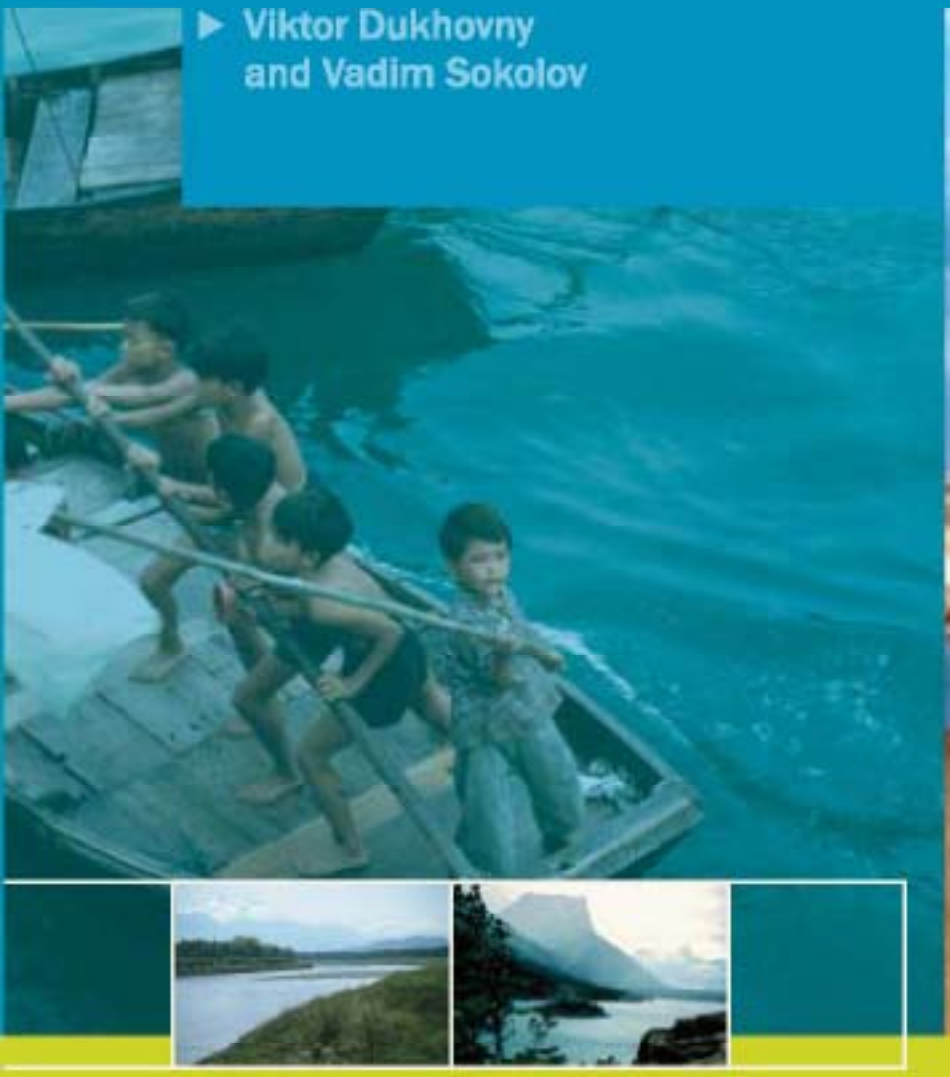
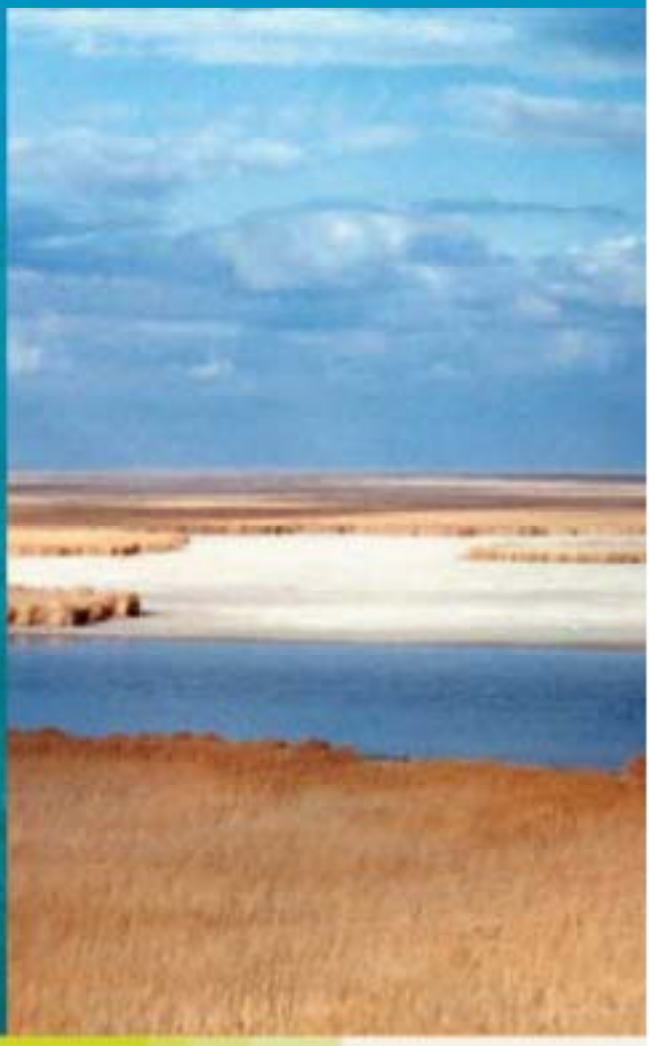
PC→CP

Lessons on Cooperation Building to Manage Water Conflicts in the Aral Sea Basin

Viktor Dukhovny
and Vadim Sokolov





UNESCO | IHP | WWAP
IHP-VI | Technical Documents in Hydrology | PC→CP series | n° 11

PCCP Publications 2001-2003

1. Frederick M. Lorenz, *The protection of water facilities under international law*, UNESCO-IHP, 46 p.
2. Sergei Vinogradov, Patricia Wouters and Patricia Jones, *Transforming potential conflict into cooperation potential: The role of international water law*, UNESCO-IHP, 106 p.
3. Stefano Burchi and Melvin Spreij, *Institutions for international freshwater management*, UNESCO-IHP, 51 p.
4. K.D.W. Nandalal and Slobodan P. Simonovic, *State-of-the-art report on systems analysis methods for resolution of conflicts in water resources management*, UNESCO-IHP, 127 p.
5. Ali M. Vali, Sree N. Sreenath and Gundo Susiarjo, *An educational tool to examine the development constraints in the Limpopo river basin*, UNESCO-IHP, 50 p.
6. Fekri A. Hassan, Martin Reuss, Julie Trottier, Christoph Bernhardt, Aaron T. Wolf, Jennifer Mohamed-Katerere and Pieter van der Zaag, *History and future of shared water resources*, UNESCO-IHP, 150 p.
7. Yona Shamir, *Alternative dispute resolution approaches and their application*, UNESCO-IHP, 43 p.
8. Branko Bošnjakovic, *Negotiations in the context of international water-related agreements*, UNESCO-IHP, 50 p.
9. Philippe Barret, Alfonso Gonzalez avec les contributions de Yannick Barret et Céline Olivier, *Société civile et résolution des conflits hydriques*, UNESCO-IHP, 78 p.
10. Ti Le-Huu and Lien Nguyen-Duc in cooperation with Apichart Anukularmphai, Do Hong Phan, Khammone Ponekeo, Pech Sokhem and Zhang Hai-Lun, *Mekong Case Study*, UNESCO-IHP, 56 p.
11. Viktor Dukhovny and Vadim Sokolov, *Lessons on cooperation building to manage water conflicts in the Aral sea basin*, UNESCO-IHP, 50 p.
12. Keith W. Muckleston, *International management in the Columbia river system*, UNESCO-IHP, 47 p.
13. Peter Nachtnebel, *Danube case study*, UNESCO-IHP (to be published)
14. Álvaro Carmo Vaz and Pieter van der Zaag, *Sharing the Incomati Waters: Cooperation and competition in the balance*, UNESCO-IHP, 102 p.
15. Munther J. Haddadin and Uri Shamir, *Jordan case study*, UNESCO-IHP, 41 p.
16. Alan Nicol, *The Nile: Moving beyond cooperation*, UNESCO-IHP, 33 p.
17. Ine D. Fritjters and Jan Leentvaar, *Rhine case study*, UNESCO-IHP, 33 p.
18. Raúl Artiga, *The case of the Trifinio plan in the Upper Lempa: Opportunities and challenges for the shared management of Central American transnational basins*, UNESCO-IHP, 13 p.
19. Eric Mostert, *Conflict and co-operation in the management of international freshwater resources: A global review*, UNESCO-IHP, 63 p.
20. Aaron T. Wolf, Shira B. Yoffe and Mark Giordano, *International waters: indicators for identifying basins at risk*, UNESCO-IHP, 30 p.
21. Pal Tamas, *Water resource scarcity and conflict: Review of applicable indicators and systems of reference*, UNESCO-IHP, 29 p.
22. Jerome Delli Priscoli, *Participation, consensus building and conflict management training course*, UNESCO-IHP, 179 p.
23. WaterNet, CCR, ISRI, Catalic, UNESCO-IHE Delft, UZ, *Basics of water resources -Course book*, UNESCO-IHP, 97 p.
24. Waternet, ISRI, Catalic, UNESCO-IHE Delft, Zu, *Basics of water resources -Reader*, UNESCO-IHP, 66 p.
25. Waternet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Course book*, UNESCO-IHP, 269 p.
26. Waternet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Reader*, UNESCO-IHP, 211 p.
27. Waternet, ISRI, Catalic, UNESCO-IHE Delft, ZU, *Conflict prevention and cooperation in international water resources - Hand outs*, UNESCO-IHP, 84 p.
28. WaterNet, CCR, ISRI, Catalic, UNESCO-IHE Delft, UZ, *Advanced mediation skills - Course book*, UNESCO-IHP, 83 p.
29. William J. Cosgrove (compiled by), *Water security and peace: A synthesis of studies prepared under the PCCP - Water for Peace process*, UNESCO-IHP, 108 p.
30. *A summary of PC->CP publications 2001-2003*, UNESCO-IHP, 34 p.
31. Janos Bogardi and Saskia Castelein (eds.), *Selected papers of the International Conference From Conflict to Co-operation in International Water Resources Management: Challenges and Opportunities*, UNESCO-IHE Delft, The Netherlands, 20-22 November 2002, UNESCO-IHP, 600 p.

LESSONS ON COOPERATION BUILDING TO MANAGE WATER CONFLICTS IN THE ARAL SEA BASIN

Victor Dukhovny and **Vadim Sokolov**

Scientific-Information Center of the Interstate Commission for Water Coordination in Central Asia

(SC-2003/WS/44)

ACKNOWLEDGMENT

This article is a contribution from UNESCO's International Hydrological Programme to the World Water Assessment Programme. It was prepared within the framework of the joint UNESCO–Green Cross International project entitled "From Potential Conflict to Co-operation Potential (PCCP): Water for Peace," and was made possible by the generous financial assistance of the Japanese government.

CONTENTS

LESSONS ON COOPERATION BUILDING TO MANAGE WATER CONFLICTS IN THE ARAL SEA BASIN

The Aral Sea Basin became notorious as an example of the rapacious attitude to nature of the Soviet command system of water management. There are many similar examples in the "western world," even in such powerful countries as the United States, which cannot rehabilitate the deltas of the Colorado and San Khoakin rivers, or Lake Mono and others to restore them to their original natural condition.

During the past ten years Central Asia has established conditions for independent development on the basis of mutual respect, mutual cooperation, and the clear political will of the presidents and governments of the five states concerned to preserve and strengthen joint water management. The framework for this was based on earlier Soviet practice and principles, which should be transformed under new economic conditions. The water authorities of the five countries facilitate cooperation under the umbrella of the ICWC – Interstate Commission for Water Coordination – which celebrated its ten-year anniversary in February 2002. This cooperation is progressing in spite of complexities and differences in the social, political, and environmental conditions in the different states and their different levels of development. It carries the promise of future success, giving objective appraisal to achievements and setbacks as well as finding ways of survival.

These commitments have led to the belief, reflected in official documents of UNESCO, OSCE, and other international agencies, that the ICWC as a body of five states, even in such conditions, can find ways to develop well-controlled and progressive collaboration. This experiment is unique, because five states are not only working together in planning, but also in operating and managing transboundary rivers in real time. For these reasons the Aral Sea Basin has been selected as an acceptable case study for the PCCP program. The expected outcomes of the case study are the lessons to be learned from the difficult and complex conditions that followed the break-up of the Soviet Union. That collapse led to an intricate environmental problem, and the countries of the basin are working through cooperation to find an effective way to manage water resources.

1. GEOGRAPHY AND HISTORY OF THE ARAL SEA BASIN

The Aral Sea Basin is located in the heart of the Asian continent, and covers the whole territory of present Tajikistan, Turkmenistan, Uzbekistan, the southern part of the Kyrgyz Republic, and the southern part of Kazakhstan (see Figure 1). Some parts of the basin are located in the northern part of Afghanistan and Iran (about 8 percent), and some in China (less than 0.1 percent).

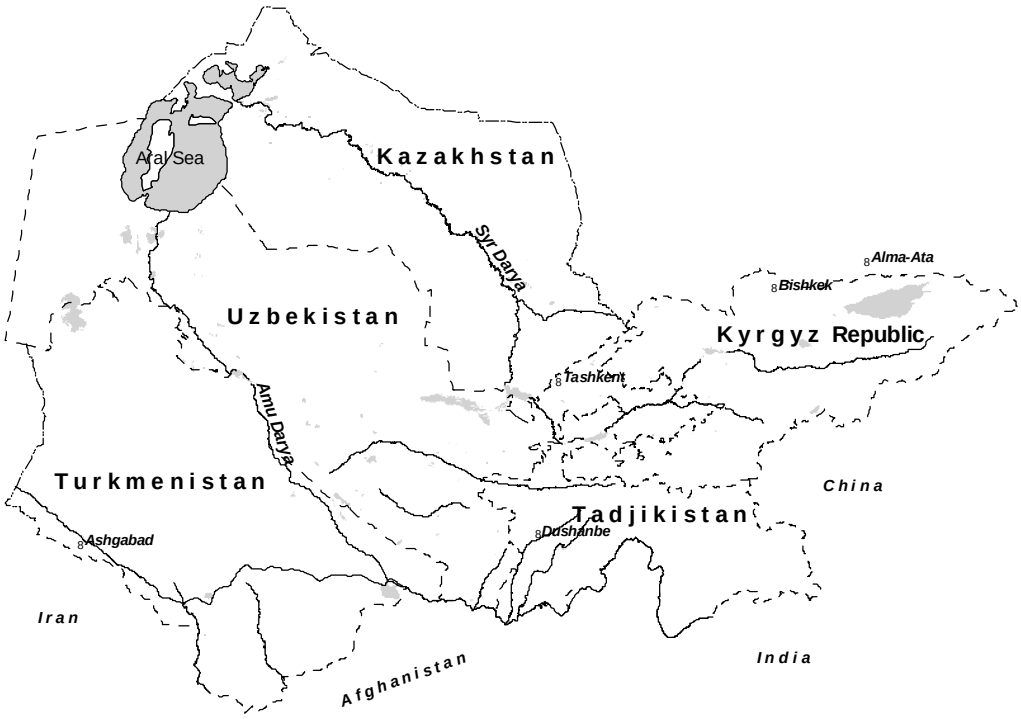


Figure 1. The Aral Sea Basin

1.1. Hydro-geographical Characteristics

The total area of the basin (within the boundaries of the former Soviet Republics; Afghanistan, Iran and China were not included in the recent case study) is about 158.5 million hectares (see Table 1). This territory extends between longitudes 56° and 78° east, and latitudes 33° and 52° north. The territory of the Basin has two main morphological zones: the Turan plain (central and western part) and mountain zone (to the east). The Kara Kum desert covers the western and the south-western parts of the Aral Sea Basin within the Turan plain, and the Kyzyl Kum desert the northern part. The mountain area includes the Tien Shan and Pamir ranges, with the highest peaks above 7000 meters. The remaining part of the basin is composed of various types of alluvial and inter-mountain valleys, dry and semi-dry steppe.

A specific feature of the region from a hydrological point of view is the division of its territory into three main zones of surface runoff: (a) the zone of flow formation (upper watersheds in the mountain areas to the south-east), (b) the zone of flow transit and its dissipation (central part), and (c) the delta zones (to the north-west).

The climate in the region is sharply continental, mostly arid and semi-arid. Average precipitation (concentrated in the spring and winter) is about 270 mm, varying between 600–800 mm in mountains zones and 80–150 mm in desert regions.

Table 1. Territory of the Aral Sea Basin in the newly independent states

Country	*Area of the country*
Kazakhstan*	34 440 000
Kyrgyz Republic*	12 490 000
Tajikistan	14 310 000
Turkmenistan	48 810 000
Uzbekistan	44 884 000
Afghanistan*	3 600 000
The Aral Sea Basin	**158 534 000**

* Only provinces within the Aral Sea Basin are included.

1.2. Water Resources

Two main rivers cross the Aral Sea Basin from the south-east to the north-west: the Amu-Darya and the Syr-Darya. They lead into the Aral Sea, which until 1960 was the world's fourth largest lake in area, but has since declined precipitously. The Amu-Darya is the biggest river in the region in terms of water availability, and the Syr-Darya is the longest. The Zerafshan river, once a tributary of the Amu-Darya, is located between them. The total available surface water resources in the basin are estimated as 116.5 km^3 per year (see Table 2).

Table 2. Total natural river flow in the Aral Sea Basin (multiyear flow, km^3/year)

State	*River basin*		*Aral Sea Basin*	
	Syr-Darya	*Amu-Darya*	*km^3*	*%*
Kazakhstan	2.426	–	2.426	2.1
Kyrgyz Republic	26.850	1.604	28.454	24.4
Tajikistan	1.005	55.73	56.735	48.6
Turkmenistan	–	1.53	1.530	1.3
Uzbekistan	6.167	5.056	11.223	9.6
Afghanistan	–	14.50	14.500	12.4
Iran	–	0.86	0.860	0.9
China	0.755	–	0.755	0.7
Total Aral Sea Basin	**37.203**	**79.280**	**116.483**	**100.0**

It is important to emphasize that most of the former tributaries no longer flow into the main rivers (Amu-Darya and Syr-Darya). Among them are the Chu, Talas, Assa, Bugun, in the Syr-Darya basin, and the ab, Tedjen, Zerafshan, Kashkadarya in the Amu-Darya basin. The main transboundary rivers are the responsibility of the regional organizations. Tributaries and other small rivers are under national water authorities.

Renewable resources of groundwater are located in 339 aquifers with total reserves of 43.49 km^3, of which 25.09 km^3 are in the Amu-Darya basin and 18.4 km^3 in the Darya basin. The actual (year 2000) water abstraction from aquifers is 11.04 km^3/year, though in 1990 it exceeded 14.0 km^3.

Recycled water is an additional source of water but, due to high mineralization, it is also asource of pollution. About 95 percent of this water comes from collector-drainage and the rest is municipal and industrial wastewater. The recycling rate increased with the development of irrigation and reached its peak between 1975 and 1990. Since then it has stabilized, and in the period 1990–9 it varied between 28.0 and 33.5 km^3/year (13.5–15.5 km^3 in the Syr-Darya basin and 16.0–19.0 km^3 in the Amu-Darya basin). More than 51 percent of this water is released back to the rivers and 33

percent into natural depressions. Due to its polluted state, only 16 percent of this water is used for irrigation.

Hydrological data on the basin is made available to the basic users. Hydrometric monitoring, as well as meteorological data collection at basic weather stations, was organized at the beginning of twentieth century, and reached its most advanced level in the mid-1980s. However, in the 1990s, because of widespread economic destabilization, this system declined; there are now only 384 climatic stations and 273 hydrometric posts, whereas in 1985 there were more than 800 posts. The water quality is registered only at 154 points.

1.3. Land Use

The prosperity of Central Asia, an agrarian region since ancient times, has always been very closely interrelated with land use. The fertile soils were the basis of the prosperity of the rural population. Out of the total land resources of about 154.9 million hectares some 59.4 million hectares are considered to be cultivable, of which only about 10.1 million hectares (see Table 3) are actually used. Half of the actually cultivated lands are located in the oases (which are naturally drained, with fertile soils). The other half of the land requires a complicated and expensive set of reclamative measures, including not only drainage and leveling, but also improvement of soil structure. The total irrigated area is about 7.9 million hectares in former NIS states and close to 0.5 million hectares in the Afghan part of the Aral Sea Basin.

A peculiarity of land conditions of Central Asia is the salt effect caused by natural conditions (initial salinity) – inefficient natural drainage, pressure mineralized groundwater, high loss from evaporation, and the high capillary capacity of soils – and also by anthropogenic conditions (so-called "secondary salinity"), which have increased the amount of mineralized groundwater through irrigation and lack of drainage. From Table 3 it is clear that almost forty percent of irrigated lands are affected by salt. This feature has some important consequences: the yield of irrigated crops depends upon the degree of salinity and it is necessary to leach saline lands by additional water annually or periodically; in the long run artificial drainage systems are needed to guarantee the release of leaching water from irrigated lands.

Table 3. Land use in the Aral Sea Basin

Country	*Cultivable area (ha)*	*Cultivated area (ha)*	*Irrigated area (ha)*	*Salt affected lands (ha)*
Kazakhstan*	23 872 400	1 658 800	786 200	218 000
Kyrgyz Republic*	1 570 000	595 000	422 000	21 500
Tajikistan	1 571 000	874 000	719 000	118 000
Turkmenistan	7 013 000	1 805 300	1 735 000	674 500
Uzbekistan	25 447 700	5 207 800	4 233 400	2 149 500
The Aral Sea Basin	**59 474 100**	**10 140 900**	**7 895 600**	**3 181 500**

* Only provinces within the Aral Sea Basin are included

1.4. Ecosystem Dynamics

The large-scale development of water resources, mostly for irrigation, has changed the hydrological cycle in the region and caused serious environmental problems in the Aral Sea Basin. The most dramatic effect has been the shrinking of the Aral Sea and disruption of its ecosystem. Other impacts have included:

- losses of biological productivity, especially of fish species in the sea, due to increasing salinity and toxic contamination

- degradation of river deltas
- deforestation of tugay forests
- transfer of dust and salts from the dried-out seabed
- lowering of groundwater levels
- desertification of the Aral Sea shores.

In other parts of basin we can see: (1) soil degradation as a result of waterlogging and salinization of irrigated land in the catchment areas of the Aral Sea Basin; (2) crop diseases and insect infestation, due particularly to the cotton mono-culture agricultural development, (3) adverse health effects due to poor water quality and wind-blown chemicals from the exposed seabed, (4) erosion of land in the upper watershed, and (5) local climate changes. A detailed assessment of social, economic, and ecological consequences of the Aral Sea catastrophe has been published in the report of the INTAS RFBR # 1733 Project.

The riparian states have agreed that the Aral Sea coastal region (the deltas of the Amu-Darya and Syr-Darya) will be considered as an independent water user whose requirements will be specified jointly by all the states. These requirements are to be defined on the basis of an approved strategy to improve the environmental situation in the coastal region, taking into account the year-to-year variability of river flows. At the same time, all the riparian states recognize the importance of environmental water requirements concerning both water quality and the preservation of biodiversity and bio-productivity of natural rivers and reservoirs.

1.5. Demographic Characteristics

The total population within the Aral Sea Basin was 41.8 million in 2000, of which almost 63.6 percent was rural (see Table 4). Rapid population growth, especially in rural areas, together with the commitment of rural populations to remaining in their native homes, exacerbated the weakest aspect of the social life of the region: demographic pressure. This particularly affected the so-called "oases," such as the Fergana valley, Zerafshan valley, Khorezm, and Gissar valley, where the population densities exceed 300–500 people per square km. This has led to unemployment, declining standards of living, and social deprivation. During the last five years the average annual population growth has been 1.5 percent, ranging from 2.2 percent in Uzbekistan to 0.4 percent in Kazakhstan.

It should be noted that in the years after the Soviet Union collapsed the national structure in the countries changed considerably due to migration of the population. There has been a reduction of many non-native groups; for instance, in the Kyrgyz Republic the number of Russians decreased from 21.2 percent to 12.5 percent, Ukrainians from 2.5 percent to 1.0 percent, Tatars from 1.6 percent to 0.9 percent, Germans from 2 percent to 0.4 percent, and Jews from 0.1 percent to 0.03 percent. It should be noted that about 70 percent of the people leaving were skilled workers, and this had a negative effect on the regional economy.

1.6. Ethnicity, Languages, Religion

Taking into account the fact that administrative boundaries between the countries were mostly established artificially by the Soviet Government at the beginning of the Soviet era (1920s), the ethnic composition in the Aral Sea Basin is very heterogeneous.

Kazakhstan has a multi-ethnic population, being composed of 130 ethnic groups, with Kazakhs and Russians dominating. The official language, Kazakh, is spoken by over 40 percent of the population. Russian, the language of inter-ethnic

communication, is spoken by two-thirds of the population, and is used in everyday business and life.

In the *Kyrgyz Republic* the majority of the population belongs to the Kyrgyzes (64.9 percent); then come the Russians, Uzbeks, Ukrainians, and Tatars (12.5, 13.8, 1.0, and 0.9 percent respectively). The languages are Kyrgyz and Russian, which under the constitution are equal official languages.

In *Tajikistan* the majority are Tajiks (68 percent), one of the most ancient nations in Asia, followed by the Uzbeks (20 percent of the population). The other nations represent about 12 percent. The Uzbek part of the population is located mostly in the north-western part of the country. The Eastern Pamir is settled by Kyrgyzes. Some Kazakh and Turkmen groups are located in the southern and south-western parts of the country. Generally there are about 100 ethnic groups in the country. The official language is Tajik (Farsi), and Russian is the language of inter-ethnic communication.

In *Turkmenistan* the majority of the population belong to the Turkmens (89 percent); then come the Uzbeks, Russians, Armenians, and others. The official language is Turkmen, while Russian is again the language of inter-ethnic communication.

In *Uzbekistan* the majority of the population are Uzbeks and Karakalpaks, who together with Kazakhs, Kyrgyzes, Tadjiks, and Turkmens are the native population and constitute 84 percent of the total population. The largest non-native group is the Russians (8.3 percent); most of them live in Tashkent, in areas surrounding the capital and in provincial centers. Uzbek is the official language, and Russian the language of inter-ethnic communication.

Table 4. The basic parameters of water-land resources development in the Aral Sea Basin (on the territory of CIS)

Indicator	*Unit*	*1960*	*1970*	*1980*	*1990*	*2000*
Population	Million.	14.6	20.3	26.8	33.6	41.8
Irrigated area	1 000 ha	4 510	5 150	6 920	7 600	7 896
Irrigated area per capita	Ha	0.31	0.27	0.26	0.23	0.19
Total water diversion	Km^3/year	60.61	94.56	120.69	116.27	105.0
Incl. irrigation	Km^3/year	56.15	86.84	106.79	106.4	94.66
Specific diversion per ha	M^3 /ha	12 450	16 860	15 430	14 000	11 850
Specific diversion per capita	M^3 /capita	4 270	4 730	4 500	3 460	2 530
GNP	Bln.US$	16.1	32.4	48.1	74.0	55.3
Including agricultural production	Bln.US$	5.8	8.9	18.3	22.0	15.0

The Soviet era of national equity has left a problematic heritage, with enclaves of different nations separated from their native countries. Enclaves of Uzbeks inside Kyrgyz territory, or of Kyrgyzes and Tadjikes inside Uzbek territory, can lead to tension, bearing in mind the close national community ties.

Religion is separated from the State in all countries of the region, but most of the population belong to various religious groups: Moslems 77 percent, Orthodox and Catholic Christians 14 percent, Protestants 2 percent, and others 7 percent.

Fortunately in the last ten years ethnic and religious considerations have never affected water allocation and water operation in practice.

1.7. Economy of the Region

Use of water resources in Central Asia, mainly for irrigation, began more than 6,000 years ago. In pre-revolution times Turkestan, and in the Soviet era Central Asia, were developed mainly as sources of raw materials and as agricultural appendices of the federal state. This was reflected in low levels of processing industry in the region, and a concentration on industries to support agriculture, with a strong dependence on the metropolis. Intensive use of water resources started in the twentieth century, especially after 1960, driven by fast population growth and intensive development of industry and, in particular, irrigation. Such one-sided development, with no processing of agricultural production into final products taking place within the region, caused a rapid increase in water delivery from rivers total water diversion in the Aral Sea Basin in 1960 was 60.6 billion m^3, and by 1990 it had risen to 116.271 million m^3 (that is, by 1.8 times). Over the same period the population in the territory had grown by 2.7 times, the irrigation area had increased by 1.7 times, agricultural production by three times, and gross national product by almost six times (see Table 4). Understanding of the negative ecological consequences in the 1980s, together with the general economic depression that followed the disintegration of the Soviet Union in 1991, led to a fall in total use of water in the region. After 1994, as a result of the coordinated water saving policy accepted by Interstate Coordination Water Commission (ICWC) of the states of Central Asia, the target policy was to decrease the common water intake. In 2000 general water intake was 11.2 km^3 less than in 1990 and stood at 105 km^3.

During the last three decades of the Soviet era (1960–90), irrigated agriculture and the sectors of economy related to water management (preparation and initial processing of agricultural products, hydropower, construction and some others), contributed more than 50 percent to the GNP. The collapse of the former USSR and the unified currency (Russian Ruble) zone caused shocks to the economies of Central Asian countries as well as of all other NIS states. The severe disruption of production, trade and financial relations were the main reasons for the drop in general output, and agricultural output especially. Uzbekistan experienced the smallest output decline among the Central Asian countries, as well as the shortest period of contraction: five years, compared to six years in the Kyrgyz Republic, seven years in Tajikistan and Turkmenistan, and eight years in Kazakhstan in the ten years of market reforms that followed (1991–2001). During this period, Uzbekistan's GDP fell back to the level of the early 1980s, while in Tajikistan and Turkmenistan it slumped to that of the beginning of 1960s or even earlier, in Kazakhstan to the late 1960s, and in Kyrgyz Republic to levels seen at the beginning of the 1970s. Corresponding to the general decline, the overall contribution of agricultural production to the GDP now ranges between 10 percent (Kazakhstan) and 46 percent (the Kyrgyz Republic) (see Table 5).

It should be emphasized that in all countries agricultural output fell less than GDP and much less than industrial output. As a whole, in Central Asia, changes in agricultural production related to an increased share of food crop output (again, except in Kazakhstan). Further reforms, with more price incentives to the farmers and a better legal framework for land and water use, are important to promote labor productivity and better living standards for farmers and the rural population in general, who make up the majority of the population (63 percent) in all countries within the Aral Sea Basin. Despite the relative decline of agriculture's share, it still plays a significant role in the Aral Sea Basin, especially in the Kyrgyz Republic, Tajikistan, and Uzbekistan. It is also important in Turkmenistan (cotton and wheat) and Kazakhstan (grain). Independence after the Soviet Union's collapse (August–September 1991) was accompanied by a serious social threat to the majority of the population in the region. Thus, Central Asia, despite a high level of human development and social services, now has poverty levels comparable to some African countries and is on the same level as in Pakistan and India.

Table 5. Changes in the economic situation during the transition period

Country	*GNP per capita (US$)*		*By Sectors of Economy, %*					
			Industry and construction		*Agriculture, forestry and fishery*		*Service sector*	
	1990	*2000*	*1990*	*2000*	*1990*	*2000*	*1990*	*2000*
Kazakhstan	2 310	1 493	36.1	34.2	28.0	21.3	35.9	44.5
Kyrgyz Republic	1 240	365	35.9	30.4	34.6	34.1	29.5	35.5
Tajikistan	910	321	33.7	27.9	27.1	23.8	39.2	48.3
Turkmenistan	1 490	820	33.6	35.1	28.6	17.9	37.8	47.0
Uzbekistan	1 700	985	32.5	19.9	31.3	34.0	36.2	46.1

Since the rural population was heavily dependent on irrigation, the water deficit had a severe impact on the social situation in some parts of the region. The last two years of water scarcity (2000–2001) caused social tensions and the migration of parts of the rural population from the lowlands of the Amu-Darya.

1.8. Some Historical Background to Current Challenges

Generations of peoples living for centuries and even millennia in the harsh arid and semi-arid climate across vast territories of the Turan lowlands, as well as in adjoining surrounding mountain and sub-mountain ranges, associated their existence, development, and welfare with water. The expression "Water means life" is more than just a slogan for the peoples of Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan, as well as Afghanistan, Sinthziang, and Iran. For them it is the reality that determines whether people can survive and prosper or are doomed to hunger and misery, or sometimes death. It is no accident that the development of irrigation in the region has been closely related to the progress of civilization, as this had been the case with ancient cultures that emerged at the same time (sixth to seventh millennia B.C.) in Egypt, China, Mesopotamia, India, and Central America. Central Asia was the motherland of many scientific discoveries connected with the need for water flow forecast, management, and use (algebra – Alkhorezmi; astronomy – Abu Ali ibn Sino, Ulugbek, and others). The relationships among Central Asian nations are rooted in deep traditions and a mutual, interrelated historical background that unites Central Asian nations into one family, heavily dependent on water use. Agriculture, for the most part irrigated, cattle breeding, fishery, household and industrial water use have always been crucial for the livelihood of the 70–80 percent of population who live in rural areas. From time immemorial, a way of life that was determined by the water factor stimulated the elaboration and strict observance of key principles of oriental and later Islamic water law (sharia) norms which reflected legal regulations of Zaroostrism (the code of law known as *videvdat*) as well as centuries-old traditions and behavior patterns. This legal and customary framework included such provisions as communal ownership of irrigated land, and particularly of water; compensation for damage caused by water use or by actions affecting water; prohibitions on pollution of natural water sources; water law linked to irrigated lands; and common participation in all activities connected with maintenance of water systems, as well as flood control and managing other water-related disasters.

Before the nineteenth century this region saw the rise and fall of independent states such as Ariana, Baktria, Merv, Sogdiana, Bokhara, Khorezm and others, which never had problems relating to the allocation of water.

The colonization of Turkestan by Tsarist Russia left local water law unchanged, especially as it applied to communal participation in works related to the operation, maintenance, renovation, and rehabilitation of irrigation nets. The institution of "aryk aksakals" and "mirabs" – water managers elected by communities – was put on a sound basis.

Seventy years of Soviet power changed these principles by creating a strict and rigidly controlled system of centralized water management that worked in a top-down manner. Some of the systems that were managed accordingly to hydrographic boundaries included:

- water management of the Zarafshan river valley
- administration of the Amu-Darya downstream canals
- administration of the Kirov main canal.

This system made it possible to deliver and allocate water successfully by means of a huge water infrastructure with vast operational costs, covered at the expense of the federal government at inter-farm and up to on-farm levels, and which also included drainage. But this water system suffered from two immense shortcomings. First, the opinions of water users and consumers were not taken into consideration; as a result, the transition of agriculture and the Central Asian economy in general to market principles showed many water users to be insolvent and not self-sufficient. Second, environment considerations were largely ignored in favor of the needs of water users; hence ecological and sanitary requirements, along with the environmental needs of deltas, Priaralye, and the Aral Sea itself, were ignored and the scale of the problems was understated.

Some aspects of Soviet heritage, however, have had positive influences on current and future development of the region:

- In the period from 1960 to 1980 the so-called "integrated development of the Hunger Steppe deserted lands" was initiated, followed by other schemes, including the Karshy, Djizak, Syrkhan-Sherabad, Kyzylkum, and Yavan-obik projects, among others. These projects increased water demands enormously. Drainage systems were developed concurrently with irrigation; large numbers of settlements, productive enterprises, roads, and communication systems were constructed. Long before the worldwide campaign for integrated water resources management was launched, these works had given regional water specialists and economists the opportunity to understand the advantages of this advanced technology, and to gain experience in a type of operation and management that is nowadays spreading across the world.
- High levels of water education, science, and skills combined to provide a secure basis on which to develop significant potential among specialists engaged in water management.
- The teamwork of water specialists of the former Soviet Union republics – working under a single leadership in one system that followed similar standards, rules, methods, and approaches – created the right conditions for sustainable work by future generations: their aspiration has been to keep the coordinated approach that was formed in Soviet times.
- For six to eight years before the USSR's collapse, the Soviet government paid more attention to plans for improving the situation in the Aral Sea Basin, and this led to approval of the "State Program on Priaralye" in 1986, the creation of Basin Water Organizations (BWOs), and allocation of huge investments into various projects, particularly into water supply and social improvements (see Figure 2). These provisions had an immense inertial effect, ensuring smooth operation and transition of water management from the former political formation to a different

one – from imperfect socialism to other forms of primary accumulation of capital with various degrees of transition accomplished in different countries.

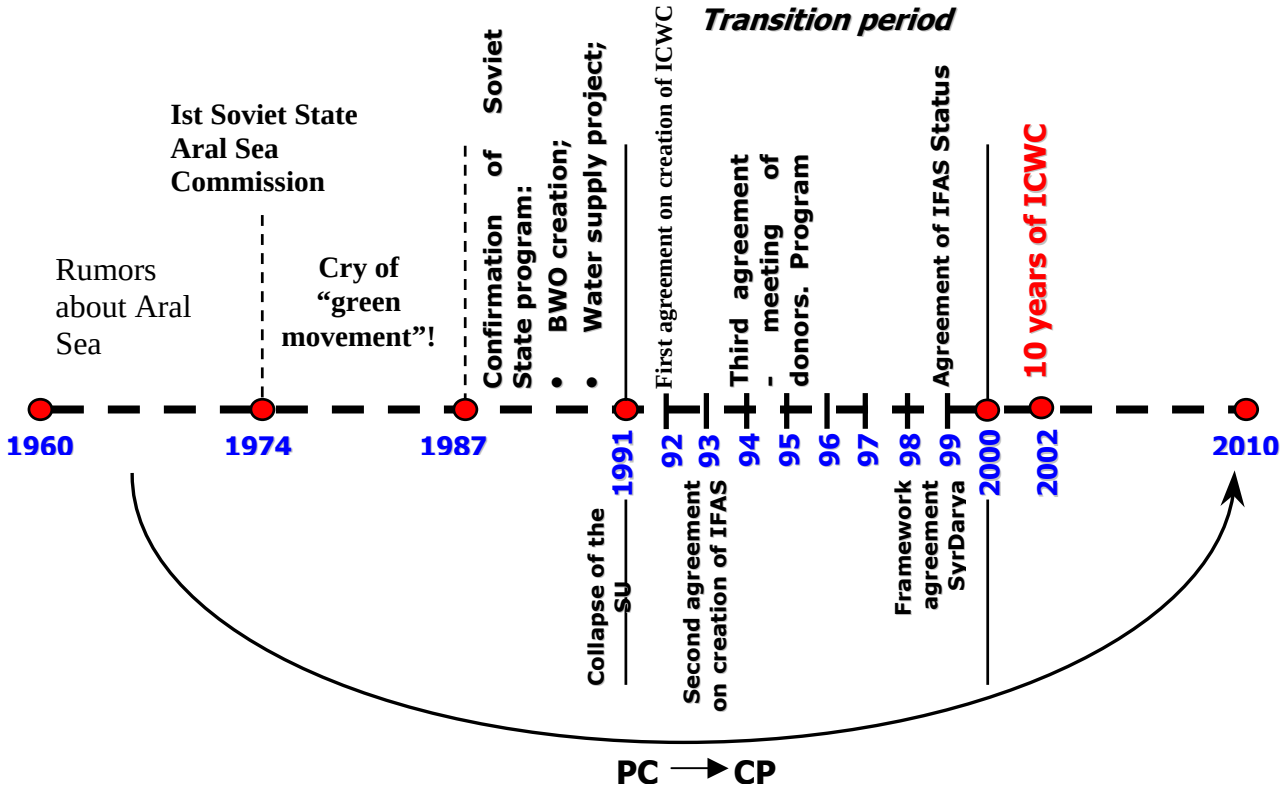


Figure 2. Chronology of the Aral Sea Basin events

2. ANALYSIS OF PRESENT SITUATION

2.1. Scenarios of National Development

Natural, historical, and geographic conditions should be analyzed to show clearly the unequal distribution of natural resources between the new independent States. The principal inequities are the following: the states of the upper watershed are wealthy in water resources per capita; the states in the lower and middle part of the basin are rich in land and mineral resources, which are lacking in the upper watershed states.

Agreements among the Heads of state (of March 26 1993 and of January 11 1994) defined major milestone provisions for cooperation on transboundary waters; however there is clearly no way to preserve the desired status quo of former water allocation and use because of emerging geopolitical and economic differences in development among Central Asian countries.

The disruption of economic ties at the time of independence immediately revealed the various advantages and disadvantages of the five countries in terms of natural resources and geographic location. There are large deposits of mineral – especially fuel – resources in Kazakhstan, Turkmenistan, and Uzbekistan; these countries also enjoy sufficient land resources per capita (excluding densely populated zones in Uzbekistan). The Kyrgyz Republic and Tajikistan in particular have few mineral and land resources, but at the same time water resource formation zones are concentrated here, and these countries have powerful hydro-energy capacities. The Central Asian countries, apart from Kazakhstan and Turkmenistan, are geographically constricted with no outlet to the sea; communications are complicated, overstretched,

and expensive, thus hindering access to international food and other commodity markets. During the Soviet period their economies had been focused along raw material (agrarian) lines, and they still depend heavily on Russia for all kinds of industrial products.

Trends in economic development have also differed drastically from country to country. Kazakhstan, for example, has moved towards complete freedom of market relations, with very little interference by the state, and little state support for various branches; the great majority of the economy, including land, has been privatized and self-financing principles have been introduced into all sectors (the water sector included). In Uzbekistan and Turkmenistan, in contrast, there has been very strong regulation by the state of all suchrelations and only a gradual transition to purely capitalistic approaches. The Kyrgyz Republic and Tajikistan have adopted intermediate positions.

All these factors resulted in the transformation of previous policies and agreements, which had to be adapted to the real dynamics of the states' formation in a new economic and geopolitical situation. They led to various deviations from approaches and management principles that existed in Soviet times:

- The Kyrgyz Republic, due to its lack of fuel resources, started to use the Naryn cascade, part of the infrastructure created in the Soviet times, in order to gradually replace expensive organic fuel by cheap electric energy. With this objective they changed the mode of the Naryn's regulation from an irrigational (accumulating water in winter and releasing it in summer) to a hydro-energy function (accumulating water in summer and releasing it in winter). To ensure continuation of the former fuel provision system from its neighbors, Kyrgyz Republic offered rather crushing sale terms for summer electric energy in return for barter gas and coal supplies from Kazakhstan and Uzbekistan at dumping prices. In the 1998 Agreement between Kazakhstan, the Kyrgyz Republic, and Uzbekistan these new "rules of the game" were accepted but, due to conflicts of interests between energy and fuel suppliers, this agreement has been difficult to fulfill. This is because each of players is trying to make profit at the expense of the others and refusing to accept parity. Thus, the Naryn–Syr-Darya power stations cascade is a "prisoner" of this agreement.
- Irrigated agriculture, for centuries a priority in socioeconomic development of the region and still the basis of life support and employment for 60–70 percent of its fast growing rural population, has lost its apparent great profitability to a significant extent due to a variety of external and internal reasons. A significant factor affecting the regional water sector is the sharp fall in world prices for irrigated agriculture produce that has occurred during the last ten years: rice has fallen by 50 percent (from $300 to 150 per tonne); wheat by 40 percent (from $200 to 120 per tonne); cotton by more than 50 percent (from $1,760 to 800 per tonne). This makes irrigation unprofitable, and farmers cannot actively participate in supporting the water sector while earning incomes of $100–200 per hectare instead of the $500–1,600 they made in the past. At the same time the social value of irrigation, which together with other related sectors provides employment for 40 percent of the (mostly rural) population, remains important. Any disturbances to the sustainability of water supplies, caused by deviation from agreed schedules of water delivery, lead to immense social damage, almost to the point of disaster, as we have been witnessing for the last two years in downstream portions of the rivers. The current "order" of water-energy exchange seems unsustainable, not only because of the lack of assurances on the part of the states that they will observe the order of water distribution, but also because of artificial terms for water releases from reservoirs, which are unacceptable to the majority, combined with evident speculative prices.

- Economic weakness of economies and significant (though varying in extent) decreases in national income per capita in all countries of the region have led to a sharp reduction in subsidies and support for agriculture and the water sector, and reduced provision to agriculture of tractors, machinery, fertilizers, and chemicals. The infrastructures. of agriculture and water management have deteriorated, especially at the on-farm level, and as a result water supply and reclamation of irrigated lands has sharply declined; this cannot but affect crop yields.
- The introduction of market mechanisms into agriculture (privatization, breaking up large state and collective farm into hundreds and thousands of small farms) was not combined with the establishment of proper infrastructures for commodity production and water distribution and use. As a result vast complications emerged in providing the new private farmers with corresponding services, as well as with seed, technologies, extension services and water. An almost twofold decrease in general incomes across the region, together with a reduction of profitability by several times, led to immense impoverishment of the rural population, while at the same making it impossible for agricultural producers to protect their interests through their own strengths, as has been done by energy and fuel producers emerging on the free market. Comparison of land productivity data shows that the average for Central Asia was 1,140 rubles or over US$2,000 per hectare of arable land in 1980; this has now fallen to nearly US$700 per hectare!
- The challenges of the new situation brought new young leaders to the fore in local authorities, and these young managers are not sufficiently experienced in using real instruments for creating, managing and improving land productivity. In the past, more than half the district and province senior managers were agricultural and water specialists, but at present most local managers do not clearly realize that water is useful only then when it is within the limits of demands. All these elements, combined with inadequate ecological education, pave the way for parochial aspirations on the part of local authorities to interfere in water allocation and distribution. This hinders equitable and reasonable water allocation and causes damage to naturally complex demands for water, which become more acute during years when water is scarce.
- Shortages of funds have affected the conditions of hydromet and meteorological nets, and thus the quality of water and weather forecasts. This in turn has a clear impact on planning and regional water resources operative management. Though some donors provide support along these lines, the activities are not target oriented; they are fragmented and not always effective.

2.2. Institutions

The need to integrate water resources management at the basin level was fully understood in the period before independence. Although the centralized water allocation system of the Federal Government (the former Ministry of Water Resources of the USSR) consulted with the governments of five republics, analysis of water shortages in 1974–1975, and especially in 1982, indicated that environmentally sound and quantitatively strict water supply along a river was impossible without a single water management organization for the whole basin. Such a basin-wide organization could manage water in the rivers in accordance with the rules and schedule agreed among the republics and approved by the ministry. The framework for this organization was approved in 1987, and as a result two Basin Water Organizations were established: BWO "Amu-Darya" with headquarter in Urgench, and BWO "Syr-Darya" in Tashkent. By State Decree No. 1110 (adopted in 1987) all headworks with

water discharge of more than 10 m^3/s on both rivers were transferred to the BWOs' operation and maintenance.

It is necessary to underline some disadvantages of the above-mentioned schemes. First, there was no agreed order of allocation and use of undergroundwaters that have transboundary locations. Second, there was no agreed order or limits for return flow utilization and water quality management.

The funding for the BWOs was provided by the Ministry of Water Resources from the federal budget for operations, maintenance, rehabilitation, and development. BWO activity was organized as follows. On the basis of forecasts prepared by the Central Asian Hydromet Services, the BWO presented to the Ministry an annual plan twice a year (in March for the vegetation period and in September for the non-vegetation period). These plans had been agreed with the republics, and covered water releases from the reservoirs and water delivery to each water management region within the basin. The water share for each republic was established in accordance with water allocations, which were approved by the Federal State Planning Committee on the base of "master plans" for both rivers.

2.2.1. The New Period of Interrelations after Independence

Concerns to create a mechanism for regional collaboration in organizing and financing water resources management have arisen since independence. The Interstate Commission for Water Coordination (ICWC) was established in accordance with the "Agreement on collaboration in the sphere of joint water resources management within interstate water sources" dated February 18 1992, and approved by the heads of state on March 23 1993. The ICWC is a collective body that manages transboundary rivers and is responsible for: water allocation among countries; monitoring; and preparing preliminary assessments of proposals on institutional, ecological, technical, and financial approaches, based on decisions mutually agreed by all sides. The two BWOs (Amu-Darya and Syr-Darya), the Scientific-Information Center, and ICWC Secretariat are executive bodies of this Commission.

The ICWC took over responsibilities for water management in both basins directly from the former Soviet Ministry of Water Resources, but with appropriate changes reflecting the creation of five new independent states:

- The commission has five members appointed by the governments. They are equal in rights and obligations. They meet once a quarter to decide on all issues related to their activities and responsibilities. The decisions are reached only on a consensus basis.
- Two BWOs were transformed into the executive bodies of ICWC; in a similar way a part of the Central Asian Scientific Institute for Irrigation (SANIIRI) was transformed into the Scientific-Information Center (SIC) of ICWC to act as a think-tank for the commission.
- All issues for the ICWC meetings, in accordance with their agenda, should be prepared by the executive bodies and disseminated among the members twenty days before each meeting; this allows for preparation of comments and opinions by each country.
- The principles of water allocation that existed in Soviet times have been retained for the purpose of annual planning until new regional and national water management strategies can be developed and adopted.

The mandate of ICWC defines its main functions as follows:

- Development and implementation of annual consumption limits for each state, and operation regimes for large water reservoirs; water allocation control, taking into account actual water availability and the water-economic situation; setting

an annual water supply volume in the river deltas and the Aral Sea as well as sanitary releases on rivers and canals; operation, support and maintenance of headworks on the rivers, which are under the supervision of the BWO.

- Definition of common water management policy, and development of its main directions with regard to the interests of the population and the economies of the state-founders; rational water use, conservation, and programs for increasing water availability within the basin.
- Drawing up recommendations to the governments on the development of common price policy and compensation for possible losses connected with joint water resources use, as well as on the legal basis of water use.
- Coordination of large project implementation and joint use of existing water potential.
- Creation of a single database on water resources use, monitoring of irrigated lands, and provision of general environmental monitoring.
- Coordination of joint research to support decisions on regional water-related problems and preparation of master plans.
- Facilitating cooperation in introducing water-saving technologies, as well as irrigation methods and techniques providing improvement of irrigation systems and water use.
- Development of joint programs to increase awareness and prevent emergencies and natural catastrophes.

The mandate of the BWOs includes:

- Ensuring a timely and guaranteed water supply to water users in accordance with ICWC-established limits for water intakes from transboundary water sources. Control over releases to the deltas and the Aral Sea according to established volumes, as well as operative control over limits, interstate reservoir operation, and water quality.
- Development of plans for water diversions by main water intakes, reservoirs, and cascade operation regimes; preparation and coordination with ICWC of water limits for all water consumers in the Amu-Darya and Syr-Darya basins.
- Creation of automatic control systems for water resources management in the Amu-Darya and Syr-Darya basins; organization of measurements of the main water intakes, and provision of the required devices.
- Performance and monitoring, together with Hydromet services, of measurements on border points to ensure accurate accounting of transboundary river flow for the purpose of balancing allocations.
- Implementation of complex reconstruction and technical operation of hydro-structures, head water intakes, inter-republic canals, and automatic control systems.
- Research, design, and construction of new water structures, and reconstruction of existing structures, which are under the BWOs' administration.

The SIC of the ICWC is responsible for preparing all the technical, institutional, financial, and legal proposals in close cooperation with ministries and members of the ICWC. Those proposals should address the improvement of general activities in terms of water use and environmental sustainability, and should then be approved at ICWC meetings and submitted to IFAS.

In addition, the SIC provides the ICWC's organizations with information, maintains international exchanges, prepares and implements technical and scientific programs of regional importance, handles and updates the regional database, issues bulletins and ICWC publications, and supports the ICWC Training Center. The SIC is responsible for preparations for ICWC meetings.

The 1992 agreement provided that water allocations should be based on "existing uses of water resources" and that the two river basin agencies (BWOs) should continue to perform basin management functions subject to control by the ICWC. Subsequently, the ICWC agreed that the 1992 agreement should remain in force until a *Regional Water Management Strategy* had been formulated that responded to new realities and which outlined more objective mechanisms and principles for water allocation and rational use.

Later (in 1993), with the Aral Sea Basin Program extension, two new organizations were established. Those were: the Interstate Council for the Aral Sea (ICAS), set up for program coordination; and the International Fund for Saving the Aral Sea (IFAS), which had the purpose of raising and controlling funds. Later these two bodies were merged into one. In 1997 the following restructuring of existing interstate organizations was done:

- ICAS and IFAS were combined and re-established into the new IFAS under the chairmanship of the president of one of five states, who is replaced every two years.
- The executive committee of IFAS (EC IFAS) was established with responsibility for providing general coordination for the Aral Sea Program.

The main objectives of the IFAS Executive Committee are:

- to ensure practical implementation of the decisions of the heads of state
- to implement appropriate projects and programs on the Aral Sea Basin
- to coordinate the activities of branches located on the territories of the state-founders
- to facilitate ICWC activities
- to expand interactions with international organizations, donor countries, and ecological and other funds to enhance solutions of environmental problems
- to raise and allocate funds
- to prepare documents and IFAS Board meetings, as well as conferences and meetings of the heads of state on the Aral Sea problems.

The political level of decision in this hierarchy belongs only to the Board of IFAS. The most important issues can be decided only at the meeting of the heads of state followed by their recommendation/approval for IFAS.

In January 1994, the presidents of the five Central Asian countries met in Nukus (Karakalpakstan) and approved a Program of Concrete Action to improve the environmental situation in the Aral Sea Basin and the region's social and economic development generally. The Aral Sea Basin Program (ASBP) included eight thematic sub-programs, the first of which addressed formulation of a general strategy for water distribution, rational use, and protection of water resources. The first stage of this work was completed in 1997 by the presentation of the fundamental provisions of the water resources management strategy. As a further step, a new Global Environment Facility (GEF) Project with five components started in 1998. Component A-1 addressed the finalization of the water and salt management strategy for the Aral Sea Basin, and its activity continues today.

Finally the existing structure of the interstate organizations responsible for water resources management evolved over a considerable period (1991–1999), and the division of their responsibilities was confirmed by the heads of state in an agreement dated April 9 1999, signed in Ashgabad (Turkmenistan). These are described below (see also Figure 3, page 19).

2.2.1.1. International Fund for Saving the Aral Sea (IFAS)

The board members are the deputy prime ministers of five states. This is the highest political level of decision-making before approval by the heads of state (if appropriate).

2.2.1.2. IFAS Executive Committee

This is a permanent body that includes two representatives from each state and implements the IFAS Board decisions through the IFAS National Branches. In addition, the executive committee of IFAS, on behalf of the Board, can establish agencies for various regional projects and programs implementation. (See Figure 3.)

2.2.2. Institutional Management at the National Level

Though all the countries began from the same level in 1991, developmental trends, rates of economic transformation, and transition from the command system to a market economy have differed widely.

2.2.2.1. Kazakhstan

Kazakhstan has been a pioneer in the application of market principles to all economic sectors, including water management. Water regulation, management, and operation have already been privatized at all hierarchical levels. The whole institutional framework from the bottom to the top is self-financing, excluding the State Committee for Water Resources. Representation of the water sector in the government via the Ministry for Natural Resources, without delegation of economic and financial functions to the committee, is inadequate. Evidently, the status of the committee will be strengthened in the near future.

A big step forward will be to decrease the influence of managerial control and reinforce organizations within the eight basin water administrations covering the main basins. These organizations distribute water among water users, grant water licenses, set water supply limits and reservoir operating regimes, keep water accounts, and so on. Provinces have also Republican State Enterprises for water management (RSE) and municipal sanitation services (MSS) reporting, first, to the Committee for Water Resources and, second, directly to the Provincial Akimiyats (local governments). Both the RSEs and the MSSs use *rayon* (district) water organizations as their branches and are based on self-financing and administrative management.

Charges have been introduced for water as a resource and for organization and management of water systems, networks and structures. State budget support is provided only for works connected with water cadastre and potable water quality. Financing, both in municipal services through public associations and water users cooperatives and in irrigated agriculture through Water Users Associations, is insufficient for sustainable support of all activities, particularly drainage and water supply works. As a result a large portion of the capital stock is out of operation (almost 1,200 km of rural watercourses, a million hectares of irrigated land, and several hundred vertical drainage wells).

Although the government has proclaimed that water is public property, the privatization of some major hydroelectric power stations (HEPS) has caused problems for effective water management (Chardara dam HEPS, etc.). This situation can be fundamentally improved through partial government support of water users' associations, especially assistance for vertical drainage and rural watercourses by municipal and government shares in joint-stock companies and cooperative household and irrigation organizations. The first steps in this direction have been taken by governments through some loans from the International Bank for Restructuring and Development (IBRD) and the Asian Development Bank (ADB) for rehabilitation of

drainage and irrigation systems with proper government guarantees and participation in cost sharing (in the Mahtaaral and Turkestan region). In the future coverage of costs by water users can be increased, while government subsidies can be decreased as agricultural profits and personal incomes increase.

2.2.2.2. The Kyrgyz Republic

The Kyrgyz Republic has adopted a more moderate development of water management: the transition to market rules is accompanied by government support for water networks' operation and rehabilitation, particularly at inter-*rayon* and inter-provincial levels. The former Ministry for Water Resources has been amalgamated with the Ministry for Agriculture to form the Ministry for Agriculture, Water Resources and Processing Industry. This state structure provides water governance through a self-supporting Department for Water Resources under the leadership of a deputy minister. This department directly controls irrigated agriculture, and this creates certain sectoral contradictions in water use. Other state structures are the Ministry for Nature Conservation, Glavgidromet (the main hydrometeorological service), the joint-stock company Kyrgyzenergo, and others.[1] Restructuring to combine state, municipal, and business property was conducted at lower managerial levels. Though the Ministry for Agriculture and Water Resources established basin organizations, their managerial functions are still based on the provincial level. The government plans to assert its right of ownership and control over various strategic structures, such as dams, reservoirs, HEPS, and main canals. At the same time it is expected to privatize water management and irrigation systems and gradually reduce the state share by establishing joint stock companies. Hydroelectric power production has not been privatized yet. However, the government are planning approaches to privatization that involve shared ownership of both large and small HEPS; at the same time, Kyrgyzstan is developing and constructing new reservoirs with HEPS, such as Kambarata-1 and Kambarata-2, using private capital and loans, including foreign investors and stockholders. Urban water supply and sanitation are also tending towards privatization and cooperative forms, with priority given to transferring operation and maintenance of these systems to private ownership.

In effect, all water management on the level of former kolkhozes and sovhozes has been transferred to water users through the creation of a network of water-user associations (WUAs). The accepted legal basis for WUAs makes it possible to transfer responsibilities from the next level (*rayon* and even inter-*rayon*) to the WUAs Federation.

A considerable shortcoming is that the Zjogorku Kenesh (Parliament of Kyrgyz Republic) has jurisdiction over price policy regulation and water tariff setting. This has politicized the economic mechanisms for water management, which are insufficiently flexible and incapable of maintaining water and irrigation systems at an appropriate level. Though state legislation has solved most legal issues concerning WUAs in advance, a range of issues on their establishment and functioning has not been settled in legal or institutional terms.

2.2.2.3. Tajikistan

Tajikistan manages the water sector through the Ministry for Water Resources. The country has been slow to adopt privatization due to four years of war, but at present is developing in the same way as the Kyrgyz Republic. The principal difference is in irrigated agriculture since the government canceled its financial support and is now trying to keep collective farms as a basis for the cooperative development of private initiatives and for support of irrigation systems. Although a new code adopted in 2000 declared renovation of capital stock in the water sector as one of the main areas for improvement, much remains to be done here. First, while seeking ways to restructure

agriculture, one should take into account the shortage of irrigated lands (only 0.10–0.12 ha per capita). Under such conditions privatization of the water sector and agriculture must meet principles of social equality. Particular features of Tajikistan's policy are licensed water use on a chargeable basis, and rights granted on a tender basis to manage waterworks within irrigated area through contracts between *khukumat* (local administrations) and water users. There is also a need for a transition to water management on a hydrographic basis in view of intersectoral interests and possible privatization of other water-using sectors, such as hydropower engineering, communal services, and recreation. The country has major interests in the privatization of the biggest HEPS, among them the Ragun and Dasht & Djun .

2.2.2.4. Turkmenistan

Turkmenistan has a specific approach to water as a public social resource. This is reflected in management structures. The main water-related managerial organ is the Ministry for Water Resources. The government has retained direct control of water management in all sectors, including irrigation, water supply, and hydropower. Water, electricity, and gas are free of charge for the population. Consumers only pay if they exceed the established limit, in the form of a fine for irrational use of natural resources. There are some options for privatization in irrigated agriculture. This can be done in the form of concessions that ensure fulfillment of a government requirement for certain crops; any produce beyond the required level can be sold at market prices. Private water supply and sanitation services are also possible in the water supply sector, while in hydropower privatization of small hydroelectric stations is allowed.

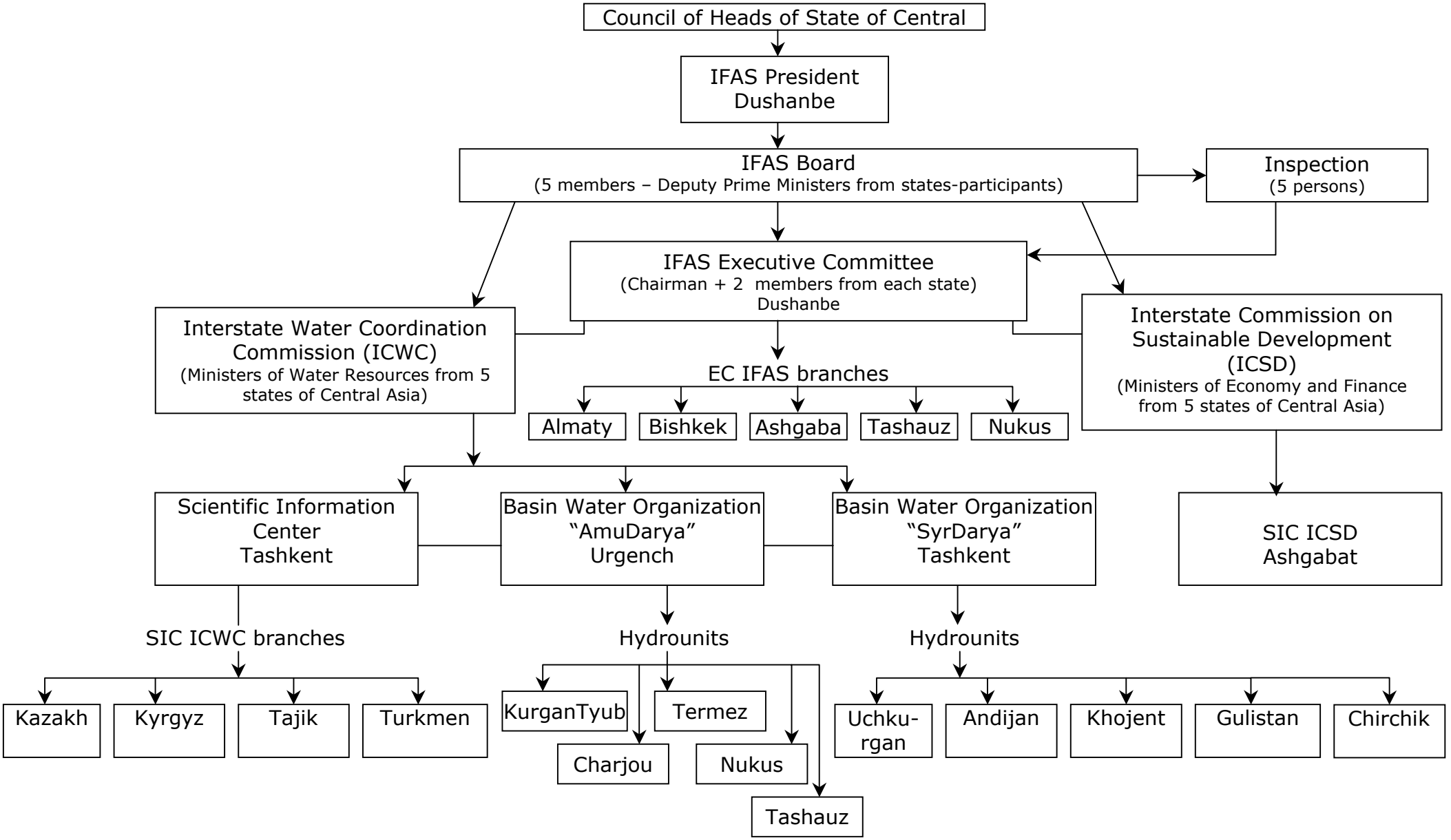
2.2.2.5. Uzbekistan

Uzbekistan is gradually moving to a market economy in the water sector, as well as in other economic sectors. At the same time it keeps substantial budget subsidies to ensure the sustainability and maintenance of the huge capital stock created previously. However, the situations in water supply, irrigation, and hydropower are different. In the water supply sector, the trend has been towards transfer of services to cooperative organizations and joint-stock companies. The government controls the hydropower sector, apart from small hydroelectric power stations. The government proposes to privatize the latter on a small to medium scale, and to construct new HEPS through public investment. It will enable the private sector to develop micro and small HEPS. It has now been decided to reform the power engineering sector by separating power generation from power transportation.

Irrigated agriculture presents a more complicated problem. The government plans to change the water governance system from one defined by administrative boundaries to one respecting hydrographic ones. In these conditions the water user associations organized at the lower level of hierarchy (former collective farm) should be responsible for water delivery, operations, and maintenance of irrigation and drainage systems. In some cases amalgamation of their responsibilities is possible during privatization of *rayon* water organizations. Transfer of irrigated lands to private companies through concessionary contracts also takes place as in Turkmenistan.

Priority is given to the future transition to basin and system water management subordinated directly to the national level, to the involvement of water users, and to the introduction of integrated management principles similar to French and Spanish models.

Figure 3. Structure of International Fund of Aral Sea



Some significant questions of institutional importance that need to be explored in more detail relate to public participation, public awareness, and the influence of local (administrative and municipal) bodies on water allocations. Although in the Soviet era the water management organizations were mostly closed to public participation, the situation has since changed to a considerable extent, but not to the same degree in all states. More broad, open public awareness of water and land issues has been found in Kazakhstan and the Kyrgyz Republic, less in the other three states.

At the transboundary level, much information can be discovered in the interstate newspaper the *Times of Central Asia* (published with the assistance and leadership of the Italian Government in Bishkek). The ICWC publishes a quarterly *Bulletin of the ICWC* with information about ICWC activity in Russian and English, which is available in paper form or by e-mail, while the IFAS puts out a fortnightly bulletin by e-mail, mostly at the national level and to NGOs who are registered to receive IFAS or ICWC communications.

Some NGOs disseminate this information among their local recipients on a lower level. Around the region, more than 160 NGOs are registered as recipients of ICWC. Unfortunately, with some exceptions, information related to water and other natural resources does not have a high profile at national, provincial or even local levels.

Public participation has, strictly speaking, only taken place at the lowest level: that of WUAs. This is the case in Kazakhstan and the Kyrgyz Republic, while some preliminary steps have also been taken in Uzbekistan and Tajikistan, but not in Turkmenistan. The strategy prepared by the ICWC envisages public participation developing from the basin level through the medium of basin committees, which should bring together representatives of different provinces, economic sectors (especially hydropower, ecology, agriculture, and water supply), along with government bodies and NGOs. Some proposals in the form of the interstate agreements were suggested by IFAS and ICWC.

2.3. Legal Basis

Water relations need a new interstate and national legal basis, because the rivers in the region are now transboundary resources. Independence and the transition to a market economy also require new juridical regulations. The Central Asian states responded quickly to the need for a new legal basis for water allocation and management. On September 12 1991, the water ministers of five countries declared that joint water resources management would be established on the basis of equity and mutual benefit. To overcome the inherited inter-regional water problems and minimize ethnic tensions, the five Central Asian countries signed an interstate water agreement on February 18 1992. Under the terms of this agreement about water resources management in the Aral Sea Basin, water allocation was to be based on the existing use of water resources, and the two river basin authorities should continue to perform basin management under the control of the Interstate Commission for Water Coordination. All the water resources of the region (surface, underground, and drainage) are classified into either transboundary (interstate) resources, which are located on the territory of two or more countries, or national ones, located on the territory of one country and not interacting with transboundary water courses.

Each state has the right to manage the national resources on its own territory and also part of the transboundary water (within limits agreed with other countries) providing it does not damage the resource. The Aral Sea and its deltas have been defined as an independent water consumer that has its own water quota. Transboundary water is in the common ownership of all the countries and its development, protection, and use are to be carried out on the basis of interstate agreements by the inter-regional bodies, in response to national requirements and regional interests.

Existing documents do not ensure proper water use and control. This is due to the fact that the existing framework agreements do not cover all the issues of joint transboundary water management in Central Asia. Water flows to the Aral Sea are not secured, emergency conditions are created, and water use is still inefficient. Therefore, legal protocols should be developed to improve joint water use in the Aral Sea Basin.

Specific issues are related to national water laws. The original water law of the five countries was based on the principles of Soviet water law, but national legal regulations have developed in steadily different ways and directions. The most market-oriented legislation is found in the Kyrgyz Republic and Kazakhstan. They separated issues related to WUAs from water law, while Turkmenistan and Uzbekistan have preserved state regulations that create many obstacles to the implementation of market mechanisms. Discrepancies in national legislation create various conflicts with international water regulations at the interstate level. For example, a special law of the Kyrgyz Republic requires other countries to pay for water that the republic exports to them.

2.3.1. Correlation with Principal International Water Laws

Unfortunately, international water law cannot serve as a good guide for the definition and elaboration of new legal regulations in the Aral Sea Basin; in the most important aspects, the interested states have been unable to find clear recommendations in the main documents relating to water law. Two conventions (the ECE/UN Convention of 1992 and the UN Convention of 1997), which contrast with the Helsinki Rules of 1966, cause confusion in understanding particular principles for specialists from the region. The following questions remain unanswered:

- What is the subject of joint actions of the riparian countries: a watershed (as in the Helsinki Rules), transboundary water resources, or an international watercourse? From the hydrological viewpoint, the notion of a "watershed" conforms to the principles of integrated water resources management (IWRM). It requires common basin (not river) management. The notion of "transboundary water resources" (Convention ECE/UN 1992) is more narrow, and the notion of an "international watercourse" (Convention UN 1997) is incomprehensible and is complicated from the hydrological point of view.
- What are the criteria for "equitable and reasonable" water use, which should make it possible to formulate principles of water allocation among countries?
- The conventions do not preserve the principal provision of international law: "not to cause harm." Also neither convention contains "previous water use" as a factor of water use, which was presented in the Helsinki Rules.
- What are the rights of present water users if limited development or degradation of rivers, deltas, and water bodies has previously damaged them?
- Why do these documents shift their terms from *any* damage to *sensible* damage and then to *significant* damage? The parameters of *sensibility* or *significance* are not defined. What should be agreed if the damage has been already caused by previous activities?

Those points could be given as recommendations to states about how they should approach principle of water allocation by taking into account equity, parity, "do no harm," and so on.

2.3.2. Legal Doctrines

Joint activities within a framework of legal documents and regional cooperation face a range of problems in representing different views that create obstacles to successful development of such activities:

- Upstream countries insist on revising former interstate water quotas in view of the restrictions imposed on their development, while downstream countries try to keep the status quo.
- Upstream countries are particularly interested in increasing use of water for hydroelectric purposes, and insist on schedules of releases from main reservoirs that are favorable to themselves, or demand compensation from downstream countries.
- Downstream countries do not cover the costs of stream-flow regulation, since in their opinion this regulation does not meet their interests.
- All the countries have declared in their laws a right of sovereignty over their water resources, forgetting that most (or a substantial share) of these waters relate to transboundary rivers or international waterways and are subject to special considerations.
- The countries, particularly upstream ones, do not want to recognize rules of the international water code such as "do not harm" and "polluter pays."
- All the countries in practice ignore environmental problems, including in-stream requirements.

In the meantime it is necessary to shift from clearly opposed positions to a search for mutual compromises and to the creation of a legal basis that takes account of the states' concept of "absolute territorial integrity." There is no other way for Central Asian countries.

2.4. Financial Aspects of the Water Sector

Water management activity in the Central Asian states is funded by state budgets and by payments for water services. In different countries the state contribution to water management varies between 40 and 100 percent. Actual costs for operation in all countries of the region are not more than 50 percent of the amount needed for proper maintenance (see Table 6).

Water charges could be conditionally divided into three elements:

- payment for water as a resource
- payment for services on water delivery to farm boundaries
- payment for services connected with the operation and maintenance of irrigation and drainage networks.

The amount charged varies in different countries, depending on government policy and state participation in water management sector support and development, water resources conservation, pricing policy for agricultural production, and so on. All kinds of water users except agricultural ones pay for water as a resource. The payment, as a rule, is symbolic. Water users who pay for water are industrial enterprises, power stations, material enterprises, and the like. These enterprises pay in accordance with the established rate for the current year, which depends on user category and water source (surface or underground). Water services for irrigation water are payable in Kazakhstan, the Kyrgyz Republic, and Tajikistan. In Uzbekistan and Turkmenistan irrigation consumers pay only for excessive water use beyond a set limit.

Table 6. Actual operational costs of water management in Central Asian countries and their conformity with demand

Indicators	Kazakh-stan (south)	Kyrgyz Republic	Tajik-istan	Turkmen-istan	Uzbek-istan
Needed operational costs	32.0	115.50	117.0	2 139.0	575.0
Actual operational costs,	1.6	5.28	9.75	39.8	392.0
including:					
budget financing	0.32	3.40	7.10	39.8	392.0
water users' fee	1.28	1.88	2.56	–	–
Actual operational costs as % of demand	5.0	4.60	8.30	18.8	68.1
Specific needed costs, $ per ha	111.3	108.90	162.00	127.9	137.0
Specific actual costs, $ per ha	5.6	5.00	13.50	24.0	93.3

Note: All figures in million $US.

Services for maintenance and repair of the on-farm irrigation and collector-drainage network could by provided by state water divisions or by associations of water users (WUA). In all cases the water users pay for these services.

In Soviet times capital investments in the water sector, including water resource conservation and land reclamation, were funded by the federal government as well as republican budgets. The current financial status of the Central Asian states has led to a reduction of investment in the water sector. It is worth noting that investment rates differ sharply for different countries depending on government commitment and financial status.

The agricultural sector in all of the countries needs state support or subsidies. This can be justified in cases where the state regulates the price of the main agricultural products such as cotton and grain, which are sold to the state for fixed prices which are lower than world market ones. All the Central Asian states recognize the need to charge for water. Payments for water use not only solve the economic problems of water organizations, but facilitate better management, rational water use, and water saving in all branches of the economy.

All the states need to decide on legally enforceable charges for pollution. The level of pollutants released in water sources needs to be determined by interstate agreements with sanctions applied to particular states when these limits are exceeded. Provisions for payment for pollution, release of substances at higher than permitted concentrations, excessive water use, restrictions on water transfer, and similar regulations should be coordinated by interstate agreements that set criteria for water allocation and use, and are based on the following well-known principles:

- the previous user presumption
- the "do no harm" rule
- equitable and reasonable water use.

At the national level it is proposed to establish charges for waste produced by non-irrigation consumers related to pollutant concentration. Using funds raised by fines for

release of pollutants to the rivers and tributaries in excess of permitted limits, or for exceeding the permitted concentration of toxic elements, it is hoped to create national ecological water funds to finance "clean technologies" and improve the ecological state of rivers and water bodies.

Water users who have licenses for guaranteed quantities of water could transfer (sell) any surplus part of their quotas, or the entire quota, to other users in mutually beneficial transactions. The main factor that could make this possible could be the use of water-saving technology. This method could be especially effective at WUA level. In the Kyrgyz Republic, in particular, official government policy predicates that, where use of irrigation water is reduced by using up-to-date technologies, the WUA has a right to sell the saved water at market prices. Trade rights should be provided to water-related organizations that invest in water-saving measures and additional water resources involvement. Other prospects for promoting water saving at the WMO level entail bonus payments to staff of the organization related to permanent expenses per cubic meter of water delivery cost.

Contrary to the provisions of existing law, which ignores public participation, new laws should initiate the creation of public bodies of stakeholders for the institutional and financial framework of water management.

Common tasks for developing economic mechanisms for the water sector and for implementing them at the interstate level are as follows:

- to provide sustainable mechanisms for financing and maintaining interstate water resource management systems and interstate bodies
- to create incentives for all states and water users to conserve water and to ensure it is available to meet environmental needs
- to apply the "polluter pays" principle in practice
- to create a mechanism to balance benefits and costs at the level of interstate water distribution and use.

There are no strict financial obligations on states to engage in joint water management and development. Although the operational budget is confirmed each year by a decision of the ICWC before the beginning of the fiscal year, only Turkmenistan and Uzbekistan have fully met their obligations to pay for operational requirements and repair work. As for research work, only Uzbekistan has fully met its obligations, with very small contributions from the other states. Attempts to facilitate the financing of reconstruction and development have met opposition from all the states' financing bodies. As a result only a small part of the required reconstruction works for hydrometeorological services on transboundary rivers and for one headwork in BWO has been done.

Some new financial measures for interstate relations are now being considered or are in their preparatory phase. One of these is a proposal to share water and power supplies on the Syr-Darya river by implementing charges for the volume of water to be delivered to lowland states as a result of water regulation; the charges might be seasonal or multiyear. The amount charged per unit of water to water users below reservoirs must cover the running expenses for collecting and conserving this volume. The charge must also compensate for the "lost benefit" of water release through dams, which might otherwise have been used for energy generation. Of course, prices charged under seasonal regulation are often less than prices under multiyear regulation.

Another of these measures relates to negotiations about the creation of a "Water–Power Consortium," as a financial body that will determine more efficient options for power exchanges and allocation among users, bearing in mind the best interests of local authorities.

A third measure is to divide funding responsibilities for hydrometerological, geological, and other facilities among water users in proportion to the volumes consumed.

2.5. Technical Aspects of Water Management Improvement on the Interstate, System and Inter-farm Levels

The main technical directions for improving WM and WO relate to low-cost measures to increase the accuracy of water measuring, forecast of water flow, and implementation of set models. These will reduce operational losses and deviations from fair proportional water allocation, and also increase trust, transparency, and mutual understanding among all water management organizations and stakeholders. Measures to strengthen capacity building for those goals include those discussed below.

2.5.1. Improving the Accuracy of Water Measurement and Forecasts of Water Resources

As was mentioned earlier, the number of measuring points on the rivers – and of those monitoring snow melting and ice melting contributions to flow – has fallen drastically. Even such important observation points as monitoring stations on the Fedchenko and Abramov glaciers, which had existed since 1911, went out of operation. The rehabilitation of thirty old stations and the creation of nine new ones by the GEF Project are very important, and mark the first step towards improvement.

The big advantage of the new project is the delivery of automatic stations for measuring water quality. These will make possible not only temporary but also permanent recording of water quality in six components. A further requirement is to install equipment that has direct connections between measuring points, hydromet centers, and BWOs. To rehabilitate existing monitoring points in mountains, the SIC ICWC propose to install between five and ten remote-controlled automatic meteorological stations at such important forecast points as the Abramov glacier and Fedchenko glacier. Some progress has been supported by USAID and SDC. The required investments amount to US$7.5 million in addition to GEF Project Component "D." This work also includes snowmelt and icemelt forecast of flow formation in the upper watershed of rivers.

2.5.2. Implementation of SCADA System for BWO Structures

The lack of renovation and modernization of structures operated by BWOs over the last ten years has created a major problem for improving of the accuracy of water delivery to each state and each irrigation system. The SIC ICWC, BWOs "Syr-Darya" and "Amu-Darya," with assistance from the CIDA, prepared a feasibility study entitled "Water Resources Management and Control Systems for the Amu-Darya and Syr-Darya Basins." In the future the proposed system will help to provide the region's countries with water in accordance with quotas established by ICWC, and to develop plans for water reservoirs and water intake operation, developing systems of management, communication, and information.

For these objectives to be realized it is necessary to equip the BWOs with updated means to control and manage water systems, communications, and information transfer. As a first stage of the Dustlik canal project, headwork automatization was performed using the SCADA system, which provides automatic regulation of water level and discharge in water systems.

The system has been in operation since the beginning of 1999 and enabled annual savings of 95 million m^3 of water. With finance provided to IFAS by local governments, a similar pilot scheme was installed in 1999 on the headwork of the

South Golodnosteppe canal at the base of a former Soviet "Sigma" system. The cost of this equipment was five times less than that installed by the "Modicon" company in the Dustlik canal. Similar projects are now being supported by USAID (the Pakhtaabad canal and structures on the Chirchik river) and SDC (Uchkurgan structure on the Naryn river). To complete this project the required cost is close to US$15 million, to be financed from a range of sources, including investment from IFAS.

2.5.3. Information System

Extensive work done under the supervision of the EU in the WARMAP Program made it possible to create an information system, though only at the regional level. This includes the WARMIS database combined with Geographic Information Systems (GIS) and remote sensing data. Information systems for land and water are to be completed, tested, and prepared for use by the ICWC, IFAS, BWOs, and all water related organizations (mostly on the national and provincial levels). This work is important for socioeconomic and ecological development, more detailed development of water and land use, and analysis of river water losses. GIS has been developed by the SIC of the ICWC and Hydromet Services, but has not been made available for general use by BWOs and national organizations.

At the moment, the major task is information service creation and development at the provincial, irrigation system, and WUA levels on principles similar to the regional system, which will form a common database based on the pyramid principle with "information grids." Such development has now started for the Fergana valley, with financial support from the SDC. We expect the participation of other donors in this direction, which should increase regional collaboration.

2.5.4. The Base of Knowledge

The base of knowledge includes databases in combination with the tools for experience dissemination through the International Network of Research in Irrigation and Drainage (IPTRID) and INFO-net (the informational network of the Global Water partnership) as well as periodic publications, bulletins, press-releases, and scientific research collections. A knowledge network and information exchange system already functions within the region among the five states, and between the region and various world information centers including ILRI, USBR, Cemagref, Wallingford, ICID, and FAO. Various bulletins and periodical collections are issued to help water specialists acquaint themselves with modern worldwide methods of water resource and irrigation management.

Actual knowledge dissemination is inadequate. The focus should be put upon knowledge and information network development at the level of province, system, and WUA. A systematic base of knowledge creation is being started by the SIC of the ICWC, UNESCO's Scientific advisory group for the Aral Sea Basin (SABAS), and other organizations, national experts, and commissions on irrigation and drainage involvement. This will make it possible to create a practical knowledge base in the short term. This should lay the foundation for extension services, whose success depends on communication.

2.5.5. Analytical Tools

The program for developing model systems was elaborated by the SIC of the ICWC. This program consists of a set of models:

- river basin models
- models of a planning zone, typically adopted in each planning zone of the Aral Sea Basin

- models for national water policy that satisfy the water demands of each sState and relate to their socioeconomic development.

This set of models can be adapted to assist in the creation of a methodology and data on an interconnected base, which will support the next phase of modeling:

- for future development at the regional level as a tool in the preparation of regional water strategy
- for future development at the national level as a tool in the preparation of national water strategy
- for multiyear flow regulation by the ICWC and for BWO multiyear planning
- for annual planning of water allocation, and correction of this planning in the interests of the BWOs
- for operational tasks of water management by each BWO.

During the WARMAP-2 Project, the SIC of the ICWC together with the Water Management Authorities of all states began the elaboration of basin modeling for future development at the regional level, and modeling of planning zone and operation work for the BWOs. In addition, modeling of the basin for annual planning purposes was carried out by the SIC, BWOs, national teams, and the Energy Dispatch Center in the USAID/EPIC Program. National and regional planning models for water development in each state were worked out by a team at the SIC using the "Globsight" methodology (Prof. Messarovich) with modifications. On the basis of this, forecasts of different options for regional development for the "World Water Vision 21 Century" were prepared. The completion of this work will permit the organization of effectively controlled water management and operations in real time as tools for the SIC and BWOs and, in the future, for defining priorities of national planning for water resources development. The required investment is estimated as about US$1.2 million. A detailed description of the proposed approach to analytical tool development is presented in the Annex.

2.5.6. Elaboration of Joint Interstate Projects

Starting from 1993, the ICWC together with representatives of IBRD prepared a set of programs (seven in all), which comprised nineteen different projects. This range of immediate projects was approved by the heads of state (decision of January 11 1994) and introduced to the first meeting of donors in Paris on June 1994. Although the meeting approved this "Program of Concrete Actions," which had a total cost of US$41 million, its implementation began with just the EU "WARMAP" project and the World Bank's "Principal Provisions of Water Strategy of the Aral Sea Basin."

These two projects, which were chiefly organized by local specialists in collaboration with foreign consultants, enabled the technical staff of the WMOs from the five states to organize exchanges of opinion at roundtables and to prepare reports for development of new technology, which combined local and western approaches to water management. The most important parts of these projects were the information system (WARMIS), field survey and demonstration plots (WUFMAS), and "principal provisions of regional water strategy." It became possible to introduce an effective collaborative style of work and create the framework for future development.

Similar mutual, but less effective, projects were implemented by USAID (EPT project, EPIC project) in the fields of modeling, water–power relations, and so. The low efficiency of those projects stemmed from the low involvement of local initiatives and knowledge, and from lack of orientation towards practical results.

A number of other projects were implemented that were significantly smaller than those of USAID in financial terms (≈ $US0.2–1.5 thousand). These were generally organized on the basis of programs and contents decided by local specialists

(the SIC and BWOs), with the assistance of sponsors: CIDA, SDC, NATO, INCO-Copernicus, and others. The advantages of this kind of approach are the following:

- direct connections with the implementing agency, which participates in preparation of projects
- high efficiency of investments thanks to the low labor cost of local staff
- ability to use western "knowledge" not in theory but to assist the real work of local specialists
- orientation of the project to a principal goal that is of interest to the region
- different states working on one project develop shared viewpoints and mutual commitment to the project.

2.5.7. Water Saving: Main Direction for Regional Survival

From ancient times, water use in the region has been based on using it for the benefit of the whole of society. Historically water use was based on water saving and the prevention of pollution. Unfortunately, the traditions and customs of water allocation, use, and conservation have been partially lost. In practice, strict controls need to be established to ensure equal access to water for everybody, along with proper operation and maintenance of the water delivery infrastructure, mostly in irrigated agriculture.

Water use in the region could be improved through analysis of the best methods of water use and management under similar conditions around the world (Israel, Jordan, western states of the United States, Spain, and similar cases). The analysis of water allocation and water losses with different levels of management shows that it is possible to set a strict limit on water use for all the countries and different zones in accordance with the "criterion level of best water use." This level is very stringent, but it is necessary for the benefit of future generations.

Water conservation for all water uses and levels (user/farm–system–basin) should be based on the principle of maximum water efficiency. At the first stage this could be achieved by reducing unproductive water losses, which are estimated to amount to 20 percent of the total diverted water. Later, when the financial capacities of water users and the governments increase, more expensive methods of water conservation could be implemented. A significant factor affecting regional water and agricultural sectors is the sharp reduction in world prices for irrigated crops in the past ten years: rice two times, wheat 1.5 times, cotton more than two times. This makes irrigation unprofitable and prevents farmers from supporting the water sector. In these circumstances specific actions need to be taken on a low-cost basis (supervision of the activity of all water users, strict limits on water use, water measurement, establishment of Water Users Associations, reclamation activities on irrigated lands, better crop patterns, and similar measures). See details in Annex.

2.6. Technical Aspects of Future Development

Technical aspects of future water development relate to two major aspects. The first is the creation of ecological sustainable and economically sound systems in the deltas of the two rivers and the remaining body of the Aral Sea. The aim should be to stop environmental degradation, compensate for the damage to natural productivity caused by the artificially created system on the Aral Sea coast, and prevent social and environmental losses that affect the population living near the Aral Sea coast. The second concern is to increase of regulation of the flow of both rivers so as to improve WM and WO capacities in the interest of irrigation, power production, and the environment.

The unexpected rate at which the Aral Sea shrunk meant the loss of the water it had produced and required the governments of five NIS to decide starkly and frankly:

What is the future of the lake? "The Concept of Social and Environment Development of ASB," accepted by the heads of the states in 1994, announced openly that it was impossible to protect the Aral Sea itself, but aimed to create a set of water resources and wetlands along the populated part of the Aral Sea shore, which would make it possible to protect nature and stabilize the socio-ecological situation in the deltas. Now this task focuses on two zones. In North Priaralye the decision, financed by IBRD's so-called "North Sea" plan, is to create reservoirs in the area of the Small Aral Sea in the north with a capacity of 25 km^3 of water; there will also be stabilizing measures in the Syr-Darya wetlands and deltas. The southern parts of Priaralye should improve their profile with the creation of wetlands and lakes; the most important of these are Mejdurechye and Sudochie, and for these two projects NATO and GEF are to organize protection and partial rehabilitation of the Amu-Darya delta.

2.7. Training Systems

The involvement of NGO stakeholders in developing training systems for water specialists is one is the most important cooperative programs of the ICWC. Following an ICWC decision, and supported financially by CIDA, a regional Training Center was established in Tashkent in 2000 in collaboration with McGill University (Montreal, Canada). The main task of this center is to improve skills and, simultaneously, to bring together the viewns of specialists from different countries. Monthly courses are organized as round table discussions. Last year more than 350 specialists from five states attended three courses on:

- problems of integrated water resources management based on hydrographic principles
- regional collaboration on transboundary watercourses
- international water law.

A new course on "Innovative practice in irrigated agriculture" started at the beginning of 2002 and is expected to continue for the next six to eight months. In future it is planned to prepare a set of new courses covering:

- environmental protection issues
- problems of drinking water supply and sanitation
- problems of sustainable development of the power sector in the region
- modeling in water management and irrigation.

To improve integration and involve more participants, there are plans to organize training activities in four sub-regional centers: Dushanbe (Tajikistan) on the problem of intermountain plains and upper watersheds (supported by the World Bank); Osh (Kyrgyz Republic) on water problems in the densely populated Ferghana valley (supported by Swiss SDC and IWMI); Kyzyl-Orda (Kazakhstan) on the problems of downstream waters and rice cultivation; Tashauz (Turkmenistan) on the problems of downstream waters and Priaralye. It is planned to use these centers in combination with demonstrations in the field in water conservation and WUA development.

The Training Center (TC) is one of the fora for presenting the common opinions of interested parties on different questions of water management. When developing the TC we initiated a "round table" approach with representation (equal in status and numbers) of different states, to whom TC moderators presented different aspects, in the form of lectures and PowerPoint presentations, as subjects for discussion. During the exchange of opinions at TC sessions, the participants can express their opinions freely and they need have no fears about speaking frankly. The popularity of the TC among water-related specialists from different sectors showed that it is an appropriate

forum, which we want to develop with more branches. The participation of official diplomatic representatives from the foreign affairs ministries of five states in two such events was a very positive experience in the work of the TC on round table scheme. We hope to develop such workshops with more broad involvement of stakeholders. The creation of negotiation procedures was part of the process of social mobilization in the project "IWRM in the Fergana valley," initiated by us together with IWMI and supported by SDC. We hope to develop similar mechanisms in other regions of the basin.

Such training networks of the ICWC involve not only training but also a "round table" system that promotes the broad involvement of different stakeholders in the most important water matters, and also makes it possible to create new frameworks for educational improvement in universities, colleges, schools, and other institutions.

3. CONCLUSION

The Aral Sea Basin is unique. Here the world can see the combined effects of specific historical and national characteristics, past and present influences, particular political and economic factors, and varying natural conditions. With all these aspects, it can be seen most importantly as an environment where five countries are trying to collaborate over water. This is one of the reasons why the Aral Sea Basin was selected for PCCP Program as a case study. The other reasons are as follows:

- the advantages and strengths conferred by the past ten years of regional collaboration
- a clear understanding of potential points of conflict in the water sector can be drawn from the lessons of experience
- a vision of future courses of action in the form of recommendations on strengthening of collaboration.

In addition, one principal reason for selecting the Aral Sea Basin as a case study for the PCCP program was the difference in understanding of the term "conflict" in local and western practice.

In local usage the word "conflict" has a different meaning from that in western understanding. We use the word "conflict" only in a situation which can be assessed as a threshold of real struggle, real destruction, or a deviation from agreed or routine patterns of actions, activity, or decisions that is unacceptable to other parties concerned and has caused real damage or harm to other participants in the process.

In the western concept "conflict" implies a "clash of interests." Such an understanding is not appropriate for water practice. Anyone who in the real world is involved in water operation and management, dealing with problems that are well known to water specialists, has to decide every day, sometimes many time in a single day, how to combine the interests of many water users located on one canal, one system, one river and so on. Changes in the hydrological situation, especially in conditions of water scarcity, require water specialists to deal with them immediately, reallocating water so as to cause the minimum constraint while being equitable and reasonable to each stakeholder in water allocation. None of us assessed such situations as conflicts; it is routine work, in which each water operator has to take the right decisions. In such work conflicts in water management within the Aral Sea Basin can be seen as disagreements of interests, ideas, and principles, which can harm attempts to provide regular satisfaction of water requirement users and to protect nature.

3.1. Strengths and Weaknesses of the Existing System

As it is clear from all the above, water resources in the region must be managed in complex conditions, which originated from two opposite challenges. In terms of the first, there is a range of factors:

- There are common ethnic, religious and customary frameworks in all states and nations in Central Asia. Communal activity in the Soviet period stimulated water saving, cooperative water use, and conservation of water, and inculcated the understanding that we can survive in these problematic conditions only through collaboration and cooperation.[2] A deep respect for water and a view of water as the framework of life (as in the old proverb "water means life") promote improvement of water resources and their quality.
- There is the political will to follow the course indicated by these views.
- The close collaboration of water professionals within the ICWC has produced a proper "Aral Sea spirit," which is sometimes lacking in many water related organizations, water users and individuals. Such a spirit has promoted friendship and respect, and led to understanding of the need for mutual solutions.

Those three factors have enabled the water management bodies of the five countries not only to execute properly their obligations (water regulation, delivery, allocation, and operations), but also to create an institutional platform for collaboration in the form of the ICWC and its executive bodies (BWOs, SIC, and Training Center). This platform allows capacity building and the involvement of a great many water specialists in negotiations about future development. The achievement is that the whole course of the actions of the Soviet Government during the last ten years of its existence, together with the past ten years of independence, have made it possible to organize a smooth transition from the command style of water management to new and more democratic water collaboration on a regional basis (see Figure 2 above). The results of this work were demonstrated at the Jubilee Conference of the ICWC in Almaty (February 2002), which underlined the following principal results of the Commission activity:

- Conflicts in water management, operation, and allocation among the countries of the region have been avoided.
- Thirty-two meetings of the Commission have been held, and have determined all activities undertaken by the ICWC and its bodies.
- A range of important legal, financial, and institutional proposals have been prepared and submitted for consideration by governments of the states, defining the principles of interaction on water issues. Two of these have been signed by the heads of state as international agreements.
- The volume of water used in the region has been reduced from 110 to 103 km^3 annually.

In terms of the second, contrasting challenge, three weaknesses should be taken into account:

- Population growth and adverse economic conditions are the two principal destabilizing factors that have made it difficult to improve the water situation, and simultaneously make it necessary to solve the problems with low cost (mostly organizing and economic) methods.
- Water, land, and mineral resources are distributed inequitably among the states. On the one hand this initiated a tendency to "hydroegoism," while on the other it was argued that there was only one way to guarantee survival and future development: close cooperation, collaboration, and the creation of a cooperative

Central Asian market for food and agricultural production (perhaps together with Russia).

- Some local and sectoral interests, aspiring to be the "nouveau riche" in the new economic market (sometimes a very erratic market), have speculated in water as they have in oil, gas, and fuel. This has created problems and put obstacles in the path of collaboration, but society needs to make such economic activity unviable.

As a whole the ICWC has managed all the complex situations of water supply and provision even during dry years without conflicts; however, in view of probable restrictions on options for the future, management procedures are not properly adequate or all-embracing. Let us list some of the obstacles to the functioning of ICWC executive organizations, particularly the BWOs:

- Several headworks have not been transferred to the BWOs' authority. This complicates water allocation. Moreover, the ICWC's decisions on water allocation are not always carried out everywhere.
- Major hydrosystems with power stations and reservoirs are under the jurisdiction of the basin states, and the latter quite often plan the operation of reservoirs without considering the ICWC operating regimes for cascades.
- There is poor coordination between hydrometeorological services and BWOs regarding the accuracy of flow forecasts and water accounting. The lack of calibration for structures and gauging stations decreases the accuracy of water accounting.
- The Syr-Darya and Amu-Darya river beds are the property of the basin states. Thus the BWOs' claims to be responsible for monitoring river water quality have remained idle and unrealizable declarations.
- The historically created command area of BWO "Syr-Darya" (up to the Chardara reservoir) does not allow it to organize rational water use in the zone from Chardara to the Aral Sea; moreover, it is difficult to obtain reliable information about the use of Syr-Darya water within this zone. In practice the BWO is unable to supply the Aral Sea and its coastal zone, which are more than 1,000 km from the boundaries of its command area, with the quantities of water stipulated by the ICWC.
- The ICWC does not control schedules and amounts of groundwater extraction, or of recycled water disposal. Similarly, it has no control over the quality of natural surface, recycled, and groundwater resources.
- The protected zones of transboundary rivers have not been specified or officially transferred to BWO authority.

Though there are slightly different views on the actual situation and suggested national management approaches, everyone can see common shortcomings in the former and current institutional structure of the water economy and irrigated agriculture under transition to the market economy. Those are as follows:

- The water sector at the national level in its present form chiefly represents the interests of agriculture. National water organization needs to represent equally the interests of irrigation and (particularly) hydropower, and set priorities for water supply, water storage, and similar measures.
- The administrative principle in the water sector and irrigation creates local pressures from provincial and district administrations for the principle of equal water supply to all water consumers.
- From the initiation of water management and irrigation projects up to their implementation, relevant decisions are made only by state agencies with no

input from current or future water users. As a result, we have a situation where the costs of irrigation systems and water structures, which are transferred to the responsibility (full or partial) of water users, cannot be recovered during their operation. Such situations are found in the cases both of salinized lands and of large water lift systems, where the costs of drainage, maintenance, and water lift cannot be covered by income from irrigated agriculture.

- The policy of transferring all operation and maintenance costs to water users depresses the maintenance system and simultaneously complicates issues related to the development, rehabilitation, and upgrading of irrigation systems. The previously most advanced systems (lined canals, flumes, subsurface and vertical drains) are now past the normal limits of their working life. However, their renovation under current conditions is an issue that falls between two stools: the water users, who do not feel they should be responsible for it, and state agencies, which do not address it pleading a lack of finances.
- In legislative and financial respects, issues concerning the distribution of responsibilities between water users and state budgets in all countries are vague and unclear. A common belief prevails that the governments should not shoulder an increasing share of the financial burden, but this neglects the fact that the decline in irrigation and water saving efficiency can cause productivity losses and a serious decline in the combined efforts of agricultural producers, as well as social harm. These facts pose a grave danger to the states, and even raise the possibility of social disruption, in view of the resulting decreases in national income and tax returns.

3.2. Lessons Learnt

Taking into account our definition of conflict as representing an extraordinary destruction of proper systems for sustainable water use and water protection, the most important lessons could be learned on the basis of analysis that would predict the likelihood of such conflict situations. The conflicting issues in the integrated water resources management process could be listed in terms of social, economic, legal, and prospective variables as discussed below.

3.2.1. Socio-ecological Conflicts over Water Use

Water has been perceived primarily in the context of social and ecological values and interaction between human beings and nature. Unfortunately, in the region until now, priority has been given to the basic needs of human beings for water and satisfaction of economic needs. As a result we can see the disaster of the Aral Sea and its coast: the lake has lost about 70 percent of its volume and 60 percent of its surface area, while water salinity has risen from 8 percent to 60 percent since 1960. There has been massive desertification (over an area of 1.6 million hectares). There have been heavy losses of biodiversity: more than eighty common species have disappeared from the water fauna and flora.

The second problem is salinization and waterlogging on the irrigated area (approximately 5 million hectares require artificial drainage). Irrigation creates a return flow, which is a source of environment threats. This polluted water constitutes more then 30 percent of total available water resources in the region. As a result there is growth of river water salinization, sometimes up to 1.5–2.5 g/L. A worsening of groundwater quality, especially through the actions of the chemical industry, has also occurred in the region. All these factors have resulted in the proliferation of various diseases and an increased mortality rate in downstream reaches of the Syr-Darya and Amu-Darya rivers, along with losses of natural productivity.

3.2.2. Economic Conflicts over Water Use

Competition for limited water resources occurs between agricultural, rural, urban, industrial, and environmental users in the region. On the one hand, irrigated agriculture is a major source for food security and simultaneously the biggest water consumer (about 90 percent of total water resources used for irrigation). On the other hand, there are growing ecological, industrial, and municipal needs.

Water allocation approaches inherited from the Soviet Era do not take into account possible changes in the priorities of the former republics, which are now independent states. They all have distinctive water and land reserves and demands, sharply differentiated due to current – and especially future – issues related to securing per capita indices. The view of the Kyrgyz Republic and Tajikistan is that they were held back in Soviet times in developing irrigation, and that they need to reassess their future water share. Downstream countries wish to take into account environmental constraints, particularly water quality in the middle and lower reaches. In addition to this there is the possibility that growing water demands from Afghanistan (after stabilization of the situation in that country) could cause new requests for reallocation.

From this point of view there are a number of fields of potential conflict over water management in the region. Among countries these relate to water sharing issues: quantity, delivery schedules, and shares of expenses to cover water management costs within the basin, including upstream and downstream relations. Among sectors (irrigation, power generation and environment) there are concerns over water allocation, use of water reservoirs, and water sharing for the Aral Sea coastal zone and the rivers themselves (sanitary and ecological flows).

In order to avoid these conflicts, it is necessary to create an efficient framework for the use of water, including a legal and institutional basis for the fair and equitable sharing of the beneficial water, with equally strict regulations for all WMOs in their activity: operation, management, and maintenance.

3.2.3. Water Conflicts in Perspective

Water is already a limiting factor (not only in terms of volume, but also in terms of quality) for some zones in the Aral Sea Basin today. This means that future sustainable development is under some stress. Also there is uncertainty about the possible impact of global climate change on water resources in the region. Over the last thirty-five years, the average temperature has increased by 1 ^{o}C and the size of glaciers in the Pamiro-Alay system has been reduced by 22 percent. Different scenarios predict a greater water deficit by the year 2020 as result of evaporation increase and a decrease of water resources of between 6 and 20 km^3 annually (or 5–15 percent of total water resources). In this context, conflicts in water management could arise as the result of different national approaches to the planning of national development scenarios. It is desirable to establish proper interstate cooperation to promote unanimity in the conduct of the planning process.

3.2.4. Prospect of Increased Water Use by Non-members of ICWC

A specific field of potential conflict is the prospect of increase water consumption by two states that are not presently members of the ICWC: Afghanistan, which different assessment indicate is the source of from 9.5 up to 13.4 km^3 of water resources connected with principal rivers, and China (Tsincjen), within which about 0.8 km^3 of water originates in the upper watershed of the Karadarya river. These aspects require future negotiations between members of the ICWC and the two states. There are strong arguments for involving Afghanistan in the activities of the ICWC.

Of, course, it is beyond the scope of this report to attempt to define the scale of such diversions from rivers, because no agreements between the former Soviet Union states and Afghanistan or China cover such problems. In our view, this potential problem may become reality in ten or twenty years time, when the economic situation in Afghanistan has stabilized. China is not so important in this aspect, taking into account the small amount of water that originates in its territory.

It should be noted that there are factors that obstruct conflict resolution in the region. Among them are the lack of information transparency and lack of proper communication systems among different levels of water related players:

- on the inter-sector level in each country and in region
- on the interstate level between water specialists and water users
- between water organizations and NGOs.

To establish proper mechanisms for conflict prevention and resolution it is necessary to concentrate activities on the following areas: (a) institutional strengthening at the national and regional levels; (b) creation of a legal framework; (c) establishment of the proper financial mechanisms; (d) technical perfection and capacity building. The following sections of the paper will discuss these issues.

4. SUMMARY OF THE RECOMMENDATIONS

Existing shortcomings in water management can be eliminated and effective water use can be achieved via real regional partnership and integration of efforts in the following six directions:

- Integration of the countries' efforts in water basin management and conservation through partnership at interstate (regional) level.
- Integration of economic and environmental interests through inter-sector partnerships in each state that take account of environmental requirements.
- Integration of water management system hierarchic levels through vertical partnership in the chain: country, to system (scheme), to administrative unit, to water user.
- Integration of water users and water management organizations through the involvement of water users at all levels of the water management hierarchy, as well as partnerships between governmental and non-governmental bodies.
- Integration of knowledge and practice through a partnership of science with water users and water organizations (using such tools as the base of knowledge described earlier).
- Integration of international donors and regional bodies though coordination and partnership of international financial organizations and the region's countries.

For regional partnership coordination, the establishment of an "Aral Sea Basin Water Council" is envisaged under IFAS leadership with ICWC and CSD participation and the participation of energy, ecological centers, and NGOs. The recommended scheme of partnership is shown in Figure 4. It is necessary to agree the ASB Water Council's status and powers of regulation among all parties concerned.

Under the aegis of the ASB Water Council, it will be expedient to organize thematic groups (including leading specialists of the region) to seek agreed decisions about integrated water resource management and use. Taking into account the existing regional problems, it is proposed to create four thematic groups relevant to ICWC working groups.

- technical aspects
- legal questions
- institutional issues for the creation of a water partnership
- financial aspects.

According to this proposal, each thematic group would assess a problem and work out an action plan and develop general recommendations to decision makers for its realization. Their proposals would be widely disseminated to the general public. It is expected that the ASB Water Council will include democratically elected leaders of thematic groups and that stakeholders at all levels, including those providing funds, will be represented.

The regional and national water strategy and its monitoring can be successfully developed and coordinated with existing scientific potential. This work is to be done, and the necessary scientific and public expertise provided, by the ICWC, CSD and SABAS group supported by UNESCO. Special attention should be paid to these programs' financing and coordination, as well as to organization of seminars and conferences for the free exchange of opinions and achieving of consensus. Science in turn, together with public awareness and participation, should promote rational water use and management.

An IT-based communication system among all participants of the regional partnership is a necessary precondition for successful activity. Connecting ministries and national centers, province and system organizations, major NGOs and then WUAs through communication technology will enable a free opinion exchange through "electronic conferences," to inform regularly the 200 to 250 organizations concerned. This will encourage trust among the partnership participants.

Thus, the problems of Aral Sea Basin cannot be easily explained in any reports. Many books, investigations, and surveys have tried to do that. Our aim here has been to summarize it from a point of view that emphasizes the viability of peaceful processes and collaboration on matters concerning water, with mutual respect for the rights of every state and every person in the region to food, water, and a decent environment.

Our conclusions about the first urgent measures for such survival are summarized below. Successful development of the region should be supported by appropriate institutional, legal, and financial provisions, both at the level of interstate relations and at the level of national policy. (See Figure 4, page 39.)

4.1. At the National Level

- Reversion to powerful inter-sectoral structures of water management at the state level, responsible for strict enforcement of the water protection and water use policy of the state.
- Extensive and all-round implementation of integrated water resource management, free from the administrative influence of local authorities, in which all interested provinces and districts will be represented and enjoy equal rights to participate in basin, sub-basin, and system organizations of water management.
- Participation of water users, alongside the state, in management and funding of operational activity (as land profitability increases, the state share is to be reduced).
- Facilitating the establishment of WUAs in agriculture and WUOs in other branches of economy.
- Establishment of consultancy services in water management and agriculture, with a network of training centers and field demonstrations as a major tool for water saving and conservation.

- Introduction of water use charges in accordance with *increasing block rate tariffs*: minimum payment for water use within the limits of crop biological water demand (technological demands of production), which increases within the limit and multiplies iteratively in the event of overuse.
- Payment for pollution of water sources.
- Implementation of mandatory water accounting at all levels of the water hierarchy.
- Mandatory introduction of water recycling.
- Development of legislation that promotes water conservation and environmental protection.
- Establishment of extensive transparent information practices and access to information systems, databases and the knowledge base.

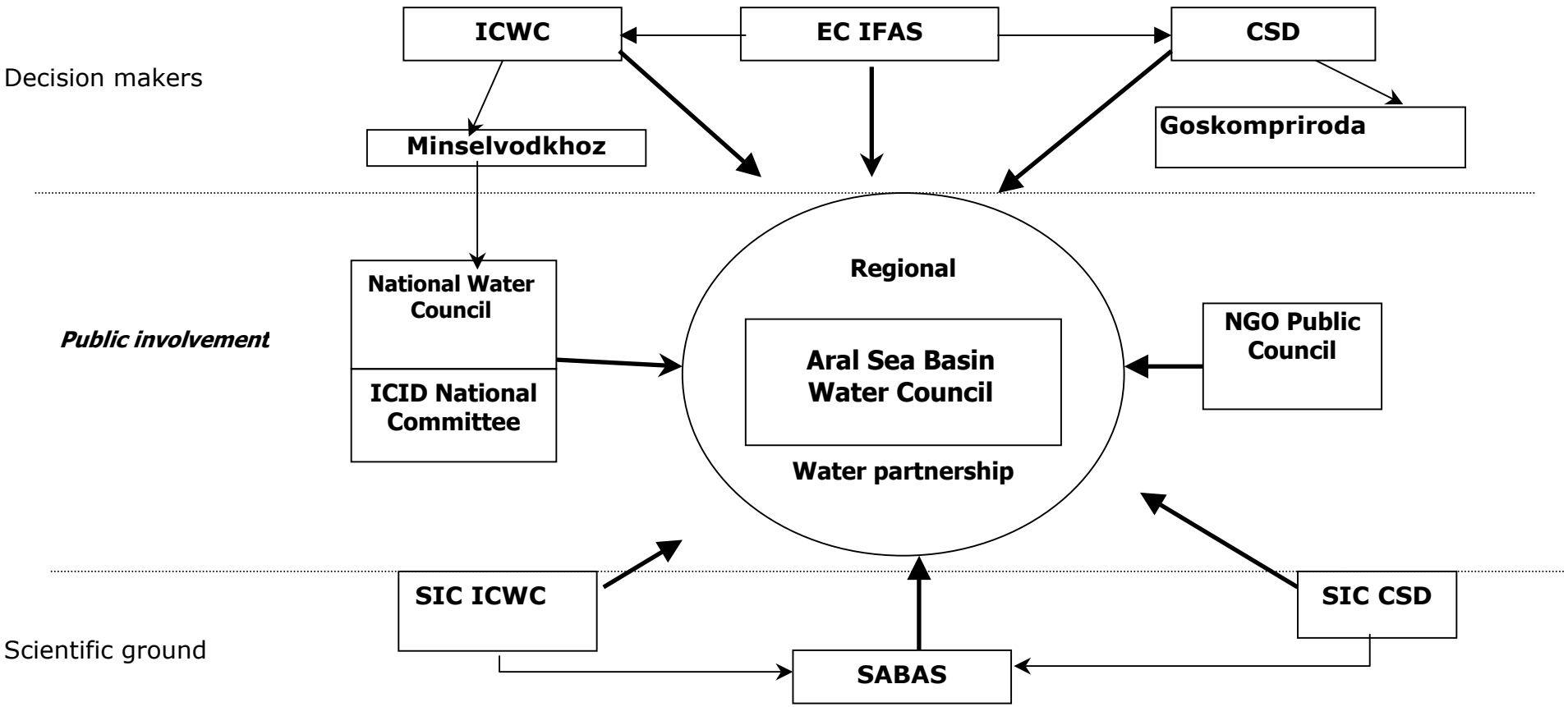
4.2. At the Interstate Level

- Assume the "common use" doctrine as a basis for inter-sectoral water relations.
- Strengthen regional bodies of the ICWC along the lines of enhancing their rights, authority, and responsibilities. There should be mandatory provisions to include in these organizations not only representatives of water management from the countries of the region, but also hydro-energy and water-delivery specialists, ecologists, and others. They should be granted diplomatic status and freed from requirements to follow decisions taken by the country they are staying in.
- Reliable financial support by the states for all water management agencies, hydrometeorological services, and nature conservancy authorities in flow formation and delta zones.
- As a substitution for fuel/energy–water exchange, implement payments for flow regulation in reservoirs (over an annual, seasonal, or other period) with participation by all countries of the Aral Sea Basin in covering expenses for flow formation, as well as protection of the deltas.
- Set well-defined limits on water withdrawal from the basins, taking into account ecologically viable volumes of water in the rivers, and allocate them among the countries in an equitable and reasonable manner.
- On the basis of these limits, implement payments for exceeding the set levels of water withdrawal at a rate that reflects the price for water as a resource, and utilize this money for development of joint water saving activities in the basin.
- Conclude a set of agreements that strictly regulate procedures and interactions among the countries as to water resources management, use, and protection (unfortunately, this process has been delayed for several years).
- Establish well-defined regulations for operating regional organizations under various conditions and in different situations (water scarcity, floods, etc.); make these activities equitable, multinational, and transparent.
- Equip all headworks of BWOs with automatic control and management systems (SCADA), preventing any possibility of uncontrolled water withdrawal from the river.
- Lay down regulations for joint design, construction, and operation of multi-objective works (similar to Kambarata, Ragun, etc.), which will ensure that these complex hydro-structures will not be used in the interests of only one country.
- Develop systems of education, professional improvement and training, and the like.
- Work out regulations for management of transboundary waters returned to the rivers.

Countries of the region have acquired broad experience of mutual interaction and understanding of their responsibilities, combined with political will. The abandonment of individual state claims could allow the region not just to survive, but to become an example to the world of rational water resource use in a large-scale transboundary basin.

Detailed recommendations on some specific issues are presented in the Annex below.

Figure 4. Scheme of Water Partnership in Central Asia



ANNEX: DETAILED RECOMMENDATIONS

Addendum to Section 2.1

It is desirable to avoid administrative pressure on water distribution and allocation, which is now creating some problems in the day-to-day activities of WMOs. This can be achieved by implementing integrated water management (IWRM) principles. This idea was first implemented in the project "IWRM in Fergana valley," which aimed to solve problems to do with:

- water management within the hydrographic boundaries
- fair water allocation among all water users
- public participation
- creation of informed public opinion and public awareness
- promotion of water saving practice.

The ICWC is now seeking potential donors who can help implement the IWRM approach in similar pilot areas, for example in the lowlands of the Amu-Darya river and the Zerafshan basin. In terms of the IWRM, the single most important element to impress upon the minds of water users is the rehabilitation of old traditions in respect to water: that is, is to equate and guarantee rights for water use to each person, each village, each city, each unit.

Addendum to Section 2.3.1

The SIC of the ICWC has prepared some principal positions which, if accepted, can be used as a guiding "compass" in a legal framework:

1. Water and associated land and other natural resources within the geographic watershed should be the considered as a *subject of joint water resources use, management, conservation, and development* according to IWRM principles. Responsibilities and commitments should be distributed among all water users in such a way that water consumption can provide sustainable conservation or development of natural capacities, and prevent their reduction. From this point of view, all water resources in the basin should be considered in terms of their interaction with human activities, paying proper attention to water, land, and other elements of the environment, introducing necessary restrictions and undertaking remedial measures for the benefit of further sustainability.
2. Requirements for the management of natural resource use should be based on *the ecologically permitted water withdrawal* (EPWW). This should be defined and strictly established for the benefit of the economy and society, to reduce the possibilities of irreversible overconsumption. In cases where this amount is exceeded (as it has been, especially in the past), the consumer countries should make a contribution to the international fund of the basin in payment for such excessive use, to finance and enable compensatory measures. For the Aral Sea Basin, the sustainable level of water extraction is estimated as 78 km^3 per annum, whereas the existing rate is 106 km^3 and it was formerly 126 km^3 per annum!
3. To preserve rivers and water bodies as natural bodies, releases from reservoirs and river flows *should not be less in summer or more in winter* than the average levels in those seasons that are shown by long-term observations. Observance of these rules would prevent the danger of turning a river into a sewage ditch. The water demand of natural bodies in deltas, as well as estuaries in open and closed water bodies, should be established on the basis of amount and time, with

regard to the regimes of bio-productivity and environmental support, and on the basis of monitoring, together with the demands of water-using countries.

4. It is proposed that all water resources in the basin should be divided into two categories: water resources of common use (transboundary or international), including surface, ground and return water resources, and national water resources.
5. Common available water resources of all types (excluding EPWW) should be considered as the objects of joint water use. For "equitable and reasonable" distribution of this amount either of the following options is possible:

   - Proportionally to historical use; if the level of development of countries and their economic possibilities are similar.
   - Proportionally to the water volume necessary to cover minimum population needs (1,000–1,500 m^3 per year per capita for arid zones) minus national water resources that could be used without damage to the environment; the population is calculated on the basis of trends for the last twenty or twenty-five years.

   To assist with the planning, budgeting, and monitoring of the basin organization activity, a special board or committee should be established by each basin organization to represent governments of all countries concerned, all interested stakeholders, and user groups. Participation should be based on principles of parity. The staff will be guided only by the basin organization regulations and are not accountable to any government. The committee is responsible only to a common body for the conformance of its activity to the above regulations.

   Basin countries are responsible for political and financial support of the basin organization, as well as for taking measures on their territory aimed at sustainable water provision at present and in the future. If any country undertakes long-term or seasonal regulation for the benefit of other countries, then all basin countries should contribute to the financing of these activities. Basin countries have a right to assign a part of their water shares, free of charge or for an agreed payment, and to enter into bilateral relations so long as these do not affect the interests of other basin countries.

Addendum to Section 2.3.2

Regulation of water relations in the region requires agreement of the following unresolved matters:

- the status of organizations within the International Fund for Saving the Aral Sea
- institutional strengthening of ICWC organizations
- formation of regional, national, and basin information systems and exchange of information
- water use from transboundary rivers
- planning of mutual actions on the transboundary rivers
- water quality and the creation of ecological sustainability in the rivers.

The status of organizations was agreed by the Board of IFAS in 1997 and confirmed by the heads of state on April 9 1999. Two subsequent agreements have gone through a long process of negotiations. The final draft of an agreement on information exchange was approved at the thirtieth ICWC meeting in 2001 and submitted to IFAS for consideration. After long discussion of an agreement on water use (the fifth version prepared and discussed between states) it was decided to prepare separate

agreements for each basin: a draft on the Syr-Darya river has been already prepared, while the one for the Amu-Darya river is only at a preliminary stage.

Basin countries need to arrange common and separate hydrometeorological and hydrogeological services to ensure water monitoring and forecasting, as well as free access to this information in real time. The costs of supporting and developing such a network can be distributed between countries in proportion to the water volume used or the ecological impact of their use of water.

Achieving a consensus among the states in the creation of a strong regional legal framework is a long-term process and requires the full involvement of national representatives, designated by the respective governments, and the participation of NGOs in preparation, negotiation, and submissions to decision makers. To achieve this goal the ICWC at its twenty-ninth and thirtieth meetings in 2001 organized working groups, empowered by the countries to develop the above-mentioned agreements, while the IFAS Executive Committee is to approve a list of national experts appointed by respective governments to work on legal documents. This working group, with the participation of a foreign expert, will be responsible for preparation of a legal framework and further improvement of existing texts. The order of work is as follows:

- Once a draft has been prepared, it should be disseminated between states and become a subject of discussion at the national level.
- In each state the government appoints a national coordinator as well as a national negotiation team that includes representatives from each national body interested in water management, use, and protection. The national coordinator is responsible for collecting various opinions and preparing a single national opinion, which must then be approved by the Deputy Prime Minister who is a member of the IFAS Board.
- Presentations collected from each state are assessed by a regional group, and then the IFAS executive committee and the SIC of the ICWC organize the next meeting of states' representatives.
- The next revision of the document should be directed towards achieving consensus among the members of the interstate group, and the revised text is then returned to the states for their approval.

The working group charged with setting up a legal framework would be responsible for clarifying the implications for national laws that affect interstate relations in terms of water and the development of the IWRM. Such a process may continue for a long time until full approval is given by the different organizations. Unfortunately, the negotiation process has no official status or schedule, although the routine processes of negotiations between members of the ICWC have regularly reached final decisions. In these negotiations, the leaders of BWOs and the SIC of the ICWC, like the invited experts, have the right to express their opinions but not to participate in the vote: the final decisions are to be made on the base of consensus only among members of ICWC. We hope that the world community can identify donors to support the ICWC and IFAS in this creative activity.

Addendum to Sections 2.4 and 2.5.7

The following measures could be implemented to improve the financial situation:

- a gradual reduction of state subsidies to agricultural producers and other users for water delivery
- the transfer of all categories of water users from a fixed tariff to one related to the volume of water used (rising block tariff system)

- a competition system to show who can save more water without heavy investments.

The GEF Project (Component A-2) implementation is an interesting example of a competitive water saving program based on bonus payments. It was very important that this competition was conducted at the following levels (results are presented in Table A.1):

- small farms
- collective farms (associations of farmers)
- associations of water users
- district water management organizations
- incentives for farmers saving water through tax privileges.

Table A.1. Volume of water saved in comparison with withdrawal quotas as a result of GEF Project Component A-2

Province	Year	Irrigated area[1]	Water quota[2]	Water limit per hectare[3]	Total water delivered[2]	Water per hectare[3]	Water saving[2]	Water saving per hectare[2]
Kyzyl-Orda	1999	68 717	1 811.2	26.36	1 688.4	24.57	122.8	1.79
	2000	132 016	3 379.1	25.60	2 717.9	20.59	661.2	5.01
South Kazakhstan	1999	184 878	2 499.1	13.52	1 793.3	9.70	705.8	3.82
	2000	203 527	1 861.0	9.14	1 068.0	5.25	793.0	3.90
Djalalabad	1999	47 223	451.2	9.55	354.2	7.50	97.0	2.05
	2000	86 587	775.8	8.96	617.5	7.13	158.3	1.83
Osh	1999	91 497	994.6	10.87	764.0	8.35	230.6	2.52
	2000	83 022	918.6	11.06	753.0	9.07	165.6	1.99
Sogd	1999	39 851	757.8	19.02	559.1	14.03	198.7	4.99
	2000	69 949	1 460.4	20.88	1 057.1	15.11	403.2	5.76
Halton	1999	49 802	769.5	15.45	737.1	14.80	32.4	0.65
	2000	79 870	1 461.9	18.30	1 337.6	16.75	124.3	1.56
Fergana	1999	85 454	594.6	6.96	621.3	7.27	-26.6	-0.31
	2000	79 144	501.0	6.33	504.2	6.37	-3.2	-0.04
Kashkadarya	1999	111 478	679.5	6.10	684.5	6.14	-4.9	-0.04
	2000	106 030	8 53.0	8.04	558.9	5.27	294.1	2.77
Total	1999	678 900	8 557.5	12.60	7201.8	10.61	1355.7	2.00
	2000	840 145	11 210.7	13.34	8614.3	10.25	2596.4	3.09

Notes:
1. Hectares.
2. Million m^3.
3. Thousand m^3.

Water Saving and Rationalization of Water Distribution and Use: The "Archimedean" Lever for Survival and Progress

It is obvious that without modification of current habits and defects there can be no improvement. A rational joint search for routes to survival and development is needed. The SIC of the ICWC has implemented, within the framework of various programs, a simulation of different future perspectives, including a "zero" scenario (that is, preservation of all tendencies and trends as they are at present, but with greater coordination), an optimistic one, an intermediate possibility, and ones founded on national egoism: "each country on its own."

It is noteworthy that in the last scenario, where "everyone grabs," each country tries to snatch as much as possible and as a result experiences a water deficit of 35–40 km^3 annually, even without taking into account water needed for the conservation of the natural environment. The demands of the region can only be met in the optimistic scenario or in the intermediate variant, which is oriented towards:

- Cooperation and collaboration of all countries in achieving food self-sufficiency, not for each country separately but for the whole region on an interrelated and rational basis by way of produce division, specialization, and mutual supplies.
- Rational interrelated water resources management, based on integrated management according to hydrographic principles with broad participation by water users at every level of the hierarchy, inter-sectoral coordination, and elimination of the administrative framework.
- Partnership between the state and water users in joint management; both parties must actively obtain funds to cover the expenses of water management development.

The main aspect of both the viable scenarios is their orientation towards achieving "land and water potential productivity (WPP)."

During the past five years, very promising results have been achieved, first by the WUFMAS Program (supported by the European Union), then by Component A-2 of GEF, and finally by the "Best practice in water use" (IWMI–ICWC) program. Over very wide areas in various field demonstrations and farms, these programs have shown that it is possible to achieve and even surpass the necessary water potential productivity (WPP) (see Table A.2). The question arises: If all countries of the region try to achieve this level, how much water will be required to meet the demands of Central Asia, which together with northern Afghanistan will have about 70 million people in 2005? In order to produce 21 million tons of cereal, 6 million tons of cotton, and 10 million tons of other agricultural produce, 47–50 km^3 of water will be required according to water potential productivity. If the efficiency of supply systems is 0.68–0.7, then gross water demand will be 70–73 km^3 for irrigation and 7 km^3 for drinking water, municipal, and industrial needs. On this basis, there is no need at all to develop new lands: at present the development cost per hectare can amount to 6–7,000 US$/ha, and the same amount of agricultural produce can be obtained much more economically by increasing the productivity of existing land. "Water saving" programs should be of an across-the-board nature at all levels of the water hierarchy. In the first place, this relates to detailed analysis of reserves over all irrigation systems at inter-farm and farm levels, and at the former collective farm levels.

At the system level, water losses in inter-farm and main networks from water intake to farms inside their former boundaries vary between 10 and 12 percent, and in some areas are as high as 26 percent (Andijan province, Uzbekistan). Generally, this indicator over a range of provinces is more or less equal to 20 ± 3 percent. At the

level of former on-farm systems, the average loss is 20±5 percent. The following measures are of importance here:

- assessment of reasons for technical losses
- maximum reduction of organizational losses, mainly through establishing and developing water users' associations; introduction of strict water rotation methods such as "warabandi" or "sheihjeili"
- water accounting in the headwork of all farms.

The main precondition for land and water productivity in irrigation is the use of water and other technological elements in the field and in farms and other units. But if a farmer increases the yield, this is achieved through the support of many participants in the process of creating a more productive area. Under market conditions, such improvement is determined by:

- organization of the environment and infrastructure that help guide farmers through the complexities of the system and marketing
- knowledge level and its update; assistance in introducing effective methods and technology
- information: access to it and opportunity to use it.

Table A.2. Water application for irrigation and harvesting crops (WUFMAS – 99)

Farm	*Crop*	*Harvesting*				*Water application*			
		Type of field				*Type of field*			
		Dem. field	*Control field*	*Difference*	*Increase*	*Dem. field*	*Control field*	*Difference*	*Reduction*
		(t/ha)	*(t/ha)*	*(t/ha)*	*(%)*	*(th.m^3/t)*	*(th.m^3/t)*	*(th.m^3/t)*	*(%)*
3 Kaz	cotton	2.92	1.38	1.54	111.6	1.22	2.17	0.95	43.8
9 Kirg	cotton	2.48	2.21	0.27	12.2	2.41	2.75	0.34	12.4
14 Taj	cotton	3.23	1.87	1.36	72.7	6.17	13.98	7.81	55.9
18 Tur	cotton	3.39	1.07	2.32	216.8	2.37	6.76	4.39	64.9
22 Uz	cotton	4.41	2.28	2.13	93.4	1.84	5.89	4.05	68.7
34 Uz	cotton	4.43	2.73	1.70	62.3	0.76	2.94	2.18	74.3
35 Uz	cotton	4.52	3.32	1.20	36.1	1.45	2.52	1.06	42.3
Average		**3.63**	**2.12**	**1.50**	**86.5**	**2.32**	**5.29**	**2.97**	**51.7**

Organization of an appropriate environment for agricultural producers depends on establishing a good mutual relationship between the state and the farmer. The state, relying on the activity of agricultural producers, tackles the most important task: providing the population with food. In countries that are not self-sufficient, huge amounts are spent from the budget to support food prices and make food available to all population strata, including the poorest. In the Central Asian states, where average income per capita is US$30–80 monthly ($1–2.5 per day), governments need to help farmers grow agricultural crops in sufficient amounts to make them available for the population.

One of the most important measures to be undertaken by the state is the creation of extension services for training farmers. As a result of the restructuring of agriculture, a large number of agricultural producers, particularly private owners and leaseholders, have been deprived of agronomic and reclamation services that used to exist in former collective and state farms. New private farmers badly need these services, as well as the state seed growing service and other support measures. They

need advice on irrigation periods and norms, cropping pattern choice for specific soils, cost reduction measures and, finally, agricultural technology. Farmers need help to recognize the particular characteristics of their land, the problems these may cause, and the reasons for crop growth and yield irregularity.

All this can be achieved through organizing extension services funded by the state (at the first stage, until a certain level of productivity is reached) and then by the farmers themselves making payments to the "Advisory Agro-technical and Water System." Such services exist in all developed countries. Attempts to create similar services were made in our republics during the period of reconstruction.

Work done in the second half of the 1980s on 150,000 hectares in several provinces of Uzbekistan revealed certain peculiarities in irrigated lands and irrigation water productivity. On most irrigated land, low yield is caused by:

- Field irregularity and variations in soil texture.
- Untimely irrigation, negative impact of over-irrigation and under-irrigation.
- Poor implementation of obligatory agro-technical operations and works, inadequate counter-weed/vermin measures, unbalanced use of fertilizers, and the like.
- Lack of skill in yield management.
- Low quality of seeds.

While the problem of seed quality needs to be addressed by the state, the lack of skill can be solved by training and education. The first three factors in the list are critical shortcomings, and elimination of these defects is very important for increasing the productivity of land.

Special research has shown that most widespread type of field irregularity in terms of productivity is the following: in a field with an average cotton yield of 2.5 t/ha, 30 percent of the area will yield of 3.0–3.5 t/ha, while 20–25 percent will yield 1.5–2.0 t/ha, and 10 percent will be below 1.5 t/ha. Thus, average yield is achieved or surpassed on only 30 percent of field area. If yield capacity on low fertility soils could be increased by up to 30–35 percent of average, then average field productivity would increase by up to 3.0 t/ha. The main reasons for these irregularities are as follows:

- Uneven surfaces of irrigated plots, which can cause parts to be boggy and others to be under-irrigated. This can be improved relatively cheaply by laser leveling.
- Different degrees of salinity and water-logging, which can be avoided by reclamation measures.
- Soil variations in terms of texture, that can be improved by the addition of sand or, for the opposite effect, by clay grouting.
- Lack of humus in some areas of fields.

Certification of lands (producing a "passport" for each field specifying its condition), which was done fifteen years ago, proved effective and increased understanding on the part of collective and state farms. Remote sensing technology, computerization, and informatics can now make this even more effective. It seems to be expedient to organize such a service within the project framework on experimental farms and then in WUA; in this will it will be possible to:

- Carry out certification of all fields and provide farmers with field passports indicating all necessary agro-technical measures to be undertaken.
- Certification will be based on the results of remote sensing, which during the first year specifies the degree of yield irregularity and through land observations identifies the reasons for this and methods of eliminating them. Then a

technological map, a plan of water use for the farmer, and a minimum cost map will be developed.

- Give recommendations on irrigation schemes and techniques, furrow length, and other elements.
- Create during the first year, using experience of the fields gained by adjacent projects organized by Copernicus, USAID, and the FAO (in the Kyrgyz Republic), field demonstrations for the purpose of training the first groups of farmers so that two or three years later they can organize these demonstrations directly on selected farms.
- Organize training of WUA members and owners of selected farms in water saving methods (following the principles of the "best practice" project), irrigation terms, furrow length, and other elements of irrigation techniques, as well as methods of achieving the highest potential land productivity.

The foundation for this system of training will be "IWRM training centers," which are now being established as branches of ICWC Training Center, and their network of field demonstrations, where existing projects' pilot sites will be used and private farms organized.

Along with these measures, modernization of irrigation equipment on private and leased farms should also be encouraged. A system to provide credit to private farmers for the purchase of modern irrigation equipment, especially for expensive drip irrigation systems, must be established. Preference in updating existing irrigation equipment should be given to areas with chronically low water supply, tracts of land whose irrigation requires costly pumping, and irrigated territories with highly water permeable soils and difficult terrain.

Of course, the technical and technological capacities of states differ in many ways from the productive structures that previously existed in Central Asia, but collaborative and market approaches can help smooth these out. The biggest obstacles to implementing new patterns of negotiation and water use are created by the lack of financial resources of states, farmers, and water users.

Addendum to Section 2.5.6

A comprehensive analysis of sustainability in regard to a country, society, or system should be based on development trends, the dynamics of external and internal factors, and estimates (or forecasts) as to how they will affect the object under consideration. On the other hand, it is important to examine – bearing in mind the extent to which it is possible to develop available reserves of capacity in the country, region, or system – reserves of capacity that could be called upon in order to overcome expected negative tendencies.

The SIC of the ICWC has attempted to define its conception of sustainability (of the region, countries, and systems) as being dependent on impacts exerted by such external factors as: climatic changes (precipitation, runoff, evaporation); fluctuation of water reserves accumulated in glaciers; increased demands for water in neighboring countries; changing prices for agricultural produce and inputs (fertilizers, chemicals, materials); energy and fuel balance changes; and world market changes. On the other hand, there is a whole series of internal factors and components in water consumption (production growth or decline, its specification, population growth, brain drain, environment deterioration), and the state and maintenance of water and agricultural infrastructure. All these trends may (or may not) be compensated depending on the availability of five internal components: productive, natural (including raw materials), social, financial, and human (educational) potentials. The combination of these factors and potentials as a whole determines the sustainability of the goal and development in general. In order to foresee possible threats to this sustainability, it is necessary to:

- Analyze factors and links relating to sustainable development, both external and internal, and create a database of them.
- Define the direction of change in trends and their possible combinations, and their consequences for sustainability of the goal.
- Analyze these links and create forecasting models that include the development rates of negative processes and the damage that these may cause.
- Decide on measures to counteract or compensate negative processes, and assess their cost and effectiveness on the basis of utilizing available potentials.
- Prepare an action plan and measures for its implementation.
- Evaluate for how long available potential can ensure sustainable development and, finally, what other temporal trends may emerge that would improve or hinder sustainability in the future.

Thus, if we want to ground really sustainable development or sustainable activity in the field of water economy, it is necessary to work out and accept a mechanism that will allow us, both visually and quantitatively, to analyze and predict all these perspectives. Such a mechanism can only be composed through system analysis and a set of models describing the behavior of these complex systems. Naturally, it is not simple to create such a mechanism, termed a "decision support system (DSS)." It involves not only a huge set of models that can adequately describe processes of water use, water development, and water funding, but also a database (or even an information system) as well as a knowledge base and a forecast system, a set of criteria, constraints, and links.

Creation of such systems is absolutely necessary for developing an integrated water resource management (IWRM) system that provides for integration (within the single management scheme framework) of different administrative sites, various sectors of the economy, the hierarchy levels of diverse territorial units, ecological concerns, and social interests. It must also allow for different timescales: from operational decisions and monitoring, up to perspective boundaries. Integrated management does not mean that one body will manage, plan, and control this complex. Rather it implies that such a system of bodies, interrelations, links, obligations, rules, responsibilities, rights, and actions has been created, which maintains successful operation of this complex. It is also very important that the system ensures preparedness and ability to respond not only to main trends and tendencies, but to unexpected (extreme) situations, by mobilizing its own potentials and reserves, or initiating restrictions (within acceptable limits) on water, energy, and resource consumption and other measures. Applying "system analysis" in the form of DSS requires proper development of a detailed "tree" depicting objectives and links, which will be complemented afterwards by a database, knowledge base, and a set of models.

In the Central Asian region a set of models has been in the course of development for long time, which includes:

- perspective planning of the water-economic complex in the Amu-Darya and Syr-Darya basin
- annual planning of the water-economic complex under scarce water resources (ASBMM)
- multi-year regulation of both rivers' flow to satisfy needs of the water-economic complex during hydrological cycles
- operative correction of water resources management processes in the basin
- consequence forecasts of water breakthrough in reservoirs and lakes formed by landslides
- assessment of water system manageability under different combinations of natural and technological conditions.

This program aims, within the PCCP program, to demonstrate the potential of system analysis and mathematical modeling of complicated water-economic complexes, including interstate water management in the Aral Sea Basin, where the interests of all countries are closely interconnected.

Re-orientation of the model complex to water resource allocation strategy that meets state priorities calls for modification of the models themselves as well as water-economic complexes in the river basins amplification (see Figure A.1):

- Coordination of tasks and models of water resource management at the territorial level (river network, planning zone, and state) and in terms of timescales (annual and long-term management).
- Strengthening "power aspects" (production, distribution, regional exchange) in proposed approaches and methodology. Introduction of power aspects does not reflect the priorities of the Kyrgyz Republic and Tajikistan priorities but rather a refinement of objectives and approaches and their re-orientation towards integrated and compromise management.
- Strengthening ecological aspects: modeling how the Aral Sea water ecosystems (the Arnasay and lakes in the Aral Sea coastal zone) are bound up with the river and collector flows by their constituents: water, salinity, and sediments.
- Strengthening managerial aspects, as applied to the formation and assessment of criteria (both those in current use and those now being developed) for water resources distribution from the angle of both annual and perennial aspects.
- Strengthening planning aspects in developing water-economic complexes: development of indicators and criteria for choice and validation of where to locate water-economic objects.
- Strengthening emergency management, in terms both of reliable forecasts of possible accidents and catastrophes that may occur, and of making optimal choices for protection and prevention.
- Accounting for hydrological peculiarities of river flow formation and transformation in time and over basins, improving the accuracy of forecasts about water resources, improving management (channel design to reduce losses, filtration inflow to channels, etc.) and specific features of flow regulation by reservoirs at present and in the future (developing new regulation capacities).
- Interface creation to combine models with databases in a single information-program complex with elements relevant to the system. One of the necessary interface functions is data import–export and information processing through special program-translators.
- The interface should make it possible to select the task, object, level, and criteria, provide for numerical experiments using sets of models and iteration links, and show results of calculations.
- Users should have access to information through the interface, allowing analysis of the water-economic situation in the region as a whole, in separate basins, states, and planning zones, and for economic branches and objects like rivers, reservoirs, lakes, and power plants. Socioeconomic and ecological information should be shown at the regional, basin, and national levels.

To cover all the key aspects, a set of annual and prospective models is needed, combining simulation and optimization procedures and working at the levels of *river networks, planning zones, and states*, and at the boundaries of branch interests (drinking water supply, irrigation, power engineering, industry, and the environment), with managerial variable elements such as "water," "salt," and "energy." The set should allow us to make water–salt balance, power, and economic calculations (effects, damages, and compensation), assess electric energy flows and fuel delivery

between the states, make effective decisions on water resources management, and predict conflict situations and interstate agreement violations among the states.

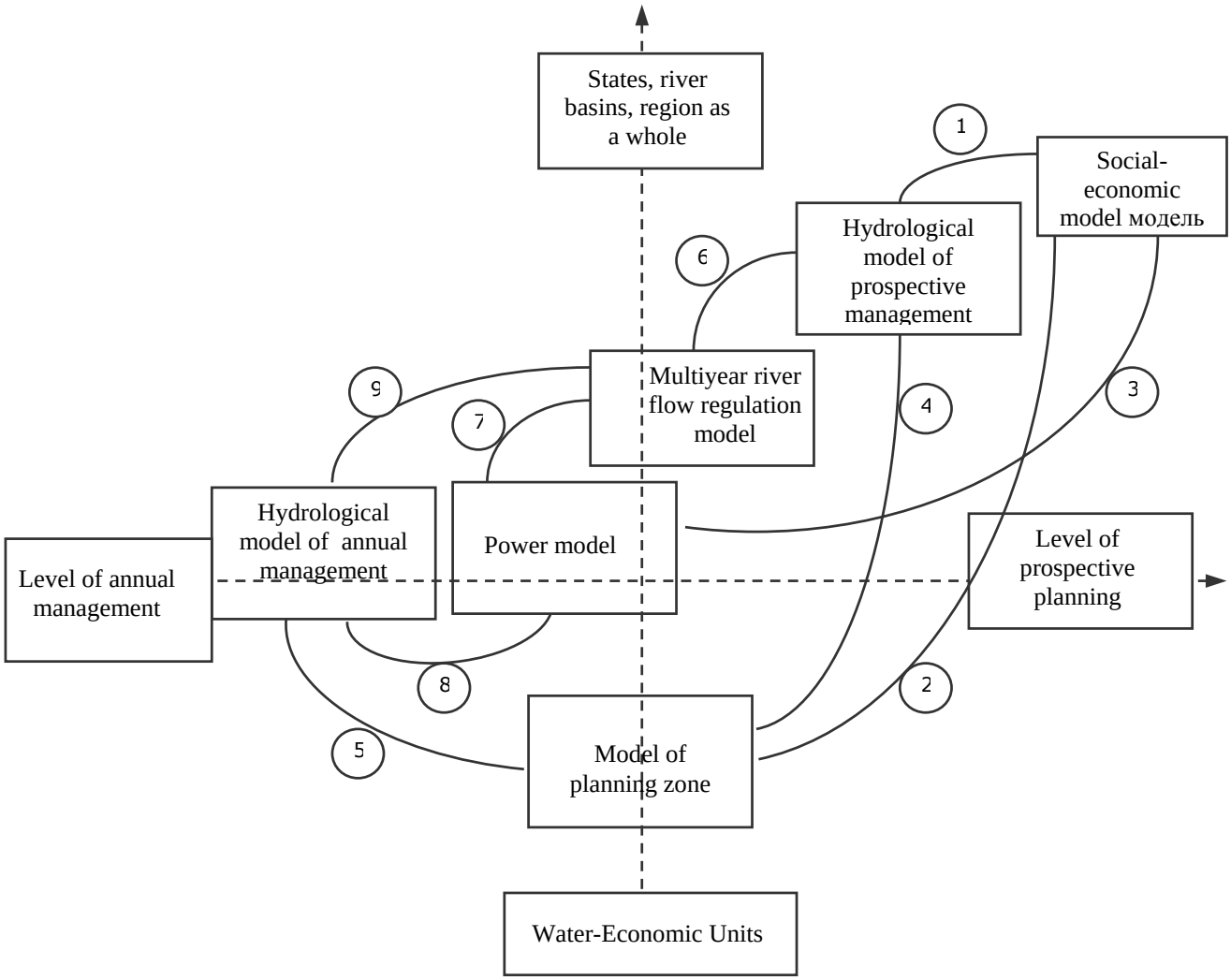


Figure A.1. Management levels and logical links within a set of models

Note. Logical links between the models on the scheme are:

1. Regional hydrological indicators of sustainable development and indicators of ecological consequences of water resources management.
2. Agricultural production, economy, social-demographic indicators, investments.
3. Power engineering (requirements, production, impacts, damages, compensations).
4, 5. Diversion from transboundary rivers, return flow, diverted water productivity.
6. Available water resources, diversion from rivers, water reservoirs and power plants operation mode.
7, 8. Power plant modes
9. Restrictions on water reservoir filling to the end of year (season).

NOTES

1. Kyrgyzenergo has now been restructured as separate power production, power transferring, and power distributing bodies.
2. This view was expressed in a survey of more than 250 participants in multi-stakeholder workshops and training in the ICWC Training Center.

Index entries: Aral Sea, transboundary rivers, water conflicts, interstate cooperation

Contacts:

UNESCO
Division of Water Sciences

1, rue Miollis
F-75015 Paris, France

Tel: (+33) 1 45 68 41 80
Fax: (+33) 1 45 68 58 11

E-mail: pccp@unesco.org
Website: www.unesco.org/water/wwap/pccp

Cover: Maro Haas - Le Pré St Gervais - France

Credits Photos:

1. UNESCO / Sabine Le Nechet & UNESCO / Dominique Roger
2. UNESCO / Dominique Roger
3. UNESCO / Dominique Roger
4. UNESCO / Franca Bequacca
5. UNESCO / Béatrice Petit
6. Andras Szöllősi-Nagy
7. UNESCO / Dominique Roger
8. UNESCO / Georges Malempré
9. UNESCO / Dominique Roger
10. UNESCO / Dominique Roger
11. Dr. Gromilio Konstantin V.
12. UNESCO / B. van Droste
13. Janos Bogardi
14. UNESCO / J.W. Thorsell
15. Uri Shamir
16. UNESCO / Dominique Roger
17. UNESCO / A. Vorontzoff
18. UNESCO / Ingrac Semajos
19. UNESCO / Dominique Roger
20. UNESCO / Georges Malempré
21. UNESCO / Dominique Roger
22. UNESCO / Dominique Roger

23 & 28. UNESCO / Daniel Riffet & UNESCO / Dominique Roger

29. UNESCO / Andes / CZAP / AZA
30. UNESCO / Alexis Vorontzoff
31. UNESCO / André Abbé

Printed by: UNESCO - Paris - France

Constitution of UNESCO (excerpt)

London, 16 November 1945

The Governments of the States Parties to this Constitution on behalf of their peoples declare:

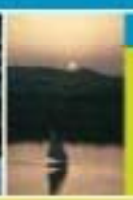
That since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed;

That ignorance of each other's ways and lives has been a common cause, throughout the history of mankind, of that suspicion and mistrust between the peoples of the world through which their differences have all too often broken into war;

That the great and terrible war which has now ended was a war made possible by the denial of the democratic principles of the dignity, equality and mutual respect of men, and by the propagation, in their place, through ignorance and prejudice, of the doctrine of the inequality of men and races;

That the wide diffusion of culture, and the education of humanity for justice and liberty and peace are indispensable to the dignity of man and constitute a sacred duty which all the nations must fulfil in a spirit of mutual assistance and concern;

That a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world, and that the peace must therefore be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind...



International Hydrological Programme

World Water Assessment Programme