide number of solutions with inadequate funding for any one program. Pilot projects will be very important in helping to establish these priorities.

61. Conserving water should begin by improving the efficiency of the present irrigation and drainage networks and introducing better irrigation and drainage practices. Of about 7.9

million irrigated hectares, about 2.5 million ha have new systems in relatively good technical condition. These are such systems as Surhan-Sherabad, Bukhara, Karshi and Golodnyi Step which still function quite well, although during the first years of independence, funds for their operation and maintenance declined every year. In a way it shows how resilient those systems are to operation and maintenance funding limitations. But other systems were built long time ago and technically they are in poor conditions. To arrest the continuing decline of their productivity a large-scale **reconstruction (rehabilitation) program** covering more than 3 million hectares is needed. However, the extent of such a rehabilitation program can be decided upon only on the basis of a careful site-specific analysis of economic viability of reconstruction investments. The basic question is: what can be done to avoid irreversible damage to these irrigation and drainage systems when over the next five to six years the overall economic situation will most probably still be difficult? According to national estimates, reconstruction and modernization of the irrigation and drainage networks may cost up to $3,000 per hectare. The general opinion of national experts is that the reconstruction costs should be covered from the state budgets. They cannot be covered by the water users themselves since, according to national estimates, about 90 percent of the national agricultural product remains in the hands of the state. But again, considering budget limitations, establishment of reconstruction priorities is an issue of key importance.

62. All national reports recognize the importance of **economic incentives** that must be introduced for any effective water conservation. One of the reasons for inefficient use of water is that it is still a free good. All of the Basin countries have introduced charges for municipal and industrial water supplies, but introducing charges for irrigation water is much more difficult. Kazakhstan and the Kyrgyz Republic already have such charges, but the current economic situation of those countries makes collection very difficult. Turkmenistan is considering the introduction of irrigation water charges in the near future. Experiments so far in the region indicate that the main problems are (a) insufficient number of flow measuring devices, (b) the lack of appropriate laws and regulations, and (c) the lack of institutional arrangements to implement and enforce a system of charges for water. The model under discussion across the Basin is a two-rate tariff, consisting of a basic per hectare fee and in addition a progressive fee per cubic meter of water above an assigned volume. This issue is closely related to reforms in the agricultural sector. National experts estimate that in agriculture water use per unit of production could be reduced by 1.5 to 2 times, providing agricultural practices are better adapted to natural climatic and soil conditions and shortages of other input factors, such as fertilizers, pesticides, mechanization, etc. are overcome.

63. The question of whether any potential savings in water via increased irrigation efficiency should be available to countries *or* to the **Aral Sea** has been raised. The riparian countries have agreed that the Aral Sea will be regarded as an independent water consumer. Its share of regional water is to be determined according to a mutually-approved strategy. National reports have not presented any quantitative assessments of the environmental demand for water, but preliminary estimates indicate that the minimum demand for water by the Aral Sea and its coastal regions in the near future is 13 km^3/year, of which 8 km^3/year

might come from the Amu Darya and 5 km^3/year might come from the Syr Darya. This should rise to a total of 19 km^3/year by 2010 (see Table 1).

64. To summarize, current water resources management in the Aral Sea Basin is not sustainable. Three major and **interrelated** causes of nonsustainability that need to be addressed in the next stage of work on the regional water management strategy are: (a) inefficient and often wasteful water use, (b) excessive volume of drainage water and its poor management, and (c) increasing water and soil salinization. The potential for improvement is large, but measures must be taken to ensure that technical improvements are paralleled by necessary policy changes and institutional adjustments. The interstate coordination of water and land use and the related national policies cannot be any longer contradictory to long-term natural resource management and environmental objectives.

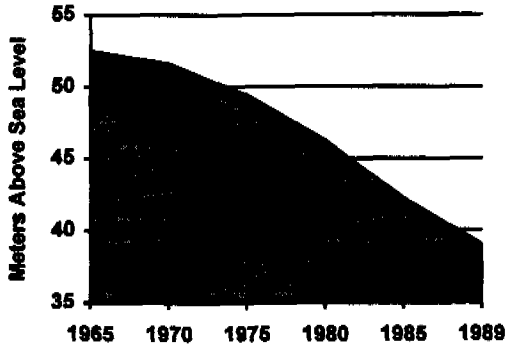
4

Environmental Challenges

65. The Aral Sea and its Basin have gained notoriety as a result of the interest of the world community in the degradation of bodies of water, for the Aral Sea is one of the worst examples. This section outlines problems of general interest to a wide audience and reviews the major issues relevant to forming a strategy. Until 1960, the Sea covered an area of approximately 66,000 km^2 and had a volume of more than 1,000 km^3. It was fed by inflows from the Amu Darya and Syr Darya (totaling approximately 47 km^3-50 km^3 per year), by precipitation (5.5 km^3-6.6 km^3 per year), and by groundwater (5 km^3-6 km^3 per year). Evaporation approximated 63 km^3 per year. These inflows, maintained the level of the Sea at 50.5 m-53.0 m; there was a stable water balance in the Aral Sea. In the years 1960-90, an increase in water use in the basin from 63 km3/year to about 117 km^3/year altered the balance of the Aral Sea.

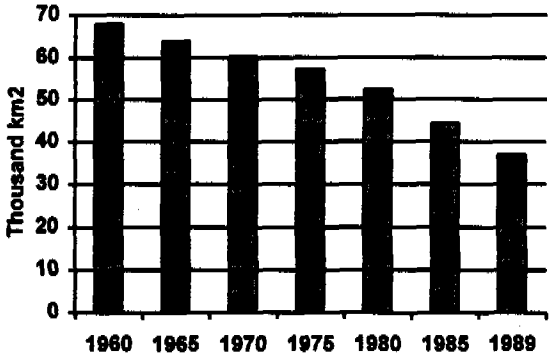
66. By 1990, annual inflows from the Amu Darya and Syr Darya to the Sea had declined to 9 km^3 -12 km^3, and the level of the Sea had dropped 15 m to the current level of about 38 m (figure 8). The Sea had lost about 50% of its area since 1960 (figure 9). Water salinity had increased from about 10 g/l in 1960 to almost 30 g/l (figure 10) as volume had declined to about one-third of its 1960 levels (figure 11). The livelihood and quality of life of about 3.5 million people living in the Amu Darya and Syr Darya deltas had been severely affected by the desiccation of the Sea and its environmental consequences, including salt storms, desertification, poor quality drinking water, and loss of fisheries.

Figure 8. Altitude of the Aral Sea, Selected Years 1960-89



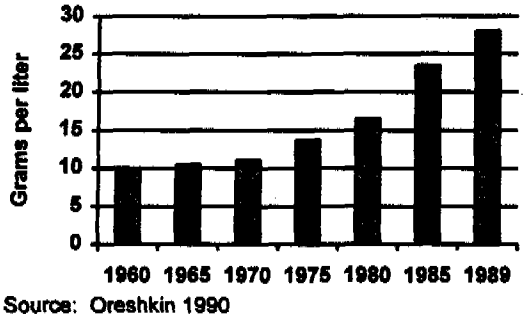
Source: Oreshkin 1990

Figure 9. Area of the Aral Sea, Selected Years 1960-89



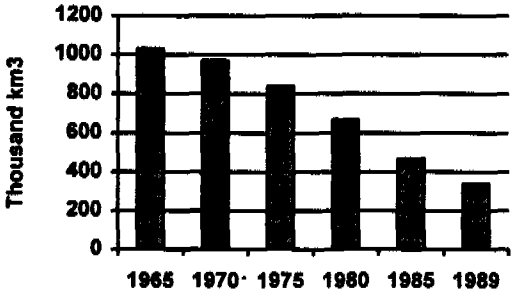
Source: Oreshkin 1990

Figure 10. Mineral Content of the Aral Sea, Selected Years 1960-89



Source: Oreshkin 1990

Figure 11. Volume of the Aral Sea, Selected Years 1960-89



Source: Oreshkin 1990

67. Despite international attention and, more importantly, despite increasing inflow from its tributaries, the **Aral Sea** continues to shrink. The early years of this decade have been relatively wet, allowing inflows to the Sea to increase to 23 km^3 on average between 1990 and 1994. But the Sea has practically divided into two parts: the Northern (Small) Sea and the Southern Sea. It is anticipated that if current water use patterns in the Basin continue, in about 20 years the Sea will be little more than a few highly saline lakes.

68. An excessive amount of water withdrawn from its two tributaries is clearly the leading cause of the Sea's demise. But the aquatic environment of the entire **Aral Sea Basin**, especially its middle and lower parts, has been severely affected by changes in water quantity and quality as well. Some Basin rivers, including large tributaries of the Syr Darya (Chirchik, Keles, Karadarya) and the Amu Darya (Surhadarya, Kafirnigan) have almost totally lost ecological

significance because of excessive water withdrawals from them and return water discharges to them. The massive discharges of collector-drainage water from irrigated land into rivers have resulted in a drastic increase in water salinity. Salinization of water in the lower reaches of Syr Darya roughly doubled between 1960 and 1994, now reaching up to 2 g/l during the low flow season. Secondary soil salinization is a serious problem, especially when there is insufficient water for leaching soils in the non-vegetative season. This has contributed to a decline in agricultural productivity in the region (see Section III).

69. Reduction of river runoff led to substantial changes in the number of lakes and their area in the lower reaches of both major rivers. In the delta of Amu Darya, the total area of freshwater lakes decreased from about 830 km^2 in late 1960s to about 80 km^2 in the 1980s. In the delta of Syr Darya, the total lake area decreased during the same period from 800 km^2 to about 400 km^2. In parallel with the reduction of natural freshwater lakes, new lakes were formed by collector-drainage waters discharged into natural land depressions. The large Sarykamysh Lake located close to the delta of Amu Darya has an area of 3,000 km^2 and a volume of about 26 km^3. The lake water salinity is 12-13 g/l, and the annual increase in salinity is 0.5-0.6 g/l. In the Syr Darya basin, the Arnasai Lake occupying about 2,000 km^2 in area and 15 km^3 in volume was formed the same way. The salinity of the Arnasai Lake varies seasonally and in different parts of the lake, from 4 g/l to 13 g/l.

70. In the coastal region of the Aral Sea over the last 30 years **climatic conditions** have changed due to the Sea's recession. Variation between average summer and winter air temperatures at stations located in the deltaic regions increased by 1.5 to 2.5 degrees centigrade. Mean annual relative humidity decreased by 2% to 3%, reaching 9% decrease in the summer season. According to observations by the local population, spring comes about a week later than before and summer is about two weeks longer. The annual cycle of precipitation has also changed. Over the last thirty years the maximum precipitation season shifted from February-March to April, and minimum shifted from September to July.

71. **Point-source wastewater** discharges from municipalities, industry, and feedlot farms contribute greatly to contamination of both surface and groundwater. Large volumes of poorly treated or untreated wastewater are discharged to the rivers, reservoirs, and lakes of the Basin. Most of the wastewater treatment stations are hydraulically overloaded. The quality of their construction is generally poor, and equipment often calls for urgent replacement. Maintenance is generally substandard. The laboratories often experience problems with obtaining reagents and equipment repairs. At the same time, the **non-point pollution** of water resources is still a basin-wide problem, despite the recent decrease in application of mineral fertilizers and toxic chemicals in agriculture. Many rivers have lost their self-purification capacity.

72. The environmental situation in the upper parts of the Basin (the **flow formation zone**) is very unsatisfactory. Over the last few decades, the upper basin has lost about 50% of its forest cover. Soil erosion has intensified, not only reducing agricultural productivity but silting storage reservoirs. Furthermore, siltation processes are raising natural river beds and water levels, causing frequent overflows which inundate human settlements and agricultural land. Massive land slides

are common. The Aral Sea Basin Program 6, concerned with environmental improvements in the flow formation zone, is of critical importance for the entire Basin.

73. The **loss of biodiversity** in the basin is substantial. Many species in the flow formation zone (such as the mountain goat, snow leopard, and lynx) are almost extinct. Several lakes have dried up as a result of decreased flow in the Amu Darya, reducing the number of spawning grounds for fish. Migratory birds no longer have secure rest and feeding areas. Bird and animal species that depend on aquatic ecosystems have been severely affected. Benthos biomass in the lower river reaches has decreased from an average of about 196 g/m^3 to about 13 g/m^3 in the last three decades, primarily as a result of the loss of organisms that feed on fish. Zooplankton has been reduced from an average of about 160 g/m^3 to about 15 g/m^3 .

Major Issues

74. The present environmental situation in the Basin demonstrates clearly that development patterns adopted in the past are not sustainable. But the major remedy proposed, that of increasing the efficiency of irrigation water use, will probably only alleviate the symptoms without changing the underlying causes of the crisis. The real cause is the demands placed on the ecosystem by the specific development pattern and the method of its implementation. To meet environmental challenges, sustainable agricultural development must be achieved. Once this goal is accepted, it should be easier to define what the solutions might be. It is important to realize that the Aral Basin does not have only a drainage or salinity problem but, above all, an **agricultural development problem.**

75. The environmental challenges in the Aral Sea Basin extend far beyond the Sea and its coastal region. Environmental degradation is a **basin-wide problem** on such a scale that only well-targeted priority actions may gradually improve the situation. Planning and implementation of environmental programs can take place only over the long term. While production cutbacks in the Central Asian states have caused some polluting emissions to decline in the last five years, emissions may increase once economic activities pick up again. In the long term, the adoption of environmentally sound national policies and practices in agriculture, industry, transportation, and urban development are fundamental for sustainable development and for the environment of the Basin.

76. The **restoration of the Aral Sea** to its original state is not feasible in the foreseeable future. In order to restore the Sea to its former level of 53 m, it is estimated that about 75 km^3 of water would have to be supplied every year for 20 to 25 years, not including the needs of the deltas (some of the national experts claim that such an inflow would restore the Sea level up to 43 m only). It is unrealistic to suppose that this could happen. Realistically, the Sea might be preserved at a level of 38 m, but according to experts this would call for regular water inflows of 30 km^3-35 km^3 per year. This level of inflow is rare, except in wet years (see Section III), and would require the commitment of Basin states to treat the Aral Sea as a water user at this level of "consumption". At the same time, however, **restoration of the Aral Sea deltas** is imperative to

improve living conditions of local population. The approach recommended by the Basin states is to establish a new ecological complex of wetlands, deltas, afforestation lines and fishery ponds on the former sea bottom. The water requirements of this complex and rehabilitated deltas in new design are being established by Aral Sea Basin Program 4. Preliminary indications are that 8.5 to 11.5 km^3 and 5.0 to 7.5 km^3 of water might be needed from the Amu Darya and Syr Darya respectively. Plans for the Syr Darya delta must be considered jointly with river channel improvements below the Chardara Reservoir and plans for rehabilitation of the Northern (Small) Sea.

77. To meet the environmental challenges of the Basin, a **long term program of specific actions** is needed. The current problems are of such magnitude that many years are needed for their gradual elimination. Within the framework of the regional water management strategy such a program will be considered under five headings: (a) policy, legal and regulatory measures; (b) institutional strengthening: (c) investment in point and non-point pollution source control; (d) special rehabilitation programs for the delta regions; and (e) public awareness and environmental education. Work will be coordinated with The National Environmental Action Plans being developed for some of the Basin states.

5

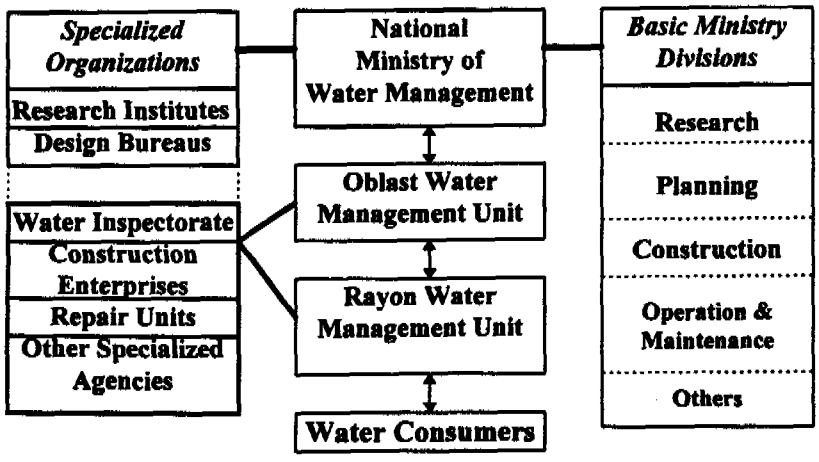
Water Management Institutions

78. Leaving aside differences in names, the national water-related institutions in the five Aral Sea Basin states are quite similar in structure and responsibilities. This is no surprise, considering that all were formed during the Soviet era, which also (in 1986) saw the establishment of river basin management associations (BVOs). On the international level, several new organizations have been formed since the breakup of the Soviet Union. This section describes the national and international institutions and presents issues raised by national experts.

National and International Institutions

79. The backbone of water management runs through the national water management ministries to oblast (provincial) and rayon (district) organizations, to the water consumers (Figure 12). The water management ministries include some divisions represented at the oblast and rayon levels, and several specialized - overall organizations such as research institutes and design bureaus. The construction, operation, and maintenance organizations, operating primarily at the oblast and rayon levels, are responsible for the upkeep of main pumping stations, irrigation and drainage networks (except for on-farm networks), and water control facilities. This organizational structure was suited to build and maintain a centrally managed water infrastructure. Actual on-farm water management is the responsibility of individual farms monitored by the rayon agencies, although there are exceptions of this rule. For example, in Tajikistan the Ministry of Water Resources is responsible for operation and maintenance of the in-farm infrastructure for farms of area greater than about 100,000 ha.

Figure 10. Typical National Water Management Structure in the Aral Sea Basin



80. As a rule, the water management ministries and their agencies manage only surface water and collector-drainage water. As for groundwater prospecting, assessment, and exploitation, state geological committees are responsible. Municipal and industrial wastewater streams are handled by the respective municipalities and industries, under the supervision of the state committees for the protection of nature (Goskompriroda). The water management ministries are principally devoted to the water needs of irrigation and (less so) industry; they do not manage water use for hydropower generation (usually the responsibility of the energy ministries). The water ministries play virtually no role in managing water quality. Obviously, efforts to manage national water resources are currently fragmented among various ministries, divisions, and organizations, nearly all of which have suffered from budget cutbacks.

81. Typically, environmental organizations are responsible for water quality. At the central level these are state committees for the protection of nature. Generally, these organizations (and their local agencies at the oblast and rayon level) are empowered to act on specific sources of individual, municipal, and agricultural (for example, farm and feedlot) pollution. In fact, Gospokprirodas are by law responsible for issuance of water withdrawal and wastewater disposal permits (in consultation with the Ministries of Water Resources). Unfortunately, monitoring is usually inadequate and enforcement of regulations insufficient. Aside from irrigated agriculture, there is typically no oversight nor attempt to manage supply and demand for water or to try to combat leakage or loss.

82. The basic institutions at the international level are

- The Interstate Council for the Aral Sea (ICAS)
- The Interstate Commission for Water Coordination (ICWC)
- The Interstate Commission for Sustainable Development (ICED)
- The Basin Water Associations (in Russian, BVOs) for the Syr Darya and the Amu Darya
- The ICWC Scientific-Information Center.
- The ICSD Scientific- Information Center.

83. The ICAS is envisioned ultimately to become a sort of water parliament, that will issue and recommend for approval interstate legislation and regulations; approve ecological measures,

scientific research and technical programs; and, in general, regulate interstate relationships regarding water management and environmental protection. The decisions of ICAS are implemented by its Executive Committee. One part of ICAS, the ICSD, is concerned with economic, social, and environmental issues. Another part, the ICWC, has a variety of more technical roles, including approving the limits of annual water use in the Basin for each state, approving the operational mode of major storage reservoirs, setting the annual volumes of water supply to the river deltas and the Aral Sea, and work out recommendations to the governments on pricing and compensation for use of transboundary waters. The ICWC concentrates specially on the strengthening of the order of annual water allocations as well as on elaboration and implementation of the Action Plan on future development. This role was assigned to ICWC by the last meeting of ICAS in April 1996. According to the 1992 agreement that created the ICWC, its decisions are binding on all countries, although this agreement is not always observed. The ICWC has a permanent Secretariat. Its minutes and resolutions are sent to the BVOs for implementation. The Syr Darya and Amu Darya BVOs prepare and secure the approval of water intake limits, schedule reservoir releases, and maintain facilities and canals turned over to them by Basin states. Finally, the Scientific Information Centers conduct research, arrange the exchange of information, and prepare reports and recommendations for the approval of the ICWC and the ICED respectively.

84. Despite the positive effects of interstate management of water resources, the national experts report a few recent incidents that illustrate insufficient attention on the part of some countries and organizations to agreed-upon water allocation. Lack of coordination within the states on procedures to implement interstate agreements, and delays in practical implementation of the interstate agreements concerning compensation measures for modification of the reservoir release patterns, led in 1995 to a serious interruption of the long-term flow regulation principles on the cascade of the Naryn-Syr Darya reservoirs. Instead of using the reserves of the Toktogul storage reservoir during that dry year, the reservoir was filled with more water. Downstream irrigated farming failed to receive 6 km^3 of water contrary to agreed limits. Inaccurate forecasts of reservoir inflows on the order of 5 km^3 were not corrected until it was too late to do anything except change the water allocation limits.

Major Issues

85. The present institutional arrangements for water and related land management are deeply rooted in the inherited system of central planning and control. Although state policies are moving toward decentralized, market-oriented approaches, changing the government's role in water administration is in an early stage. In the next stage of Project 1.1, considerable thought must be given to the responsibilities and arrangements of government for water management, especially in light of changes in the land tenure systems. While policy will remain the prerogative of government, local initiatives such as water users associations will doubtless play a stronger role in actually managing the resource.

86. Presently, the constitutions of all Basin states consider water to be national property, with the sole right of allocation lying with the state. The laws and codes of the Basin states are not all the

same, however. Since transboundary resources belong to all of the states, national rules and standards concerning these waters should be harmonized across the Basin. Such rules and standards include, among others, water quality standards, compensation arrangements, and procedures for managing collector-drainage water.

87. At the moment, about 72% of the costs of interstate organizations such as ICWC, the ISC of ICWC, and BVOs are paid by Uzbekistan. National experts have proposed a number of alternatives for financing joint water management. These alternatives of course reflect the interests of individual Basin states. In the next stage of Project 1.1, these proposals will be elaborated in greater detail; the countries must then negotiate and agree on a method of financing transboundary water management. An important issue to be decided is financing for completion of water storage projects that could benefit all Basin states (examples are the Rogun dam in Tajikistan and the Naryn cascade in the Kyrgyz Republic).

88. Although the founding of the ICWC immediately after independence evidenced the commitment of the Basin states to collaborate on mutual problems, international agreements are needed to give this commitment real force. In addition to proposing financing alternatives, the national experts have suggested a list of specific treaties to be drafted in the next stage of Project 1.1 and subsequently to be negotiated by the Basin states. Among other topics, the proposed treaties should cover

- The expansion of rights and responsibilities of the ICWC to include groundwater issues, water pollution control, etc.;
- The allocation and use of transboundary waters, including the specification of rights and responsibilities of BVOs;
- Procedures for joint policy-making and planning;
- Liability and compensation rules for water misuse and degradation of water quality.

89. There are many deficiencies in the existing water management structure at the local, national, and international levels, perhaps chief among them a lack of orientation toward comprehensive, sustainable water resources management. The national experts involved in Project 1.1 work emphasized several key matters.

- The objectives of water resources management are not well-defined at the national level. New goals and policies are necessary to develop market-oriented approaches and to establish the necessary institutional arrangement to reach the goals.
- Over the past few years the financial and material base of water resources management has sharply deteriorated at both the interstate and national levels.
- Related to the above, on-farm water management is in serious trouble. This is a key aspect of the transition to a responsibility on the part of consumers for water management and associated costs. In many situations farmers have neither the money nor the personnel to maintain infrastructure. National institutions must assist many farms in the transition period, whether with funds or with setting up new arrangements such as water users associations.

- There is no single or uniform information system to account for or report the availability and quality of water resources at all levels of consumption.
- Staff training in new methods and technologies for water management is not adequate. The training system developed in the past does not function any longer; people are not sufficiently motivated to improve their professional skills; there is a shortage of personnel to operate irrigation and drainage infrastructure.

6

National Concerns and Regional Issues

90. The preceding sections of this report have identified major issues in four areas: the economic and social setting, water and land, environment, and the institutional arrangements. Each country, however, has identified specific priorities in the national reports prepared for Project 1.1. This section lists some of these priorities and discusses regional issues reflected in the work plan presented in section VIII.

National Priorities

91. *Kazakhstan*

- Additional water resources for development of irrigated agriculture
- Solution to wasteful (inefficient) use of irrigation water (water conservation)
- Improvement of situation in the Syr Darya delta and the establishment of the North Sea (Small Aral)
- Water quality improvements, especially related to salinization
- Improvement of drinking water supplies
- No more outflows to Arnasay depression (a bilateral issue with Uzbekistan)
- Solution to serious land productivity losses
- Appropriate financing to support water management and agriculture
- Modification of cropping patterns (adaptation to local conditions needed)

92. *Kyrgyz Republic*

- Development of hydropower resources

- Expansion of irrigated agriculture; additional water resources will be needed
- Solution to wasteful (inefficient) use of irrigation water, land, and other natural resources (conservation)
- Solution to land productivity losses due to soil erosion
- Technological advancement of irrigation practices
- Solution to environmental problems in the upper watersheds (especially erosion control)
- Provision of safe drinking water to population
- Appropriate financing for operation and maintenance of irrigation and drainage systems

93. *Tajikistan*

- Expansion of irrigated agriculture; additional water resources will be needed for irrigation, industry and municipal use;
- Hydropower production, including continuation of investments initiated earlier;
- Improvement of existing irrigation systems and irrigation methods;
- Resolution of dangerous situation concerning maintenance of irrigation and drainage systems; decreasing farming potential
- Solution of environmental problems in the upper watersheds (erosion control);
- Protection of human settlements against flooding
- Provision of irrigation systems with other factors needed to secure appropriate level of agricultural production, such as chemical fertilizers, pesticides, agricultural machinery, etc.
- Energy conservation in pumping irrigation schemes
- Rehabilitation and maintenance of the vertical drainage systems
- Analysis of the problem of Sarez Lake (created by landslide in the beginning of the century)

94. *Turkmenistan*

- Expansion of irrigated agriculture (additional water resources will be needed)
- Water conservation and reconstruction of the old irrigation and drainage systems
- Expanded re-use of drainage water
- Improvement of the Amu Darya delta (including water quality);
- Reduction of water losses in the Kara Kum Canal
- Water and soil salinity management

95. *Uzbekistan*

- Productivity improvements in the newly developed lands
- Water conservation by:
- Reconstruction of the old irrigation and drainage systems

- Introduction of new irrigation technologies and irrigation methods
- Construction of missing elements of the drainage network, including reconstruction of some of the existing main collectors and inter-farm drainage canals
- Rehabilitation of the vertical drainage system, taking into account the increasing maintenance and electricity costs
- Lining of the main feeders and inter-farm irrigation canals to reduce water losses
- Optimization of the structure of agricultural production, especially in irrigated area
- Rational use of water and hydropower resources
- Improvement of land productivity, especially in the areas which are affected by soil salinity and are already short of water;
- Support of vertical drainage systems given the increasing costs of electricity and maintenance
- Energy saving, especially in large-scale water pumping systems;
- Improvement of the Amu Darya delta (including water quality)
- Selection of rational crop patterns.

96. Since about 90% of water in the Aral Sea Basin is used for irrigation, it is understandable that agriculture-related problems dominate national priorities. All these priorities are mutually related and must be approached in an integrated fashion with physical, economic, social and environmental factors taken into account. But the national priorities listed above indicate some issues common to the entire Basin. Because of the expected population growth, all states would like to increase agricultural production, presumably by expansion of irrigation farming. There is a broad agreement among states that this can be achieved only by increasing the efficiency of water use and water conservation. A related issue is reconstruction (rehabilitation) of the old irrigation and drainage systems. Reconstruction of these systems is expected to reduce substantially both per hectare water input and also drainage water output. This in turn would address ambient water quality concerns and the related problems of drinking water supply. The increase of water use efficiency, water conservation, and improved irrigation practices would also be beneficial from the point of view of soil salinity control.

97. Depending upon one's perspective, there are many ways to view the problems of water management in the Aral Sea Basin. In Sections II, III, IV and V some of the major economic/social, water and land, environmental and institutional issues were discussed. That thematic perspective is augmented in this section by the lists given above of national priorities identified in the preparatory phase of Project 1.1 by national experts from each of the Basin states. Considering both thematic issues and national concerns, eight major regional issues emerge. These regional issues, which call for special attention in the next stage of work on the regional water management strategy, are discussed in the remaining part of this section.

Regional Issues

98. ***New political, economic and social setting.*** One of the fundamental issues in the Aral Sea Basin is that, for almost 70 years, the Basin was located in one federal state governed by a single set of norms concerning society and the economics. Since the Aral Sea Basin states became

independent in 1991, regional interdependence has taken on a new meaning. Absent federal coordination, the newly independent countries must coordinate regional issues among themselves. This is not an easy task, since all infrastructure in the Basin, including that for managing water resources, was built on the assumption that it would all serve one country. For example, water intakes may be in one country, the irrigated area may be located in another, and the drainage water discharged in a third. The difference between the past and the present (and the future) extend far beyond national and purely technical matters, however. The entire system of human incentives, attitudes, and motivation is changing - the one known in the past is gone, and the new one is far from certain. New institutional arrangements are taking shape that do not have much to do with those known in the past. This issue emphasizes the need for capacity-building, human resources development and participatory decision-making in water and land management. In this context, it has to be recognized that the mutual understanding and political aspirations of the Heads of State, of the governments, and of the top level water management specialists, expressed on several occasions during the past five years, indicate that all participants are interested to achieve a sustainable water management in the region.

99. ***Information improvements.*** International water resources can be efficiently managed only if there is a common information system for important variables, and if the system is open to all parties who share the resources. A Basin-wide information system built on national "nodes" is needed to share hydro-meteorological data and information on water, land, and environmental resources and their use. At present there is no such a system in the Aral Sea Basin. The monitoring systems already in place in the riparian countries, for example those for geology and groundwater, should be incorporated in a Basin-wide design consisting of five main components: (a) data collection, (b) data transmission, (c) data storage, analysis and transformation into "user-friendly" information, (d) information transmission, and (e) information dissemination. An important step in this direction is the WARMIS information system under development by the EC TACIS WARMAP project. The WARMIS system includes two main blocs of regional and national information and it will be installed initially at the Ministries of Water Resources, the Scientific-Information Center of the ICWC, the BVOs, and the EC of ICAS.

100. ***Managing transboundary water resources.*** As indicated in this report, water resources of the Basin have been classified as local national and transboundary. A new system of national and interstate rights concerning the use and protection of water is needed, a system that takes into account water quantity, quality, and variability. The new system should include transparent procedures for sharing costs, benefits, and risks among the riparian states. Strongly needed for management of transboundary waters is a mechanism for coordination of national water policies; this could benefit the Basin as a whole and also each country individually. First, establishing common principles and criteria for water allocation and use, and sharing results of research and approaches to technical problems, could in the long run save each state substantial expense. Second, despite common coordination, intersectoral and interstate disputes cannot be avoided. Both on a national and an interstate level, procedures are needed to resolve such disputes. Third, given high uncertainty about how much water will be available in a given year, special attention must be given to operational management of resources and their use. This in turn requires common arrangements

for monitoring and oversight of the continuously changing environmental, social, and economic situation in the Basin.

101. ***Increasing water use efficiency (water conservation).*** All of the states of the region recognize that conservation and more efficient use of water in the basin are imperative, especially in relation to irrigated farming. Reduction of on-farm and inter-farm water losses is highly important, but losses in large international water conveyance canals, e.g. the Kara Kum canal, are also an issue. Water conservation on either a national or transnational level has its own financial implications, however. Who will pay and who will benefit? Will conserved water be used only in the country where it was conserved, or might water saved be used by other countries or for the Aral Sea? The current tendency is to establish specific water use regulations and quotas. Experience has shown, however, how difficult it is to enforce such regulations. Gradual transition from a system of "norms and quotas" to "demand management" that uses economic and financial incentives seems unavoidable, especially in view of land tenure (ownership) changes. Viewing water as an economic resource, with a price not only for the resource but also for its inefficient use or for pollution (the introduction of a "polluter pays" principle), will help to encourage conservation. A specific issue in this regard is maintenance of irrigation and drainage canals and facilities. The introduction of a "user pays" system should help to generate at least part of the resources needed for operations and maintenance, especially if those paying participate in the management of such a system. This could be effected by introduction of Water User Associations.

102. ***Water quality control.*** The pollution of surface and groundwater by agrochemicals, salt and organic waste has impaired the water quality on a regional scale, with particularly negative effects on public health and drinking water supplies. Industrial and mining pollution, urban sewage and waste disposal are also significant sources of pollution. Most of the wastewater treatment stations, where they exist at all, are hydraulically overloaded. The quality of their construction is generally poor, and equipment often calls for urgent replacement. Maintenance is generally substandard. The regulations concerning Maximum Allowable Concentrations (MACs) of pollutants are frequently violated (especially during the low flow season) for most of the polluting substances that are analyzed. Moreover, the reliability of water quality data is questionable because laboratories often experience problems with obtaining reagents and with equipment repair. In the future, a Basin-wide system of water quality standards is needed. At the same time, target water quality requirements should be set up for specific reaches of the major rivers. Introduction of the "polluter-pays" principle is important, both at the national and interstate levels. All these issues call for a long-term program of water quality management in the Basin, to be funded through introduction of new financial mechanisms. Initially, polluters will probably pay only for exceeding water quality standards (fines). Gradually the rules should become more stringent. Limits will have to be agreed at the interstate level on distribution of pollution streams among water management regions (especially collector-drainage waters). An important requirement is identification of the best interstate schemes for poor-quality water reuse and removal from drinking water sources.

103. ***Salinity management.*** Water and soil salinity are ever-present and mutually related hazards of irrigated farming, particularly in arid regions. The Aral Sea Basin is not an exception in this regard. One of the most serious and widespread effects of the way irrigation water has been used in

the Basin has been the secondary salinization of soils (see also Sections 3 and 4 of this report). During the growing season, the water table rises as a result of irrigation and salts accumulate in the upper soil layer. During the non-growing season water is applied to flush out potentially harmful salts which would otherwise accumulate in the root zone. However, any attempt to leach without provision of adequate drainage is not merely doomed to failure but can indeed exacerbate the problem. The optimal quantity of water that should be applied to effect leaching is difficult to determine. The application of too much water can be as harmful as the application of too little. There is a clear relationship between increasing soil salinization and declining yields. High concentrations of salts, moreover, have a deleterious effect on soil properties, causing a deterioration of soil structure and a reduction of its porosity and permeability. The middle and lower reaches of the Amu Darya and Syr Darya have serious soil salinity problems that are less pronounced in the upper parts of the Basin.. The results of past investigations carried out in the Basin as well as lessons to be learned from new pilot projects initiated under the Aral Sea Program, will be used for development of salinity management and control strategies.

104. ***Environmental concerns.*** Although the dessication of the Aral Sea offers a dramatic example of the consequences of unsustainable development of agriculture, environmental problems extend beyond the Sea and its two main river deltas. Aside from the stark problems of human health and the economic consequences of mismanagement of water (such as the disappearance of fisheries or falling productivity due to soil salinity), there is also the issue of the inherent worth of ecosystems and of water as an element that supports diverse life. There are a great number of sensitive ecosystems at risk in the Basin. At the source of the rivers, in the upstream flow-formation zone, environmental problems such as soil erosion, mudslides, and mining waste are particularly difficult to deal with. But there is no single blueprint for the Basin. What works in one country may not work for another. Recognizing all differences, an environmental effort for the Aral Sea Basin must be seen in the unique context of a transition from centrally planned to market economies. The solutions must go far beyond the transfer of clean technologies, better wastewater treatment and environmentally sound irrigation practices. Not less important are non-structural solutions, such as appropriate institutions, good and effective legislation, and economic incentives. As everything cannot be done at once, the environmental component of water management strategy should focus on a limited number of high-priority problems, emphasizing inexpensive and cost-effective approaches. Without a clear articulation and ordering of priorities, there is a danger that the severity of other problems in the Basin will push environmental issues to the margin of economic and social reform.

105. ***Implementation capability.*** One of the pervasive major weaknesses of the past water resources planning in the Aral Sea Basin has been ineffective implementation of plans and programs. Failures in implementation are manifested by delays in project completion, cost overruns, and shortfalls in planned outputs. Failures in implementation have stemmed from distortions such as inadequate funding; lack of incentives for good operation and maintenance; and little or no involvement of affected local people in project planning and implementation, with consequent lack of feedback from project users and beneficiaries. This history shows why, in formulating a regional water management strategy, one should never lose sight of how the strategy will be implemented. To this end, a number of legal and other normative acts will be needed to introduce common "ground

rules" for all the riparian states. Since uncertainty concerning future situations is high, implementation procedures must be designed in such a way that they can easily adapt to changing objectives and constraints. The important aspect of the regional water management strategy will be clear identification of national and interstate institutions responsible for implementation of the entire strategy and its particular elements.

7

Addressing the Main Regional Issues

106. Since 1970s, proposals to address different aspects of the Aral Sea crisis have been made by a number of respective proponents: government agencies, research institutes, design bureaus, local authorities, non-governmental organizations, international conferences and interested individuals. These proposals have been reviewed by the national and regional working groups of Project 1.1, taking into account preliminary results of projects initiated in 1995 under the Aral Sea Program, especially Project 1.1. This process has led to identification of the principal regional issues which will be investigated further in the next stage of the project. This section outlines briefly principal ways of addressing these issues as now seen by the Project 1.1 team.

107. The overarching concern has to do with the importance of integrating the search for solutions to the water management problems with the "big picture" framework to ensure that all the parts fit into a coherent whole. If the regional water management strategy is to approach its stated mission of helping achieve technically sound, economically feasible, and socially acceptable economic development in the Basin, macroeconomic changes and large-scale policy changes will need to take place. Unless the water management strategy is well integrated and coordinated with other studies and efforts (e.g. energy studies), the "solutions" recommended may turn out to be superior when viewed narrowly from the water perspective only, but inferior when viewed from the perspective of comprehensive and sustainable economic and social development in the Basin ads a whole. For example, the "big picture" perspective might give smaller-scale, more local solutions (e.g. improved irrigation efficiency), or institutional/policy reforms (e.g. water pricing) greater advantage over large-scale conventional engineering solutions.

New political, economic and social setting

108. The need for capacity-building, human development (including establishment of a regional water management education center), better communication, and introduction of more participatory decision-making in the Basin states does not require any further discussion. There are, however, some special requirements of the new political, economic, and social setting that are directly related to formulation of a regional water management strategy. Water management, which was once a national issue affecting just one country, is now an international issue affecting five countries. To develop alternative projections of future water demands, the overall socio-economic development plans of individual states, especially those touching on the agricultural sector, are needed as input. Policy documents upon which water management strategy can be based must be developed by the appropriate government agencies in each of the Basin states.

109. The future level of regional integration which is not yet established is an important factor in development of the regional water strategy. National experts have agreed to study further four possible integration scenarios: (a) complete integration of the Basin states; (b) integration with mutual compensation; (c) adoption of a principle of equal economic growth per capita in all Basin states; or (d) maximization by each Basin state of its own interests, with agreement on a few regional issues only. These scenarios will have to be translated into criteria to be used to select priority actions of regional significance.

110. Economic and social transformation processes are naturally proceeding at a different pace in each country. Some countries have taken bold steps to establish the preconditions for the transition, such as price liberalization, ambitious privatization programs, and efforts to establish currency convertibility. In other countries, greater political and economic complexities require that the pace of economic reform be slower. However, in each country, the gravity of the economic situation inherited from the centralized planning model makes reform inevitable. Some key items of the reform programs which will play an important role in water management are: (a) introduction of clearly defined (private and communal) property rights; (b) price and tax changes to establish proper economic signals and practices; (c) improvement of the banking systems; (iv) establishment of clear regulatory frameworks for enterprises in all sectors of the economy; and (v) creation of an accurate land ownership and water use registers. The approach adopted for water management improvements in the region includes a combination of strict regulation and limitation, strengthening of line actions -- all supported by legal, economic and administrative rules as well as by development of economic incentives and promotion of self-management at the lowest level of water use.

Information Improvements

111. The water agencies in the Basin states are data rich but information poor. Large quantities of data have been and are being collected, but data collection activities are not well coordinated and the quality of data is uncertain. As the focus of these agencies changes from

development of new water projects to better operation and maintenance of the existing ones, there is a need for a refocusing also of their data acquisition, processing, and utilization procedures. There is a great need to facilitate the transfer of information among national agencies, particularly those which collect the same types of data for different purposes.

112. In the next stage of work on development of a regional water management strategy, full use will be made of the WARMIS, an information system for water and land resources in the Aral Sea Basin being developed by the EC TACIS WARMAP project. Continuing investigations on the regional water strategy will also take advantage of recent improvements in hydro-meteorological data gathering, transmission and processing, which have been effected under the Aral Sea Project 2.1. As for the environmental data base, it is not yet clear when Project 2.2, "Regional Environmental Information System", will be sufficiently advanced to be used in the strategy investigations. It is fundamental, however, that the appropriate national data bases are developed and filled with reliable data, characterizing the real situation of irrigation and drainage systems, farms and fields, allowing for evaluation of a potential for the increase of their productivity and water conservation. These data should include not only official information, but data collected by the pilot projects program as well. An important part of a regional information system should be hydroecological monitoring, allowing for constant analysis and prediction of the possible, positive and negative, changes of the environment.

Managing transboundary water resources

113. To improve management of transboundary water resources, national experts have outlined several priority interstate agreements to be drafted and negotiated in the next stage of work on the regional water strategy. Agreements have been proposed (a) on expanding the rights and responsibilities of the ICWC; (b) on the rules concerning use of transboundary water resources; (c) on securing an ecological balance in the region and protecting water quality; (d) on joint water resources planning; (e) on financing of interstate water management bodies; (f) on protection, maintenance, and safety of interstate water management facilities; and (g) on creating and introducing a Basin-wide shared information system (see paragraph 112 above).

114. An economic mechanism to be used for managing transboundary water resources is to be developed and agreed upon by the Basin states. It should take into account the prevailing price distortions and market imperfections. It should not, however, require a rapid modification of the interstate water allocation procedures presently in force. On the contrary, a sudden departure from procedures practically tested under a number of different situations would be risky and unwise. Only gradually should economic incentives, in combination with self-monitoring and self-control approaches to water resources management, gain priority over the procedures inherited from the past. As part of the next stage of work on the regional water management strategy, it is proposed to install at some strategic locations (especially interstate boundaries on Amu Darya and Syr Darya) about 10 water flow and water quality automatic monitoring stations to be managed by the respective BVOs. Such installations will be of importance for implementation of the current agreements concerning interstate water allocation (in space and

time), such, as for example, the 1996 agreement on Syr Darya reached by the Kyrgyz Republic, Uzbekistan and Kazakhstan.

115. An integrated approach towards managing transboundary water resources should include: (a) integrated planning for a joint use of water by all riparian states; (b) integrated planning of water resources management on the basis of inter-sectoral and interstate analyses; (c) joint investments for water resources development and management; (d) integration of seasonal schedules of water releases from storage reservoirs, taking into account the needs of energy production, agriculture, recreation, fishery and ecosystems; and (e) integrated advisory committees - national water councils with participation of the NGOs.

Increasing water use efficiency (water conservation)

116. A fundamental shift in water management is required in the Basin, toward more efficient use of available water supplies, toward water conservation and demand management. Basin-wide comparison of water values in alternative uses should become increasingly important, leading to resource reallocation to higher-value uses. Economic incentives cannot accomplish this alone, especially in the difficult transition period. In the Basin states, water sectors require a new type of management that, within the framework of the regional strategy, strikes an appropriate balance between government regulation and economic incentives. All management proposals must take into account the realities of political boundaries cutting across the Aral Sea Basin.

117. An increase in water use efficiency, especially in irrigated agriculture, has been accepted by all Basin states as a necessity for achieving sustainable development of their economies and improving the environmental situation in the Basin. It should be recognized, however, that increasing water use efficiency (water conservation) only makes sense if all riparian states participate. In this context, definition of a potential water demand is very important for the assessment of water use by each of the Basin states. At its meeting held in Kzylorda in April 1996, the ICAS has approved a statement on water saving oriented towards such a potential level of water demands. Measures to be taken include some of an investment and some of a non-investment nature. Besides all possible improvements in crop rotation, crop watering procedures, and introduction of economic incentives, non-investment measures will include withdrawal of excessively saline and unproductive land from cultivation. The determining factors in selecting the right mix of these measures will be the technical state of irrigation and drainage networks and site-specific natural and economic conditions. In the foothill and the mountain zones, introduction of drip and sprinkler technologies should be given special attention (combined water and energy savings; positive effects for the downstream areas).

118. Water conservation program will include: (a) development of Basin-wide norms of water use in all branches of the economy as well as the instream minimum (biological) flow

requirements; (b) wide introduction of water reuse and re-cycling concepts; (c) assessment of a real potential productivity of water and land; (d) development of criteria for evaluation of water use efficiency; (e) introduction of payment for water (charges and fines for exceeding the permit values - quantity and quality); (f) control of water losses from river channels; (g) an agreement among the states about national water limits; (h) introduction of better water use practices (e.g. in irrigation short furrows, land leveling, etc.) as well as advanced water use technologies; and (i) introduction of water conservation advisory (extension) service. The pilot projects program - initially at least 1-2 pilots in each of the Basin states - will be of fundamental significance for the design and implementation of a water conservation program. The program will have to be based on adequate information system allowing for modeling and analysis of water conservation alternatives. This way the most efficient, economically feasible, and realistic methods of water conservation will be selected, taking into account site-specific natural conditions and economic situation.

119. The Kyrgyz Republic and Tajikistan have chosen to promote water conservation principally by introduction of modern irrigation equipment and irrigation methods, and by canal lining. Water conservation in the flow formation zone affects the entire Basin, reducing the volume of withdrawals, reducing energy use for pumping, the volume of drainage water returned to the system, and the build-up of groundwater levels. This is very positive from the point of view of both water and soil salinity control. The downstream states of Uzbekistan, Kazakhstan and Turkmenistan employ the above measures and also attach special importance to reconstruction (rehabilitation) of the large areas of the old irrigation and drainage systems (750,000 ha, 384,000 ha and about 400,000 ha respectively). Ultimately, water use efficiency improvements will be recommended on the basis of an analysis of land and water productivity carried out for specific crop pattern in each water management region and large irrigation system.

Water quality control

120. More efficient utilization of water in each of its uses is the highest priority requirement to overcome deterioration of water quality in the region. This efficiency requirement concerns especially irrigation farming where highly mineralized drainage water makes up to 45 percent of irrigation water withdrawals. In properly designed and operated systems, this value should be on the order of 15 to 20 percent. The standard drainage module in the Basin should not exceed 0.06 to 0.08 l/s/ha. The use of weakly mineralized water mixed with freshwater should be introduced, especially in the foothill valleys. Drainage water with a salt concentration of 6 to 8 g/l should be used for irrigation of salt-tolerant plants and trees in the sandy desert regions.

121. The construction of large-scale drainage water outfalls (such as the proposed right bank collector drain along the Amu Darya) is being reviewed in light of the of the ultimate volumes of drainage waters and time schedules of their discharge. In the water-scarce Aral Sea basin, drainage water will always represent a significant resource potentially available for uses which, from the point of view of water quality, are progressively less demanding. The regional water management strategy will take full advantage of the results of Aral Sea Project 3.2 (Uzbekistan

Drainage Project). It is hoped that other, similar projects will be initiated, particularly in Turkmenistan.

Salinity Management

122. One of the most significant issues facing the sustainability of the Basin is the distribution and storage of salt. For example, in some areas the annual salt load being imported with irrigation water is in the order of 15 tones per hectare. In some areas salt exports of 60-70 tones per hectare have been recorded (salt mobilization from deep groundwater aquifers is an issue). A key decision that needs to be taken is where this salt is to be stored in the environment. Review of work done in the past and some new work on the hydrogeology of the region is necessary to obtain a more complete picture. The standard of drainage service necessary to support irrigated agriculture in the variety of settings that occur in the Basin must be determined. However, the economics of provision of the drainage service in ameliorating the impacts of salinization is fundamental. Without such analysis, it is impossible to determine whether investments in various high levels of drainage service (i.e. sub-surface drainage) are necessary.

123. Desalinization of drainage water is probably not a viable option. However, it is important to view drainage as an integrated process including on-farm usage of drainage water and its evaporation in selected sites to reduce the total volume of water that needs to be disposed of. To maintain appropriate salinity of river flows, design and implementation of salt removal schemes (right and left bank collectors in the Amu Darya basin, etc.) are very important. These salt removal schemes should allow for reduction of salt discharges to the rivers whenever it is necessary. Furthermore, the experience of other countries indicates that if one can get the economic signals right both in terms of a reasonable price for water and for drainage services, then the amount of drainage water reduces very substantially. The usage of brackish and moderately-saline waters should be given prominence.

Environmental Concerns

124. It has been already decided by the ICWC that the Aral Sea and two major delta regions should be considered to be specific water users. Critically important is joint (interstate) management of irrigation and drainage waters to achieve ecological sustainability and to prevent accumulation of salts in the soil. The "on-site" usage of brackish water and other return flows should be promoted. Strict limitations on the permissible discharge of specific pollutants will be introduced, together with administrative, legal and economic pressure on water users that discharge wastewater - introduction of the "polluter pays" principle. Fines for exceeding pollution discharge limits will be introduced. The environmental rehabilitation of the Basin will require substantial funds and institutional improvements to control better polluting entities (monitoring).

Improving Implementation Capability

125. At the interstate level improvements should include: (i) strengthening of the BVOs structure and expansion of their scope of activities; (ii) transfer of the control of transboundary groundwater resources and irrigation return flows to BVOs; (iii) improvement of hydrometeorological services and improvement of the reliability of hydrometeorological forecasts; (iv) establishment of a training center for water specialists; and (v) participation of governments (state budgets) in financing water management measures and programs (in parallel to the introduction of an effective system of water pricing); and (vi) support of professional staff.

127. Improvements foreseen at the national level include: (i) transition to the basin management principles; (ii) introduction of Water User Associations; (iii) involvement of the "stakeholders" and NGOs in management decisions concerning water and related land resources; (iv) supply of necessary equipment; (vi) development of construction and maintenance (repair) agencies operating on the basis of commercial principles (privatization); (vii) improvement of a system of national contributions to the interstate water management fund; and (viii) introduction of a system of licenses, payments and penalties (fines) for the excessive discharge of wastewater.

8

The Work Plan for Stage 2 of Program 1.1

128. The next stage of investigations for the development of the regional water management strategy in the Aral Sea Basin provides for continuation of effort initiated in the preparatory phase of Project 1.1. All the differences that surfaced during the first stage of work should be given special attention in the Stage 2 investigations. The fundamental assumption of water management strategy is recognition of an essential reality, that the Basin states are joined in one water system comprising the basins of the Amu Darya, Syr Darya and Aral Sea. It is equally recognized, however, that each state is sovereign, and will evaluate regional strategy in the light of its own interests and priorities. Thus regional strategy can have meaning only if it reflects the interests of each state, and national activities can have meaning only if they are consistent with regional objectives and measures to address common ecological concerns.

129. A general scheme of interaction between regional issues and national concerns in strategy is shown in Figure 13. In this scheme, developed in the preparatory phase of the project, the process begins with the assessment of transboundary and local water resources, which together constitute water resources available for use in the Basin. In this context, attention will be given to transboundary flow and seasonal quality changes of drainage water and its disposal schemes. The next task proceeds along three parallel paths (three columns in Figure 13). A series of regional assessments is to be carried out (left column), such as assessment of water demands to sustain the Aral Sea and its coastal region or assessment of regional impacts of the collector-drainage discharges, or assessment of regional water quality requirements.

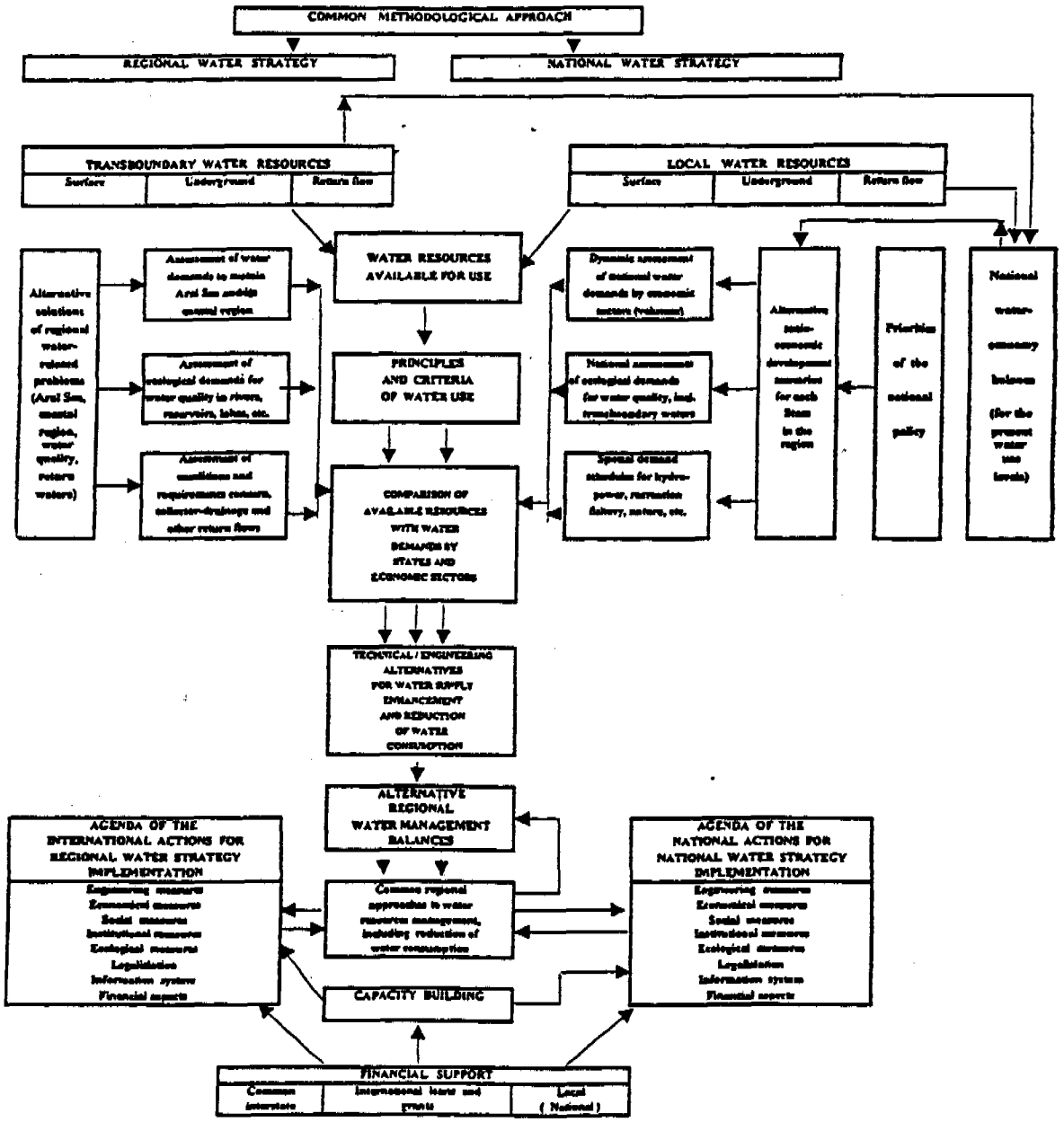


Figure 13. General Scheme of Work on the Regional Water Management Strategy

130. In parallel (right column in Figure 13), a series of national investigations is to be carried out. These begin with an analysis of the current water situation in each state, followed by national assessments taking into account the respective socio-economic development scenarios developed by each state. Following the development of common principles and criteria for water use in the Basin (central column in Figure 13), comparison is made between available water resources with water demands of each state. The following step is identification of technical options for water supply enhancement and reduction of water use .

131. Water balances together with the associated economic analyses will eventually lead to the formulation of short, medium and long-term action programs. The long-term interstate drinking water supply program is an example of special programs to be developed in the next stage of the project. The action program alternatives will be evaluated and priorities established with the aid of a system of mathematical models using data from the common information system and the results of pilot project investigations. In the process leading to the formulation of the action programs, financial opportunities and constraints must be considered. In the short-term, because of the current economic problems of the Basin states, action programs will have to depend upon a multiplicity of financial sources for their implementation; some combination of normal and concessional lending, supplemented by outright grants, will be needed from bilateral and international financing agencies. This input is represented as underpinning the central column in Figure 13. For the long-term, the concerned governments will need to adopt innovative strategies for program financing to overcome the limitations of slow growth, tightly constrained budgets, and competition for limited financial resources from other important sectors.

132. The detailed work program proposed for stage 2 is presented in Tables 4 and 5. Table 4 presents the investigations to be conducted at the regional level. Table 5 discusses the work to be done by each of the Basin countries.

133. At the regional level, the first need is to finalize terms of reference for all regional and national activities, including organizational preparations and communication arrangements. Next, it is necessary to develop and agree on common methodologies, approaches, criteria and procedures to ensure compatible results from regional and national investigations. These methodological studies are listed in items 1.2 through 1.10 of Table 4. They include work on mathematical models needed for evaluation and choice of the best strategic options (1.8), utilization of the information systems developed within the Aral Sea Program (1.9), and utilization of information produced by the Basin-wide program of pilot projects (1.10).

134. The second and third groups of investigations are respectively regional assessments, ranging from the socio-economic development projections (item 1.11) to the evaluation of a possible impact of global climatic change (item 1.15) and special studies that require being conducted at the regional level; these are listed in Table 4 under items 1.16 to 1.23.

135. Finally, the fourth category of work to be done at the regional level is development of action programs (items 1.24 to 1.27). The level of detail of these programs will be compatible with their

time horizon. For the short-term perspective of the next five to seven years during which the Basin states will overcome the current difficulties and economically recover to the level of 1990, the action program should be quite specific with clear responsibilities assigned for implementation of its respective elements. The medium-term and long-term action programs will provide more flexibility to accommodate political, economic and social factors that currently cannot be predicted with any certainty. The long-term drinking water supply program (item 1.27) is an example of special programs to be developed within the framework of Project 1.1. In this category of work special provision is made for communication and dissemination of work results (item 1.28) as well as for training, study tours, workshops and other capacity and human resources improvements (item 1.29).

136. In parallel with regional assessments and investigations, each Basin country will undertake a series of national investigations (Table 5). The fifteen items proposed in the work plan will range from analysis of national socio-economic issues to assessment of national programs for water conservation. Development of good channels of communication between the national teams, as well as close cooperative links between national teams and the units responsible for regional investigations, is imperative.

137. Implementation of the second stage of Phase 1 of the project is scheduled for a period of approximately two years. Figure 14 presents a general schedule of work; inputs expected from other projects and programs are indicated for each category of work. It is not yet known when these inputs will be available. Depending on their availability, the final scope of work on the strategy may change. Of special importance in this respect are development of the integrated water, land and environmental information system, and the pilot projects program. The analytical tools, techniques and mathematical models developed under Project 1.1 for integrated analysis of factors affecting water management decisions in the Basin will need reliable inputs; the regional information system and the pilot projects program are of particular importance in this respect.

138. It is envisaged that the following outputs will result from project activities: (i) a set of short, medium and long-term action programs supporting sustainable development and management of water and related land resources over next 20-25 years; (ii) identification of diverse water resources in the Basin available for use; (iii) water consumption "norms" (standards) mutually agreed upon by the riparian states; (iv) Basin-wide water conservation program, including a common system of regulations and economic incentives; (v) a set of mathematical models for planning and operational management of Basin's water and related land resources; (vi) a set of legal documents, agreements, normatives and regulations (interstate and national) as mechanisms for strategy implementation; (vii) a system of pilot projects (which later will be used for promoting extension services); (viii) recommendations and pre-feasibility studies for engineering projects (water management infrastructure); and (ix recommendations for institutional improvements at national and interstate levels.

139. It is assumed that funds will be secured sufficiently early in 1996 to allow initiation of work on the regional water management strategy in the beginning of 1997. Following finalization of terms of reference, work on the development of common methodologies and regional assessments (items 2 and 4) should be initiated first. These regional investigations can be organized quickly on the basis of working arrangements developed in the preparatory stage of the project. Organization of

regional studies and national investigations will require more time (items 4 and 6); therefore, it is proposed to launch them about three months after project initiation. This is especially important for national investigations, because they must be initiated on the basis of mutually agreed methodological principles. The work on regional water balances (item 5) is to be initiated about one year after the beginning of the project, and, finally, six months are reserved for formulation of the action programs (item 7). It is expected that several interstate agreements, such as agreement on water conservation and drainage priorities, will be negotiated and concluded in the course of strategy development.

140. The estimated total cost of stage 2 of Project 1.1 is $6,945,000. Table 4 estimates a total cost for regional work at $3,685,000. The program of national work presented in Table 5 will cost approximately $3,260,000 with the following distribution among the Basin states:

Kazakhstan	- $630 thousand;
Kyrgyz Republic	- $600 thousand;
Tajikistan	- $630 thousand;
Turkmenistan	- $680 thousand;
Uzbekistan	- $720 thousand.

140. The success of the next stage of work on the regional water management strategy will to large extent depend on the proper organization of this large, multinational effort. The complexities involved must be fully recognized. It is expected that the Executive Committee of ICAS will continue to be responsible for the overall coordination of work. The work shall be organized in a modular way because of the multiplicity and diversity of donors funding specific projects of the Aral Sea Basin Program. Responsibilities for regional investigations will be assigned by ICAS to some local organizations, based on competitive bidding. As for national investigations, lead institutions responsible for within country organization of each nation's work should be nominated by the respective governments.

141. The assistance of international consultants must be organized in a way that is compatible with the local organization, at both regional and national levels. They may be specially useful by providing an objective assessment of issues being subject to interstate debates. Beside short-term international consultants, it would be advisable to have a core team of local and foreign experts working together for the entire duration of the Project. The core team would be responsible for coordination and integration of the results of national and regional investigations. This type of arrangements are needed to ensure that the strategy documents are prepared in a timely and consistent manner.

TABLE 4. REGIONAL WATER MANAGEMENT STRATEGY: PHASE I, STAGE 2
PROGRAM OF INVESTIGATIONS TO BE CARRIED OUT AT THE REGIONAL LEVEL

SUBJECT OF INVESTIGATION	COST (THOUSAND US$)	OUTPUT	LINKS	ISSUES ADDRESSED
1.1 Development of TOR for all regional and national investigations; organizational preparations and communication arrangements	300	• TOR • Organizational Structure • Communication channels	• All cooperating programs	• Strategy development
Development of common methodologies 1.2 Development of criteria and procedures for evaluation of present water use and volume of water reserves.	80	• Methodology report		• Methodological development
1.3 Development of sustainability criteria for evaluation of water quality and the related ecosystems.	70	• Methodology report; • Monitoring scheme for water quality control in the Aral Sea Basin	• ASP - Program 3	• Methodological development
1.4 Development of an approach for the assessment of sustainability of water sector development plans, both at the national and regional levels.	80	• Methodology report;		• Methodologica l development
1.5 Development of analytical procedures for preparation of national and regional water balances (quantity, quality, variability).	60	• Methodology report;	WARMAP	• Methodological development
1.6 Development of analytical procedures for evaluation of the potential and feasible productivity of land and water resources in irrigation farming, for the assessment of water conservation program (economic evaluation methodology)	100	• Methodology report; • Assessment of potential land productivity	WARMAP	• Methodological development

SUBJECT OF INVESTIGATION	COST (THOUSAND US$)	OUTPUT	LINKS	ISSUES ADDRESSED
1.7 Development of an approach for establishment of water use "norms" in the basin and gradual transition from "norms" to demand management involving application of both regulatory and economic instruments.	170	• Approach report; • Water "norm"	WARMAP	• Methodological development
1.8 Development of a set of mathematical models to support planning (identification of the best strategic options) and operational decision-making in water and related land resources management; procurement of necessary hardware.	480	• Set of mathematical models installed at the appropriate regional institutions	• Other ASP programs; • WARMAP; • US AID	• Methodological development
1.9 Development of an approach towards utilization of the basin-wide databank on water, land and environmental resources (interaction with WARMIS and ASP-Program 2.	130	• Principles of utilization of a common information system;	• ASP-Program 2 • WARMAP	• Methodological development
1.10 Development of an approach towards utilization of pilot project results (improvement of water and salt management) analysis and evaluation of the existing pilot projects	130	• Pilot data	To be agreed with other donors	• Methodological development
Regional Assessments 1.11 Assessment of the regional socio-economic development potential, taking into account various options of economic integration and demographic trends.	80	• Short, medium and long-term socio-economic forecast. • Recommendations on the rational use of the region's potential		• New political, economic and social setting
1.12 Assessment of natural water losses, especially from the Amu Darya.	185	• Evaluation of water losses from natural river channels and reservoirs; • Assessment of available water resources	• ASP-Programs 1.2; 1.3 and 4	• Managing transboundary water resources • Increasing water use efficiency • Information improvements

SUBJECT OF INVESTIGATION	COST (THOUSAND US$)	OUTPUT	LINKS	ISSUES ADDRESSED
1.13 Assessment of transboundary water resources (volume, quality, variability) including groundwater and its relations with the surface water resources; improvements in water quantity and quality measurements at the interstate border points (about 10 cross-sections)	580	• To be used in the process of interstate water allocation; • Identification of the sphere of activities of the ICWC • Installation of modern flow and water quality measurement stations		• Information improvements • Managing transboundary water resources
1.14 Preliminary assessment of the possibilities of supplying the Aral Sea Basin with water from outside regions (long-range water transfers) .	Additional funds	• Evaluation of supply enhancement alternatives, especially from the Caspian Sea; B/C analysis	• ASP-Program 4	• Managing transboundary water resources
1.15 Evaluation of possible impacts of global warming (climatic change) on regional water resources and water requirements.	70	• Impact assessment		• Managing transboundary water resources
Regional Studies 1.16 Drafting legal and normative documents regulating water resources planning and operational management at the regional level, with due attention paid to the constitutions of the riparian states.	120	• A set of international agreements, norms and regulations	• Project guided by WARMAP	• Managing transboundary water resources
1.17 Drafting proposals for the system of water-related interstate financial relations , including compensation mechanisms and introduction of national systems of payment for water, including their regional implications.	140	• Recommendations, on financial relations and compensation mechanisms at the basin level. • Recommendation for the states concerning introduction of a payment for water systems	• US AID	• Managing transboundary water resources • Improving implementation capability
1.18 Institutional improvements in the area of water and related land management, at the regional, national and local levels.	150	• Recommendations on institutional and organizational improvements	• WARMAP • UNDP	• Improving implementation capability

SUBJECT OF INVESTIGATION	COST (THOUSAND US$)	OUTPUT	LINKS	ISSUES ADDRESSED
1.19 Legal, economic and technical aspects of the "Polluter-pays" principle and procedures for its introduction in the riparian states.	70	• Recommendations, procedures, legal and normative documents	• ASP-Program 3 • WARMAP	• Water quality control
1.20 Integrated evaluation of various measures oriented towards reduction of the deficit of water resources and demand management initiatives - water conservation.	240	• Specification of alternative basin-wide water conservation strategies	• ASP-Program 3	• Increasing water use efficiency
1.21 Assessment of basin-wide alternatives for disposal of collector-drainage water and salinity management.		• Recommendations on the most promising alternatives	• ASP-Program 3	• Water quality control • Salinity management
1.22 Evaluation of water requirements of the Aral Sea to sustain the needs of endangered ecosystems (with the delta's requirements taken into account).	120	• Water requirements of the Aral Sea satisfying ecological needs and feasible from the economic view	• ASP-Program 4	• Environmental concerns • Managing transboundary water resources
1.23 Regional water balances under different demand, water availability and policy scenarios	150	• Analysis and evaluation of water management alternatives		• Regional water management strategy
Development of Action Programs 1.24 Formulation of the short-term regional water management strategy	150		• ASP - all Programs • WARMAP • UNDP • UNEP • US AID	• All main regional issues (see Section 7)
1.25 Formulation of the medium-term regional water management strategy	100	• Priority actions and their time schedule	Same as above	Same as above
1.26 Formulation of a long-term regional water management strategy	100	• Priority actions and their time schedule	Same as above	Same as above

SUBJECT OF INVESTIGATION	COST (THOUSAND US$)	OUTPUT	LINKS	ISSUES ADDRESSED
1.27 Formulation of a long-term drinking water supply program	120	• Recommendations for regional drinking water supply schemes • Evaluation of their political, economic and technical feasibility		• Drinking water supply
1.28 Communication and dissemination work results	200	• Involvement of strategy "stakeholders'	All cooperating programs	• Improving implementation capability
1.29 Training, study-tours, workshops	300	• Capacity and human resources improvements	All cooperating programs	• Importing implementation capability

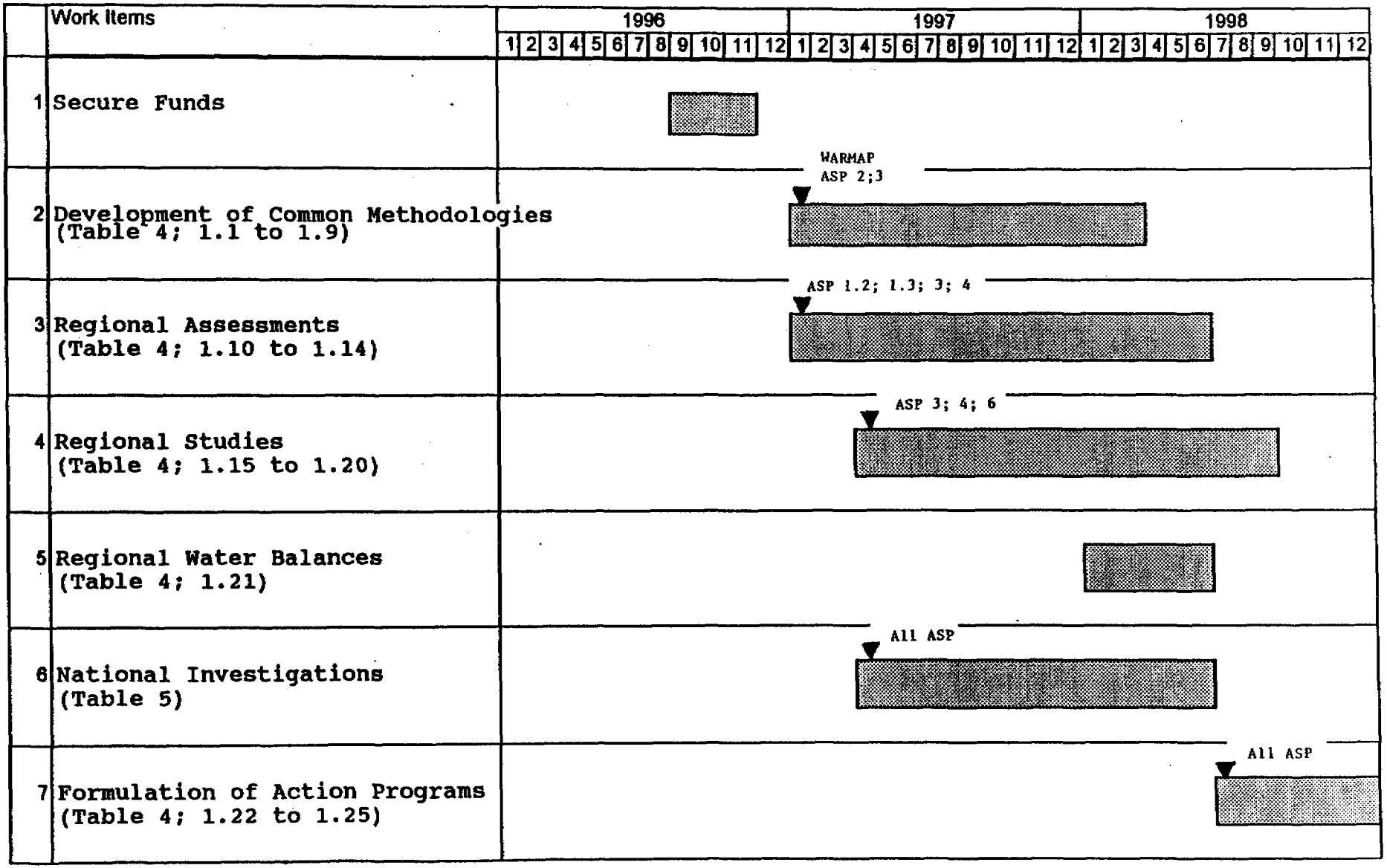
TABLE 5. REGIONAL WATER MANAGEMENT STRATEGY PHASE I, STAGE 2. PROGRAM OF INVESTIGATIONS TO BE CARRIED OUT AT THE NATIONAL LEVEL

SUBJECT OF INVESTIGATION	OUTPUT	ISSUE ADDRESSED
2.1 Analysis of water-related national socio-economic issues in the transition period of economic reform, and long-term development perspectives for the next 20-30 years, including • development alternatives, • production volumes of water-consuming sectors • approximate capital requirements for their development	• Structure, dynamics and volumes of future water requirements, taking into account limited availability of water resources; • Estimates of future investment needs in water sector and the sector's own financial potential; • Potential for the increase of water-use efficiency due to national and interstate cooperation and specialization.	• New political, economic and social setting
2.2. Assessment of water resources availability (quantity and quality, local and transboundary) and retrospective analysis of their use for evaluation of development potential of specific water resources regions of the country.	Resource assessment and water management zoning	• Information improvements
2.3. Assessment of water demand alternatives (volume, quality, time patterns) by population, economic sectors (especially agriculture) and environment.	Evaluation of water demands by population, natural ecosystems and economic sectors	• Increasing water use efficiency • Water quality control
2.4. Assessment of national measures that can be undertaken for the protection of natural water bodies and aquatic ecosystems located in other riparian states, especially the Aral Sea and its coastal region	Basin-wide environmental action programs	• Environmental concerns • Water quality control • Salinity management
2.5. Dynamic water balance calculations by water management regions, river basins and for the entire country	Water balances	• Managing transboundary water

SUBJECT OF INVESTIGATION	OUTPUT	ISSUE ADDRESSED
2.6. Assessment of land and soil resources towards their more efficient use in irrigation farming, taking into account potential for specialization in agricultural production.	Recommendations on land use,with land productivity, the state of land reclamation facilities and water quality taken into account; Location of agricultural production in the naturally and economically most suitable zones with recommendations concerning cropping patterns.	• Increasing efficiency of water (and related land) use
2.7. Evaluation of the potential and feasible productivity of land and water resources in irrigation farming; preparation of water conservation programs for typical zones.	Recommendations on water-saving measures in various natural conditions and evaluation of water conservation impact on land and water productivity	• Increasing water use efficiency
2.8. Analysis of economic efficiency of technological improvements in water use by all economic sectors (costs, benefits,etc.), especially in irrigated farming, necessary capital outlays, by water management zones and basins.	• Estimates of economic efficiency of capital investments in the improvement of irrigation and drainage systems. • Evaluation of investment needs in specific water management zones.	• New political, economic and social setting
2.9. Analysis of institutional (organizational) arrangements in water sector, with possible changes in land tenure taken into account.	Recommendations on institutional improvements.	• Improving implementation capability
2.10. Development of a system of payment for water use, including cost of water as a natural resource.	Recommendations on economic relations between government water agencies and water users	• New political, economic and social setting
2.11. Development of draft laws and other normative acts to regulate relations between the state and water users (including Water Law and regulations establishing Water User Associations).	A set of draft laws and other normative and regulatory documents	• Managing transboundary water resources • Improving implementation capability
2.12. Environmental impact assessment of water management strategy alternatives (ecosystems, landscapes, etc.).	Recommendations on the protection of endangered ecosystems, landscapes, etc.	• Environmental concerns

SUBJECT OF INVESTIGATION	OUTPUT	ISSUE ADDRESSED
2.13. Assessment of catastrophic water-related events and elaboration of preventive measures.	• Improved reliability of hydrotechnical structures and river channels; • Recommendations on flood and mud-slide mitigation measures.	• Environmental concerns • Increasing water use efficiency
2.14. Analysis of the possibilities of reuse of collector drainage waters, with and without treatment; reuse of municipal and industrial wastewater	Recommendations on the reuse of collector-drainage and wastewaters	• Water quality control
2.15. Assessment of the possibilities of introducing water-saving technologies and measures to intensify utilization of desert and mountainous areas for expansion of agricultural production	Recommendations on the expansion of less water-intensive agricultural production	• Salinity management

FIGURE 14. REGIONAL WATER MANAGEMENT STRATEGY (Phase I: Stage 2) TIME SCHEDULE



kindler\temp\timesch.xls

Appendix

Members of Program Group 1 (PG1)

PG1 Coordinator
V.A. Dukhovny, Director General, SANIIRI and Head of the ICWC Scientific Information Center

Task Manager
J. Kindler, The World Bank

PG1 Members (Alphabetical Order)

V.I. Antonov, Director General, Uzvodproject, and head of the PG1 national group of Uzbekistan
A.E. Bekenov, Head of the the Operations Department, Ministry of Water Mangement, Kyrgyz Republic
L.N. Dmitriev, Director, Kazghiprovodkhoz Institute
N.K. Kipshakbaev, Chairman, the State Committee for Water Resources, Republic of Kazakhstan, and head of the PG1 national group of Kazakhstan
N.R. Khamraev, Director, Institute of Water Management Problems of the Academy of Sciences of Uzbekistan and head of the PG1 regional group on socio-economic aspects
V.P. Krohmal, Deputy Chief Engineer, Turkmenghiprovodkhoz Institute
M.D. Madenov, Director, Kazghiprovodkhoz Institute
D.M. Mamatkanov, Director, Institute of Water Management Problems and Hydropower Engineering, Kyrgyz Republic
N.K. Nasyrov, Director, TajikNIIGiM, and head of the PG1 national group of Tajikistan
G.P. Petrov, Vice-President, TajikEnergo, and head of the PG1 regional group on water resources management
R. Rakhmatilloev, Director, TajikNIIGiM Institue and head of the PG1 regional group on land resources
T.C. Sarbaev, Director, Kyrghyzghiprovodkhoz Institute, and head of the PG1 national group of the Kyrgyz Republic
M.M. Sarkisov, Director, Turkmenghiprovodkhoz Institute and head of the PG1 national group of Turkmenistan
B.S. Saparov, Director, Institute of Water Management Problems of the Academy of Sciences, Turkmenistan, and head of the PG1 regional group on ecology
U. Saparov, Head of the hydro-geolocial amelioration expedition of the Ministry of Water Management, Turkmenistan
V.I. Sokolov, Head of a division of SANIIRI, and head of the PG1 regional group on water resources
Y.I. Sokolsky, Head of the operations department at the Ministry of Water Management, Tajikistan
N.N. Yudakhin, Head of the technical department at the Ministry of Water Management, Kyrgyz Republic
A.H. Zaurbekov, Head of a chair at the Jambul Irrigation Institute
A.V. Zemlyannikov, Chief Engineer, Kazghiprovodkhoz Institute