Chapter 5

WATER RESOURCES MANAGEMENT

5.1 Introduction

Water management may be the single most important issue for Uzbekistan. Forty years of poor management now threaten agriculture, soil quality and availability of water for all purposes. The Government faces difficult political choices. Cotton, a significant foreign-exchange earner, consumes more water in irrigation than can be sustained. (See Chapter 10.) Salinity of soil, surface water and groundwater is increasing to unacceptable levels. Run-off from irrigation is negatively affecting the quality of drinking water from the main water streams. Water is becoming scarce for all purposes.

5.2 Water resources

Uzbekistan's surface water resources are mostly located within the Aral Sea basin. This basin includes the largest rivers of Central Asia, the Amu-Darya and the Syr-Darya. Beside these large rivers there are other important rivers like the Zarafshan, the Surkhandarya and the Kashkadarya. Water abstraction allocations for Uzbekistan are presented in Table 5.1.

Table 5.1: Water abstraction allocations from the basins of Amu-Darya and Syr-Darya for Uzbekistan Hydrological year 2000 – 2001 (million m^3)

	Total water allocation	From Amu-Darya and Syr-Darya Rivers	Internal small rivers	Groundwater	Collector-drainage water
Total for Uzbekistan	49,381	30,554	16,497	600	2,829
Total for Amu-Darya basin	25,636	19,514	5,667	225	1,330
Karakalpakstan	7,520	7,406	0	0	114
Kashkadarya	5,257	4,048	1,947	90	272
Bukara	3,909	3,341	255	60	253
Navoi	1,440	533	791	39	77
Samarkant	3,027	0	2,674	36	317
Korezm	4,483	4,186	0	0	297
Total for Syr-Darya basin	19,795	9,936	8,334	325	1,199
Andijan	3,060	775	1,954	92	239
Namangan	2,755	2,337	230	27	161
Fergana	4,262	1,802	2,068	162	230
Djizak	2,250	1,935	260	2	52
Syrdarya	2,588	2,385	0	28	175
Tashkent	4,880	702	3,822	14	342
Additional inflow Surhandarya	3,950	1,104	2,496	50	300

Source: Ministry of Agriculture and Water Management, 2001.

The availability of the groundwater and its use in the Republic of Karakalpakstan and in the different *oblasts* is presented in Table 5.2:

In 2000 groundwater resources that were used totalled 17,075 thous.m³/day 26,756 wells.

5.3 Water quality and water-quality monitoring

Sources of pollution

The principal sources of water pollution in Uzbekistan are industry, agriculture and human settlements. Facilities for the treatment and disposal of municipal and industrial wastes also seriously pollute groundwater with heavy metals and hazardous organic substances. Untreated medical waste is a special threat to groundwater.

In addition to discharges of collector-drainage water containing salt, fertilizer and pesticide residues into virtually all surface waters, the Syr-Darya basin is also contaminated by industrial waste-water from mining and metallurgical industries, steam power plants, and agriculture. (See Chapters 9 and 10.) The main pollutants in the waste-water are iron, oil, chlorine-organic pesticides and other organic substances, heavy metals and dry sediment. The concentrations of these pollutants exceed their MAC several times.

There are water-quality problems in almost all *oblasts*, but especially in the Republic of Karakalpakstan, and in Khoresm, Fergana and Navoi *oblasts*.

Groundwater quality

Pollution of groundwater is *regional, diffusive* or *local*.

Regional groundwater pollution is the result of the intensive use of chemicals in agriculture and the percolation of polluted surface water. In the Amu-Darya river basin intensive agriculture has contributed to the contamination of groundwater, increasing salinity, hardness, nitrate and pesticide content. Contamination is particularly widespread around lower river stretches and in areas with well-developed irrigation.

Diffuse pollution of ground water occurs on irrigated land because of the application and further percolation of mineral fertilizers and chemicals, especially pesticides. Even at a depth of 100 to 150 m groundwater is often polluted.

Table 5.2: Use of available groundwater resources in 2000 (thous.m³/day)

Regions	Resources available	Total used in 2000	For drinking water in cities	For drinking water in rural areas	In industry	For irrigation	For other purposes	Number of wells
Total for Uzbekistan	66,412	17,073	3,043	3,872	1,772	3,722	4,608	26,756
Republic of Karakalpakstan	6,627	110	10	23	7	3	60	839
Total for Oblasts	59,785	16,963	3,033	3,849	1,765	3,719	4,548	25,917
Andijan	5,394	1,696	28	656	123	273	616	2,283
Namangan	7,973	1,474	52	391	49	519	462	1,882
Fergana	8,976	4,922	413	848	796	1,290	1,575	5,429
Tashkent	7,828	3,133	1,116	721	557	173	517	3,368
Syrdarya	4,223	800	90	109	9	126	467	1,210
Djizak	2,986	315	112	144	15	8	35	790
Samarkand	6,253	1,342	717	300	53	219	53	2,714
Navoi	2,474	600	21	40	33	244	262	1,170
Bukhara	2,641	742	58	27	70	290	297	1,966
Kashkadarya	1,786	870	286	66	16	304	198	2,799
Surkandarya	4,166	985	125	540	39	273	8	1,994
Khorezm	5,085	84	15	7	5	-	58	312

Source: State Committee for Geology and Natural Resources, 2001.

Local groundwater pollution occurs close to large industrial enterprises. There are some 500 pollution sources of this kind in the country, reducing the supply of fresh drinking water by 35-40%. This trend is continuing.

Monitoring

The water-quality monitoring system has considerably declined within the basin of Amu-Darya and SyrDarya rivers. Many monitoring stations fail to provide systematic data; others simply are not operated. The equipment and methods used to sample and analyse water are not adequate. There are no automatic monitoring devices to check water quality 24 hours a day. Consequently, there is a lack of detailed and reliable monitoring information on surface water, groundwater and drinking water. The data are simply arithmetic averages; they do not include information on the quantity of water taken from the natural watercourses or on pollutants discharged into natural watercourses and reservoirs during different seasons of the year. There is a need for more information on the quantity of water used, polluting substances, quantities discharged into water, their concentration in water and their environmental impact.

The national monitoring system provides information on water-quality and water-quality trends in the Amu-Darya and Syr-Darya rivers and their tributaries. But differences in monitoring methodologies and equipment in the riparian countries (Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan) cast doubt on the reliability of the data and their comparisons.

The Ministry of Health's Sanitary and Epidemiological Service (SES) monitors the quality of drinking water from the moment it is released to water pipes or used for human consumption. Water is also monitored by Vodocanal services. Not all SES stations and Vodocanal laboratories are sufficiently equipped by modern analytical devices, and there is a lack of chemical reagents used for analytical control. This limits the ability to carry out analyses of pesticides and microbiological components in drinking water.

5.4 Water use

Abstraction and major users

A total of 60 km³ of water is distributed annually in Uzbekistan. The major source of water supply is surface water; groundwater accounts for only 5%. Most surface water is taken from rivers. Some collector and drainage water from irrigation systems is also used for water supply.

The main water users are presented in table 5.3.

As can be seen, 93% of all water used in 1988 was for irrigation and drainage. In 1998, this fell slightly to 91%. The total volume of water used for all purposes decreased by 18% during this period; the amount used for irrigation, by approximately the same amount.

This decrease resulted from three factors: technological improvements, reduced water supply for irrigation and replacement of part of the cotton crop with grains. Some measures were taken to reduce water losses, for example by modernizing part of the irrigation system, introducing simple water meters, and putting limits on water use per hectare of irrigated land. This resulted in a 10% cut

Table 5.3: Trends in water use in different sectors of the national economy, 1988-1998

	Total	Drinking-water supply		Agricultural water supply*		Industrial water supply		Fishery		Irrigation and drainage	
	million m³	*million m³*	*as % of total*	*million m³*	*as % of total*	*million m³*	*as % of total*	*million m³*	*as % of total*	*million m³*	*as % of total*
1988	69,068	1,609	*2.3*	1,022	*1.5*	1,990	*2.9*	475	*0.7*	63,972	*92.6*
1990	63,610	2,353	*3.7*	723	*1.1*	1,298	*2.0*	1,080	*1.7*	58,156	*91.4*
1992	63,271	2,051	*3.2*	839	*1.3*	1,260	*2.0*	783	*1.2*	58,338	*92.2*
1994	58,564	2,580	*4.4*	950	*1.6*	1,100	*1.9*	534	*0.9*	53,400	*91.2*
1996	54,974	2,354	*4.3*	712	*1.3*	844	*1.5*	503	*0.9*	50,561	*92.0*
1998	57,920	2,205	*3.8*	1,120	*1.9*	902	*1.6*	821	*1.4*	52,872	*91.3*

Source: National Environmental Action Plan, State Committee for Nature Protection, 2000.
Note:
* Excluding irrigation

in water consumption. At the same time, the allocation of water from the main transboundary basins, the Amu-Darya and the Syr-Darya, was affected. The Interstate Commission on Water Coordination (ICWC) establishes yearly water quotas for countries in the region, but these quotas are not consistently honoured and enforced.

Irrigation

Cotton and other agricultural crops have been consuming more than 90% of all available water just for irrigation. This is having increasingly serious, potentially irreversible, effects on water availability and quality, land, health and other social concerns. At present, 4.3 million hectares are irrigated. Already in 1997, the supply of water for irrigation under the current system fell short by 17% of the quantity needed; in 1998, it was 22%; and, in 2000, when it was compounded by severe drought, the shortfall was 40%.

The irrigation system is also inefficient. Equipment, control devices and technologies are obsolete and need either repair or replacement. Due to the transition to a market economy there is a lack of economic incentives and financial resources to improve the irrigation system, and neither land-use nor water-use practices encourage efficiency in water use.

Drinking water

Seventy-four per cent of the urban population and 65% of the rural population have access to piped water. By 2010 all urban areas and 85% of rural areas should be covered

There are difficulties in supplying high-quality drinking water in the west of the country, where the Amu-Darya, the Syr-Darya and many groundwater sources are polluted. To satisfy drinking water demand in these areas, pipelines from distant locations supply water.

About 65% of groundwater is used as drinking water in urban and rural areas. A small quantity is used in industry and agriculture. The volume of groundwater under the Aral Sea basin is about 44.0 km³, of which 6.4 km³ is used by Uzbekistan, including for irrigation. The total capacity of drinking water supply is 6.8 million m³/day, of which 4.4 million m³ is from groundwater and 2.4 million m³ is water from surface sources.

The drinking-water consumption figures include treated water supplied to industrial users (it accounts for about 25% of all drinking water). Water leakage due to outdated equipment is estimated at 11-40%, depending on the oblast.

Drinking-water consumption in Uzbekistan is high. However, water consumption is rarely metered, so the statistics may not be reliable. Only large enterprises have water meters. It is estimated that the consumption of drinking water could be reduced by 15-20% if water meters were installed and users were charged for the quantities they actually use. This has happened to a limited extent in Tashkent. Families with water meters have been able to monitor and adjust their consumption. The result is that these families pay an average of about 200 sum a month, against 800 sum without a meter. The effective use of existing water meters, however, is hampered by the high mineralisation of the water, which damages the meters over time.

There is a real shortage of drinking water in Karakalpakstan, Khorezm and Bukhara *oblasts* and in the west of Samarkand, Kashkadariya, Djizak and Surkhandariya *oblasts*. The deficit is caused by the irregular distribution of groundwater in the west of Uzbekistan. At present more than 30% of the population drinks and otherwise uses water that does not meet national and international quality standards.

5.5 Waste-water treatment

Collector-drainage water from irrigation

At present collector-drainage water is not treated at all. The annual discharge of collector and drainage water into surface water amounts to 20-25 km³: about 10 km³ into the Syr-Darya, 5 km³ into the Amu-Darya and the rest into small rivers and natural salt lakes. The most mineralized of these waters is found in the lower reaches of small rivers and the Amu-Darya. The solution is to build compartment collectors or treatment installations for collector-drainage water. These measures could make a considerable contribution to saving water in Uzbekistan and in the region as a whole.

Industrial waste-water

Uzbekistan's main industries are energy, mining, metallurgy and chemicals. There are 502 industrial users of water. They discharge into surface water 2.2 km³ of waste-water, of which 131 million m³ is untreated polluted water.

Industrial waste-water containing specific substances is treated separately but not with the same efficiency. Concrete measures should be taken to improve the efficiency of industrial waste-water treatment installations or to construct new facilities with modern equipment and technologies.

The water quality of the Syr-Darya basin is affected by industry around Fergana and Tashkent. In the Fergana Valley, 564,70 tons of pollutants are discharged into Syr-Darya. In the Amu-Darya basin, the disposal of industrial waste-water mainly affects the Zarafshan basin. The oblasts of Samarkand, Navoi and Bukhara cities are the most affected; 415,40 tons of industrial pollutants are discharged into the rivers with waste-water.

Other Central Asian riparian countries also contribute to the contamination of both the Syr-Darya and the Amu-Darya. The problem is exacerbated by the lack of treatment facilities for industrial waste-water situated along the Syr-Darya and Amu-Darya rivers.

Municipal sewage

Many cities have installations that only partially treat domestic sewage, but, due to obsolete equipment and technologies in many of them, their efficiency for municipal and industrial waste-water is about 50%. Sewage water and industrial water are usually treated together by mechanical and biological methods. Treated and partly treated sewage is discharged into surface water. This increases biological oxygen demand (BOD), nutrients and pathogens in the surface water.

Water conservation

Water conservation is an important factor in the rational use of water resources in the region. In addition to the 40%-60% of water lost due to inefficient irrigation systems, about 5-10% of drinking water is lost because of corroding and aging water pipes, and another 15-20% of drinking water is lost due to outdated and inefficient equipment used for drinking-water supply.

There is no integrated water and land management, and irrigation planning fails to involve agro-business sufficiently in the management and distribution of irrigation water.

5.6 Water policies and objectives

Policy objectives

Water management and its interrelation with agriculture and energy are considered the highest priority in Uzbekistan. This is particularly reflected in the National Environmental Action Plan, the Framework on Water Supply Development for the period up to 2010, the Framework on Groundwater Protection and Use, for the period up to 2010, and the Programme on Maintaining Population by Drinking Water and Gas up to 2010.

The National Programme on Maintaining Drinking Water calls for providing clean drinking water to rural areas and upgrading the water supply systems, the distribution network, and sewage as well as building the waste-water treatment facilities in urban areas. The NEAP requires pretreatment or primary treatment of toxic waste-water discharges. Water saving and conservation are addressed through stricter control over water use, supported by water prices, introduction of water metering for agricultural and municipal use and the modernization, upgrading, and better maintenance of irrigation and drainage networks. Emphasis is also placed on integrated management, including integrated land, water and salinity management and watershed management.

The Framework on Water Supply Development to 2010 is based on new water norms and standards. It describes the existing water-supply conditions in every oblast and includes both measures to prevent pollution of the water supply and a plan for improving water supply based on regional water-supply systems and local sources. However, financial resources necessary for the full implementation of the Framework are only partially available.

The Framework on Groundwater Protection and Use to 2010 includes a reassessment of the reserves of fresh groundwater, specific data on the use of water and land resources and an evaluation of changes in groundwater stocks and quality. The Framework foresees possible changes in groundwater stocks, describes the interaction between all the big groundwater deposits and surface waters, and maps sources of pollution and industrial facilities. The Framework also contains proposals for the rational use of existing wells, including for irrigation, and for measuring groundwater capacity.

Legislation

Uzbekistan's Constitution stipulates that water, as well as land and its subsoil, flora, fauna and other natural resources, are national assets that should be rationally used and protected.

The main legislation is the Law on Water and Water Use (1993), which stipulates the classification of water, responsibilities for water management and the procedure for issuing permits for water use. The Law calls for the protection of water from pollution by chemicals, oil and other substances through the enforcement of quality standards for sewage disposal, industrial waste-water treatment and its disposal.

Other legal documents that address water management issues include:

- The Resolution of the Cabinet of Ministers (No. 179, 1992) on arrangements for the use of groundwater, and its protection from contamination and depletion;
- The Resolution of the Cabinet of Ministers on Limited Water Use (No. 385, 1993);
- The Resolution of the Cabinet of Ministers (1998) approving the procedure for developing and maintaining the State water cadastre.

Institutional arrangements

The Ministry of Agriculture and Water Management is involved in water research, planning, development and distribution. The Ministry is responsible for the construction, operation and maintenance of the irrigation and drainage systems, and maintenance of the surface water cadastre.

The Agency of Municipal Services and local authorities (*Khokimiyaty*) are responsible for the infrastructure of municipal water supply and waste-water treatment.

The State Committee for Nature Protection (*Goskompriroda*) is responsible for monitoring compliance with standards for waste-water. It is assisted by the State Special Inspectorate of Analytical Control (GosSIAK). The Main Administration on Protection and Wise Use of Land-Water Resources within the State Committee monitors and regulates industrial waste discharges. Other responsibilities of the State Committee for Nature Protection include the protection of water resources from municipal pollution, monitoring the quality of water at major waterworks, analysing the impact of pollution on water quality, issuing permits for water use and sewage-water discharge, and supervising measures to decrease the quantity of harmful substances in the environment from sewage. It also is responsible for ensuring that water discharges meet water quality standards (MACs).

The Main Administration on Hydrometeorology within the Cabinet of Ministers monitors surface water, collects and analyses information and forecasts the state of surface water. It provides systematic information on the level of water pollution to the relevant State and community bodies, enterprises, departments, and organizations.

The State Committee for Geology monitors changes in the condition of groundwater in the underground hydrosphere, including its level, quality and volume. It also maintains the groundwater cadastre.

The Sanitary and Epidemiological Service of the Ministry of Health (SES) monitors drinking-water quality in cities and large settlements, particularly piped water. (See Chapter 12)

Instruments

Water-quality standards are represented by maximum allowable concentrations (MAC), which were developed by the Ministry of Health. There are water-quality standards for drinking water, surface water, and fishing waters.

Some national drinking-water standards are less strict than those recommended by WHO, for example Uzbekistan's MAC for nitrates is 4.5 times the WHO standard. Special national standards exist also for water quality in reservoirs and fish-breeding ponds. There are no specific quality standards for collector water and drainage water from irrigated land. This type of water accounts for 78% of all discharged waste-water. Industry generates 18% of all waste-water, and sewage 4%.

Standards do not correspond to the current situation in the country, nor are they in line with EU and WHO standards. Almost all water-quality standards should be revised and new ones should be introduced for some hazardous substances and for collector water and drainage water from irrigation systems.

The water pollution index (WPI) is used to categorize water according to its quality, which can range from very clean to extremely dirty. The index is based on MACs of dissolved oxygen, biological oxygen demand (BOD) and four widespread pollutants. There are six categories of surface water (see Table 5.4).

Table 5.4: Treatment guidelines by different water sources for negligible virus risk

Type of source [1]	Recommended treatment
Ground water	
Protected, deep wells; essentially free of faecal contamination	Disinfection [2]
Unprotected shallow wells; faecally contaminated	Filtration [3] and disinfection
Surface water	
Protected, impounded upland water, essentially free from faecal contamination	Disinfection
Unprotected impounded water or upland river; faecal contamination	Disinfection and filtration
Unprotected lowland rivers; faecal contamination	Pre-disinfection or storage, disinfection and filtration
Unprotected watershed; heavy faecal contamination	Pre-disinfection or storage, filtration, additional treatment and disinfection
Unprotected watershed; gross faecal contamination	Not recommended for water supply

Source: WHO, 1995.

[1] For all sources the median value of turbidity before terminal disinfection must not exceed 1 Normal Turbidity Unit (NTU) and must not exceed 5 NTU in simple samples.

[2] Terminal disinfection must produce a residual concentration of free chlorine of >0.5 mg/l after at least 30 minutes of contact in water at pH<8, or must be shown to be an equivalent disinfection process in terms of the degree of enterovirus inact

[3] Filtration must be either slow sand filtration or rapid sand filtration preceded by adequate coagulation-flocculation (with sedimentation or floatation). Diatomaceus earth filtration or a filtration process demonstrated to be effective with virus could also be used. The degree of virus reduction must be >90%. Additional treatment may result in slow sand filtration, ozonation with granular carbon absorption, or any other process demonstrated to achieve 99% of enterovirus reduction.

Mountain rivers are virtually free from pollution. Their water quality is very high. The more downstream the lower is the water quality. The middle and lower reaches of most rivers are heavily mineralized. In the middle reaches the salt content is 1 to 1.5 g/l and in the lower reaches up to 2 g/l.

The water of the Amu-Darya and the Syr-Darya in the middle and lower reaches is polluted and breaches MACs for mineralization, hardness, sulphates, chlorides, phenol and silicon.

Drinking water quality and health

Drinking-water quality is the main indicator of the impact of drinking water on health. To prevent the public drinking contaminated water, the following WHO treatment methods are recommended (see Table 5.5).

The quality of drinking water in Uzbekistan is a very complex problem that has a broad range of health effects, including water-borne infectious diseases, effects on the urinary system, hypertension and long-term effects related to the consumption of water contaminated by pesticides. Microbiological and chemical pollution arise mainly from insufficient waste-water treatment, insufficient water disinfection, the difficulty and high cost of removing pesticides from contaminated water, the scarcity of good-quality water in the Aral Sea basin, and the lack of public information and education on the appropriate use of water resources. Simple, cost-effective measures are not always available. For example, the high level of mineralization of water damages pumps and filters, and many banned or restricted pesticides persist as water contaminant. Furthermore, expensive treatment plants would be necessary to rid the water, in particular, from pesticide contamination.

Table 5.5: Surface water quality

Category	Comment	Examples
I.	Pollution does not exceed MAC levels	Pskem, Akbulak, Kyzlsay, Tashkesken, Terekly, Aksu and Geledarya
II.	Natural background mineral concentration does exceed MPC levels	Aktash-Sai, Ugam, Ahangaran (above Angren City), Gavasai, Kashkadarya at Varganza Village, Amankutan, Sazagan, Charvak and Gissarsky Reservoirs
III.	Background concentrations of some organic or mineral substances are 2-3 times the MAC-	Chirchik River, Akhangaran (medium stream), the upper reaches of the Salar and chanel Karasu, Kokandsay, Naryn, Karadarya, Isfayramsai, Margilansai, Zarafshan above Samarkand City, Tusunsay, Chimbulak,Tuyabuguz,Yujno-Sukhandary, Kayraum, Tuyamuyun, the lower stream of Surkhandarya, Chimkurgansk, Kuyumazar, Tupalang Reservoir, Syr-Darya in the Fergana area and Amu-Darya near Termez and Nukus Cities
IV.	Background concentrations for specific substances are 3-5 times the MAC	Chirchik River below the Chrichik industrial complex, Kokandsai below Kokand City and the Ciab and Sever-Bagdad collectors.
V.	Specific substances up to 3-5 times the MAC	Right bank of the Karasu in Tashkent, Akhangran and Chirchik cities.
VI.	Concentration of specific pollutants can reach 40- 50 times the MAC	Kalgan-Chirchik River, the Salar River below Tashkent and Yangiul cities.

Source: National Report on State of Environment, 1998; State Committee for Nature Protection.

5.7 Aral Sea

Irrigation for agriculture has been used in the Central Asian countries for more 5,000 years, but during the last 40 years, this has become unsustainable. It has resulted in an ecological crisis in the Aral Sea and significant environmental problems throughout Uzbekistan as well as in the region as a whole. The main problems faced in the Aral Sea basin could be summarized as follows:

- The level of water has dropped by 15 metres and only 5 km^3 of water reaches the Sea, compared with 50 to 60 km^3 before 1960;
- The Sea has shrunk to less than half its size;
- The amount of drinking and irrigation water in the region is insufficient and its quality, poor;
- Both water and more than 50% of irrigated land have high salinity, and salinization continues to increase. The annual loss caused by salinity is estimated at US$ 2 billion that is 5% of GDP in the whole of Central Asia. Along the former shoreline, salt and dust have formed a thin white crust, and, when the strong northeastern winds blow, salt and small dispersed dusts are transported and deposited over vast tracts of cultivated land.
- Sea water is contaminated from fertilizers and pesticides that are transported with collector-drainage water and by the wind;
- Biodiversity has been drastically reduced as a result of desiccation and shrinking of the Sea. This includes the loss of river habitat in the deltas;
- Desertification of the Amu-Darya and Syr-Darya deltas is changing the climate in the region;
- All of these factors have had an adverse socio-economic impact on the population in the region through health risks, poor nutrition and unemployment. For example before the crisis there were more than 24 commercial species of fish; these are gone, and 60,000 people are unemployed in the region.

Resource sharing in the Aral Sea Basin

One of the most difficult problems in the region is water resource sharing from the Amu-Darya and Syr-Darya Rivers between upstream (Kyrgyzstan and Tajikistan) and downstream countries (Kazakhstan, Uzbekistan and Turkmenistan). Upstream countries use the water from these two rivers for hydroelectricity generation from the dams during wintertime. As a result, downstream countries receive a lot of water during the winter

but not during the summer when the need is highest for irrigation.

The countries in the Aral Sea basin need to integrate their planning of energy and agriculture, and, equally important, they need to improve cooperation among themselves. There is agreement on water resource sharing and energy production in the region, but it is not consistently implemented, nor does it address the social, economic and environmental impacts of the situation.

Institutional arrangements, policy objectives and programmes

An Interstate Council on Aral Sea Problems (ICAS) and its Executive Committee (EC-ICAS) and an International Fund for Aral Sea Rescue (IFAS) were established to solve the above-mentioned problems. Until 1997, IFAS operated in parallel with the Interstate Council on the Aral Sea Problems (ICAS); in 1997, ICAS was taken over by IFAS.

The Interstate Commission on Water Coordination (ICWC) is a joint commission of the ministers of water resources in the region. It is intended to develop and implement water policy management in the Aral Sea basin. ICCWM includes a secretariat, a scientific international centre and two basin water organizations (BWO Amu-Darya and BWO Syr-Darya). The policies of the ICCWM for the Syr-Darya and the Amu-Darya are implemented by the basin water organizations (BWO). The Commission, which is largely dominated by people representing irrigation, could be more effective if it were to provide for stronger representation from other sectors, and particularly from energy and industry.

There are several interstate institutions and bodies involved in water resource management in the Aral Sea basin. In many cases there is no clear definition of their respective responsibilities, and this results in duplication of decisions and activities. At the minimum, further coordination among them is needed; a new look at an overall reorganization of the water management structure at the regional level may be more effective. In particular, a structure that provides for good multisectoral representation and with a mandate to carry out both cooperation and negotiation is needed.

In cooperation with donor organizations and countries, the five member States of IFAS adopted the Aral Sea Basin Programme, which contains practical projects to be implemented at the regional level. In 1998, the member States of IFAS started seven Regional Programmes. The following regional environmental problems were established as priorities for the Aral Sea basin:

- stabilisation and improvement of the management methods for Aral Sea environment
- rehabilitation works within the Aral Sea zones
- improvement of the water management methods under the conditions of water lack in the region
- capacity building of local and national authorities aimed to implement the regional programmes in efficient way

Activities carried out by Uzbekistan

Uzbekistan is well aware of the problems associated with the Aral Sea crisis, and it has formulated a number of important objectives in its NEAP toward improving the situation. These include the following:

- Development and implementation of a regional strategy for water resources;
- Mitigation and restoration activities in the Amu-Darya and Syr-Darya deltas
- Broader use of a basin (watershed) approach to water management, including the creation of basin agencies and water authorities, to ensure a more efficient and sustainable use of water resources;
- Improvement in environmental health and sanitary living conditions of the local population;
- Restoration of the delta ecosystems with a focus on restoring fisheries, and bird and animal species;
- Reuse of mineralized waste-water for crop irrigation when applicable; and
- Integration of international obligations into national programmes and action plans on environmental and water resources management.

5.8 Conclusions and recommendations

Uzbekistan needs to develop a strategy for water management that recognizes the need for long-term shifts in the structure of all water uses, with a particular emphasis on the use of water for cotton irrigation. In addition, it is essential that the Central Asian countries, including Uzbekistan, will follow the recent agreements and decisions on

allocation of water from the Amu-Darya and Syr-Darya rivers' basin.

The unsustainable use of water resources in the Aral Sea basin has resulted in a major ecological crisis, with widespread social, economic and environmental impacts in the region. Both the rational use of water resources and a negotiated agreement for sharing these resources at the regional level are urgent tasks for the Governments of the Central Asian countries. Further, this regional cooperation and planning must look at energy and agriculture as interdependent sectors.

There are a number of interstate institutions and bodies involved in water resource management in the Aral Sea basin. However, their respective responsibilities are not well-defined and frequently overlap. There is also inadequate representation of stakeholders in these institutions. Attention needs to be given to a reorganization of the overall water management structure at the regional level.

The Interstate Commission for Water Coordination (ICWC) establishes water quotas, and every year the Governments of the riparian countries decide and jointly agree on the quantity of water that should be allocated to each country. Distribution of quotas is carried out by two interstate water basin management organizations: one for the Amu-Darya basin and the other for the Syr-Darya basin. However, questions have been raised regarding the extent to which the quotas are monitored.

There is also no enforceable intersectoral agreement that addresses the environmental, social and economic problems and that takes into account sharing of water resources, sustainable development of agriculture and energy production in the region.

At the Aral Sea basin level:

Recommendation 5.1:
The Ministry of Agriculture and Water Management and other responsible bodies in cooperation with the ministries and bodies involved in water management in the riparian countries in the region should:

- *Ensure that all stakeholders are represented in the Interstate Commission for Water Coordination;*
- *Develop and implement an inter-sectoral agreement that addresses the environmental, social and economic impacts of the Aral Sea crisis and takes into account sharing of water resources, sustainable development of agriculture and energy production in the region; and*
- *Create an inspection or other control mechanism for the implementation of the agreement.*

Significant industrial surface-water pollution is generated in Uzbekistan, but other riparian countries also contribute to the contamination of both the Syr-Darya and the Amu-Darya rivers. Special measures are needed to prevent water pollution of these main rivers. Improving existing or building new treatment facilities for industrial waste-water at the enterprises situated along the Syr-Darya and Amu-Darya rivers are urgent tasks for riparian countries.

Recommendation 5.2:
The Ministry of Agriculture and Water Management and the Agency of Municipal Services and industrial enterprises, in cooperation with their counterparts in the other riparian countries, should improve existing or install new treatment facilities for industrial waste-water for the enterprises situated along the Syr-Darya and Amu-Darya rivers in order to prevent further contamination of main surface water sources in the region.

A monitoring system provides information on water quality and water quality trends in the Amu-Darya and Syr-Darya rivers and their tributaries. However, due to differences in methodology and equipment among the riparian countries (Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan), it is not possible to compare data.

In addition, monitoring equipment and methods used for analysis of water pollution are obsolete. There are no automatic devices to control water quality 24 hours a day. There is a lack of detailed and reliable information on the quantity of pollutants discharged into natural watercourses and reservoirs and a need for more information concerning the range of polluting substances, quantities discharged into the water, their concentration in the water and their environmental impact.

Recommendation 5.3:
The State Administration on Hydrometeorology, the State Committee on Nature Protection the Ministry of Agriculture and Water Management in cooperation with other riparian countries should harmonize the monitoring systems used for transboundary water, in particular the Amu-Darya

and Syr-Darya rivers. This includes the use of the same analytical methods and equipment for measuring water pollutants and the same software for processing and comparing data.

At the national level:

At present the economy suffers from the depletion of surface and groundwater resources; the poor management and condition of the irrigation system; the lack of training and knowledge about rational use of water in agriculture; the absence of economic mechanisms to save and protect water resources and improve their quality; and the lack of modern drinking-water supply equipment. Solving these problems requires the development and implementation of integrated basin management approaches and the development of a strategy for the sustainable development of agriculture.

Water conservation is a critical component of the rational use of water resources in the region. Measures should be taken to develop and introduce integrated management of water and land, to involve the agricultural sector more actively in the management and conservation of water for irrigation, to restructure and improve the water supply and distribution system, to improve the planning of irrigated lands, to introduce water meters, to develop an information system for water abstraction, supply and distribution and to use economic instruments.

Recommendation 5.4:
The Ministry of Agriculture and Water Management should:

- *Develop and implement a strategy for the sustainable development of agriculture that recognizes that water is scarce and that use of water for irrigation must be decreased;*
- *On the basis of this strategy, develop a plan for the use of irrigated lands, taking into account the quantity and quality of the water resources available in the region and the salinity of the soil;*
- *Improve the irrigation system and introduce water metering in agriculture;*
- *Involve the agricultural sector more actively in the management and distribution of water for irrigation.*
- *Set up an association of water users and develop the economic and legal rules for use of water;*
- *Develop regulations and norms on improving water management through restructuring state agricultural units into private ones;*
- *Develop a system of water management on the basin river principles taking into account the experience gained in the countries of the European Union, in particular those with intensive agricultural activities.*

The quality of drinking water in Uzbekistan is a very complex and serious problem with a broad range of health effects. Microbiological and chemical pollution arise mainly from insufficient waste-water treatment, insufficient water disinfection, and the difficulty of removing pesticides from contaminated water. Compounding these problems is the scarcity of good-quality water in the Aral Sea basin and the lack of sufficient public information and education on the appropriate use of water resources. Major efforts need to be made to bring water management practice in line with health priorities and economic realities.

Recommendation 5.5:
The Ministry of Agriculture and Water Management and the Ministry of Health, in cooperation with Agency of Municipal Services, should:

- *Revise the drinking water quality standards in line with WHO guidelines;*
- *Revise the operational procedures for drinking water plant management aimed at overall quality assurance rather than end-of-station chlorination;*
- *Conduct an evaluation of economic instruments for water (including systematic use of water meters to calculate user charges) and if needed, extension programmes to educate households on rational uses of water.*
- *Build facilities for the demineralisation and recycling of collector-drainage water in order to save and protect surface water resources.*

Many cities have installations that only partially treat domestic sewage. The efficiency of existing installations is about 50% for both municipal and industrial waste-water treatment because of obsolete equipment and technology. Concrete measures should be taken to improve the efficiency of existing industrial waste-water treatment installations or to construct new facilities with modern equipment and technologies. At present collector-drainage water is not treated at all.

Recommendation 5.6:

(a) The State Committee for Nature Protection should establish Maximum Allowable Concentration (MAC) for highly toxic substances such as mercury, cyanides and chromium- and strengthen the existing MAC in line with WHO and EU standards. The Ministry of Agriculture and Water Management (MAWM) should enforce these standards and implement the requirements of the NEAP for treatment of toxic wastewater discharged by industry.

(b) The MAWM and the Agency of Municipal Services should create the necessary financial resources for the implementation of the Plan on Water Supply Development, in particular by introducing of metering and appropriate pricing for water consumption.

Recommendation 5.7:

In implementing the Plan on Fresh Ground Water Use and Saving the Ministry of Agriculture and Water Management should urgently take measures to reduce the use of clean ground water for industrial and irrigation purposes with the long-term aim to restrict the use of ground water to the supply of drinking water for the population