WATER FOR ENVIRONMENT AND NATURAL COMPLEX OF CENTRAL ASIA

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An intensive development of economical activity in the Aral Sea basin has been accompanied with an increase of irrevocable water withdrawals from the Amudarya and Syrdarya rivers, mainly, for irrigation needs. Since sixties of XX century, this intensive withdrawal has led to sharp reduction of inflow from those rivers into the Aral Sea and to radical changes in delta.

Professionals note that by the end of the past century, inflow to the Amudarya dela decreased almost by 80% as compared to the mid of the century (1931-1960). This resulted in drying of the Aral Sea, breach of stability of natural hydroecosystems in river downstream and degradation of huge areas in Souther Priaralie (Aral Sea coastal zone).

Dynamics of inflow to the Aral Sea and of sea water level (Fig. 1) shows river flow quantity trends for the second half of XX century and their consequences.

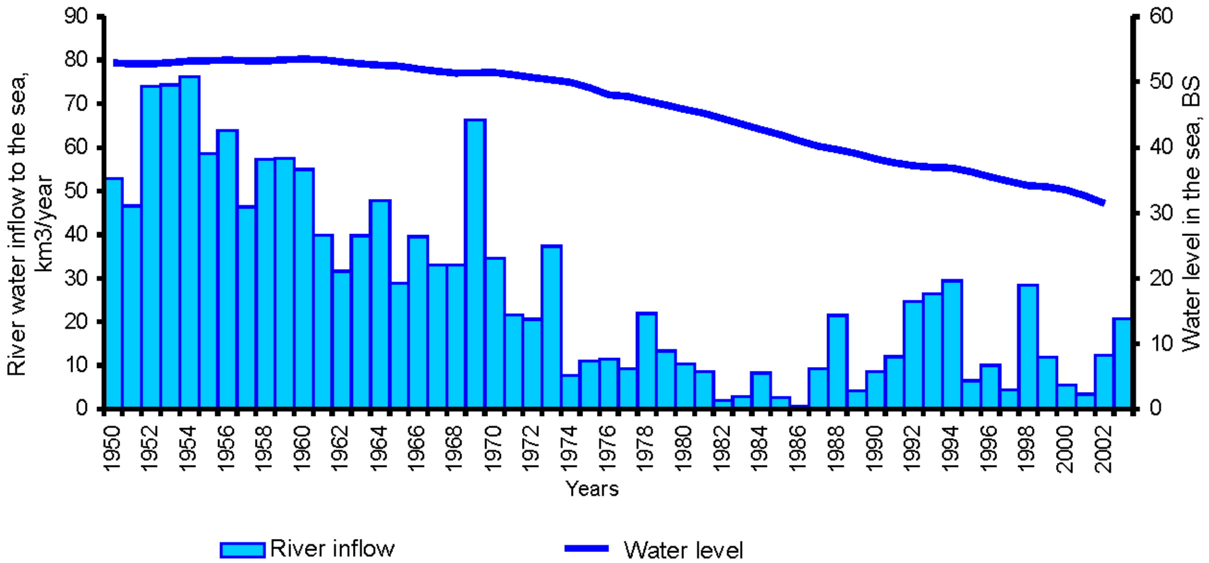

Fig.1.Dynamics of inflow to the Aral Sea and of sea water level

As a result of decrease of the Amudarya and Syrdarya flow and increase of discharge of return water, particularly drainage and waste water from irrigated schemes into the rivers, river water quality deterioration, especially abrupt increase of salinity have been observed since 1980.

For example, in March 1985, river water salinity was 575 mg/l in Kerki section of the Amudarya river, while it amounted to 2700 mg/l in Kyzyldjar section that is 2,5 times more than maximum permissible level. The same situation is observed along the Syrdarya river.

Understanding the acuteness of backlog of environmental problems in eighties led to general conclusion regarding priority of environmental improvement in all water sources located in Central Asian region.

Water quantity and quality

Surface water resources in the Amudarya and Syrdarya basins amount to 114,4 km^3 (Djalalov A.A. et al., 2000) under flow probability of 50 % and 90,6 km^3 under flow probability of 90 %, and the average annual flow is **123,08 km^3** (Glavgidromet's data) (Table 1).

Table 1. Average annual water resources in Central Asian rivers

River – section	Surface runoff		Groundwater inflow	Total
	accounted	unaccounted		
Amudarya river basin				
Vaksh-Tutkoul	20,29	0,05	0,07	20,41
Pyandj-lower Pyandj	34,02	-	-	34,02
Kafirnigan- sum of rivers	5,63	0,12	0,05	5,80
Surkhandarya- sum of rivers	3,77	0,06	0,22	4,05
Sherabad-Sherabad	0,23	-	-	0,23
Kunduz- Askarkhana	4,11	0,01	-	4,12
Total in Amudarya river	**68,05**	**0,24**	**0,34**	**68,63**
Kashkadarya- sum of rivers	1,07	0,03	0,07	1,17
Zarafshan-Dupuli+Magiandarya-Sudji	5,29	0,30	-	5,59
Rivers of Northern Afghanistan, rivers of Turkmenistan	6,10	-	-	6,10

River – section	Surface runoff		Groundwater inflow	Total
	accounted	unaccounted		
Total over Amudarya basin	**80,51**	**0,57**	**0,41**	**81,49**
Syrdarya river basin				
Naryn-Toktogul+lateral tributaries	14,02	0,40	0,30	14,72
Fergana Valley rivers	11,89	0,67	0,69	13,25
Chirchik, Angren, Keles	8,82	0,30	0,33	9,45
Midstream rivers	0,36	0,50	0,35	1,21
Total up to Chardara	**35,09**	**1,87**	**1,67**	**38,63**
Rivers of Kazakhstan	2,45	-	0,51	2,96
Total over Syrdarya basin	**37,54**	**1,87**	**2,18**	**41,59**
TOTAL in the region:	**118,05**	**2,44**	**2,59**	**123,08**

Source: Glavgidromet, Uzbekistan, 2001

About 6% of Amudarya basin runoff and 13% of Syrdarya basin runoff are formed in Uzbekistan. Water quantity flowing to the republic from neighboring countries is 8 times more than its own resources in the normal year.

Fixed available water volume over two river basins as a whole is estimated to be 133,6 km^3, of which 72,4 km^3 is Uzbekistan's share. Out of this share 61,6 km^3 are used in irrigation and 11,3 km^3 for non-irrigation needs.

The mean annual changes of runoffs in Amudarya and Syrdarya are shown in Figures 2 and 3.

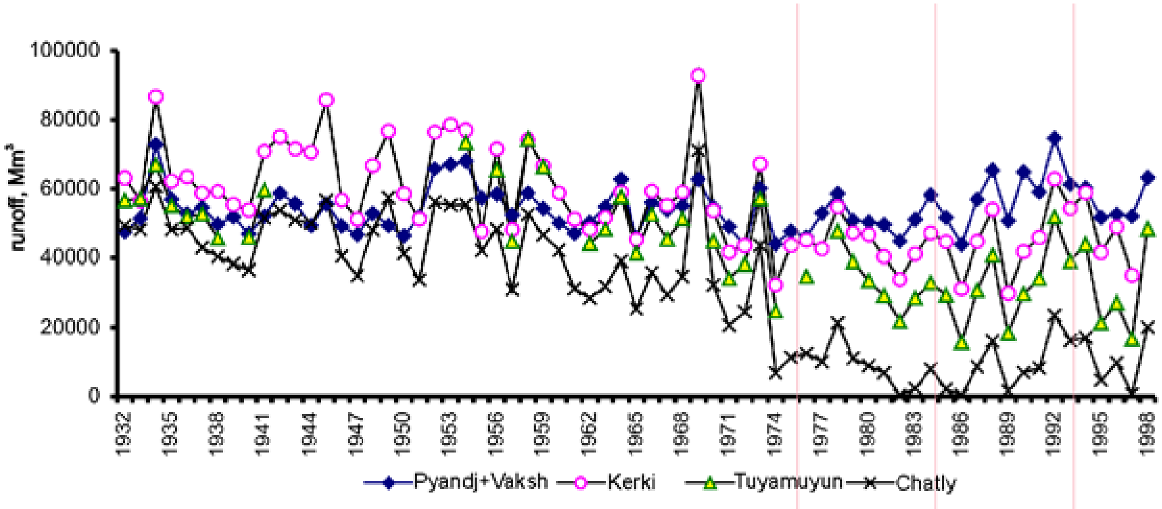

Fig. 2. Dynamics of the mean annual runoff in Amudarya river, 1932-1999

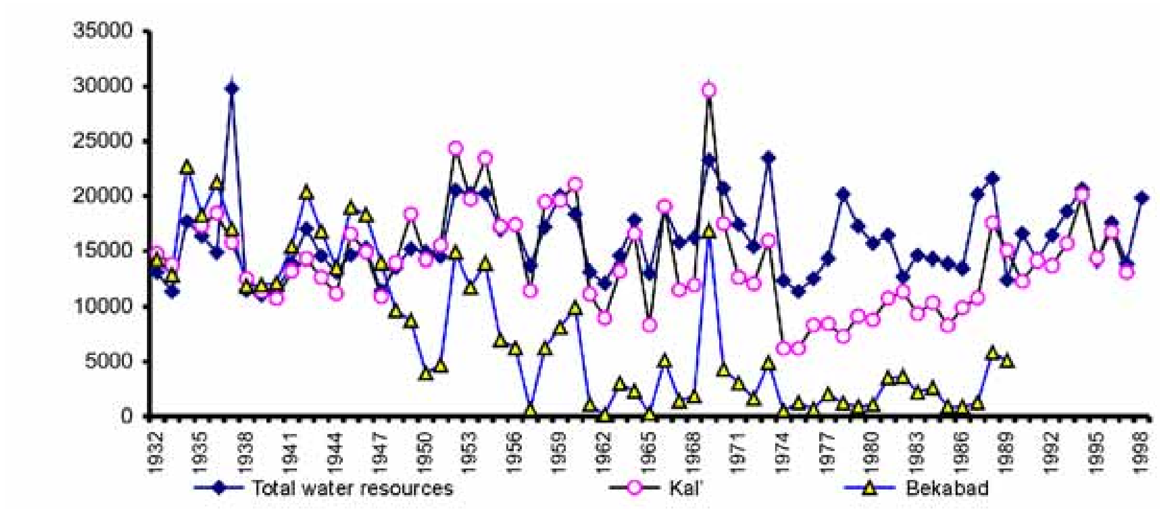

Fig. 3. Dynamics of the mean annual runoff in Syrdarya river, 1932-1999

When river runoff changes, water quality changes as well.

Observations over water quality in Amudarya and Syrdarya over long-term show that in 1950-63 salinity of these rivers varied all over the year within 330 - 715 mg/l, i.e. met acceptable norms. During mentioned period, other river water quality indicators such as major ions, organic compounds, biogenic elements, pH, pesticides, oil products, etc. did not exceed the maximum permissible values.

Lately, in particular, since seventies, the salinity have started to increase gradually and in some of months, especially in winter (January-March) reached up to 2800 mg/l (Amudarya river, Kyzyldjar section).

The mean annual changes of salinity in the Amudarya and Syrdarya rivers per river section as shown in Figures 4 and 5 indicated to salinity growth trend in both time and space. The figures show that salinity started to increase since initiation of river flow regulation and intensive land development.

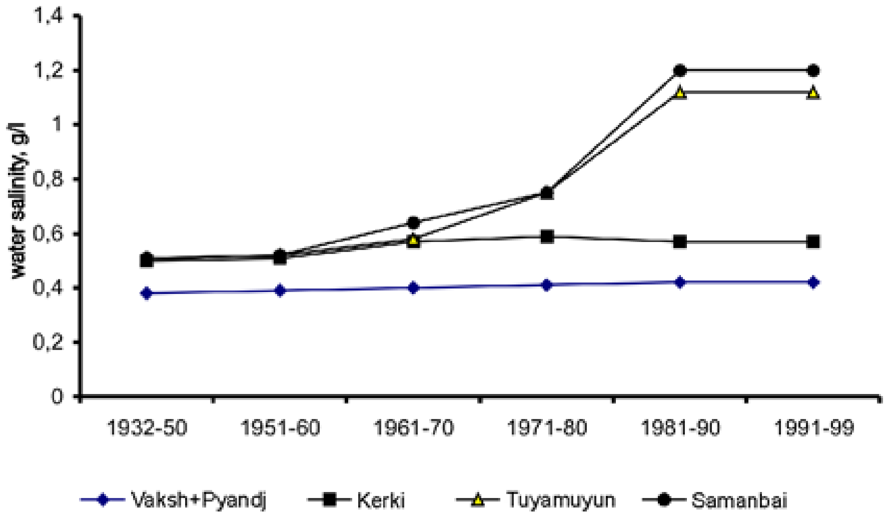

Fig. 4. Mean annual salinity changes in Amudarya per river section

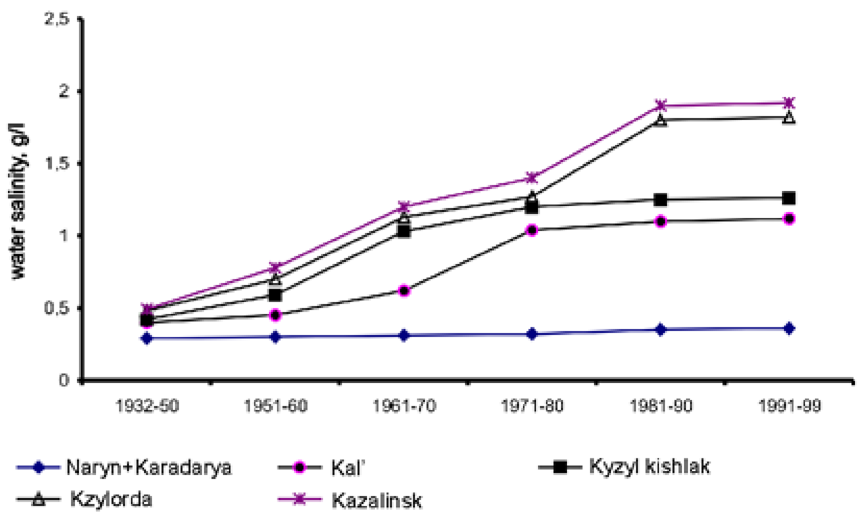

Fig. 5. Mean annual salinity changes in Syrdarya per river section

Thus, higher salinity is observed in downstream river sections, for example, during certain periods in a year the mean monthly salinity reaches 2,0-2,5 g/l in Kyzyldjar section of the Amudarya.

As to the Syrdarya river, high salinity is observed in section located at the outlet from the Fergana Valley, where it is 1,2-1,4 g/l in several months. Water salinity is 1,4-1,6 g/l in Chardara section, 1,6-2,0 g/l in Kyzylorda section, and up to 2,3 g/l in Kazalinsk section, whereas it is not higher than 0,3-0,5 g/l in upstream sections.

Hence, current hydrological and hydrochemical changes in the rivers cause new problems in the regional natural complex, in particular runoff changes in the Amudarya river became one of the causes of the Aral Sea shrinking and of the nature degradation in Southern Priaralie. At the same time, regime changes in the Syrdarya river have posed a threat of ecological instability in area adjacent to Arnasai lake system.

Environmental sustainability around the Aral Sea and in Southern Priaralie (Amudarya river delta)

Until sixties, the Aral Sea was the fourth world largest inland lake. At that time, the sea area was 68478 km^2, and the water volume amounted to 1093 km^3 (1960) that corresponded to a water level of 53,5 m B.S.

Hydrological and hydrochemical regimes of the Aral Sea completely depend on quantity of inflow from the Amudarya and Syrdarya rivers. According to the long-term observation, the maximum inflow to the sea is 76-88 km^3 (1954-1969). Since 1950 to 1964, the total annual inflow from both rivers ranged from 40 to 76 km^3, of which 60-70 % referred to the Amudarya river.

As is well known, since 60-ties, irrevocable withdrawals have greatly increased, and, as a result, river water inflow has decreased to the Aral Sea (Fig.6).

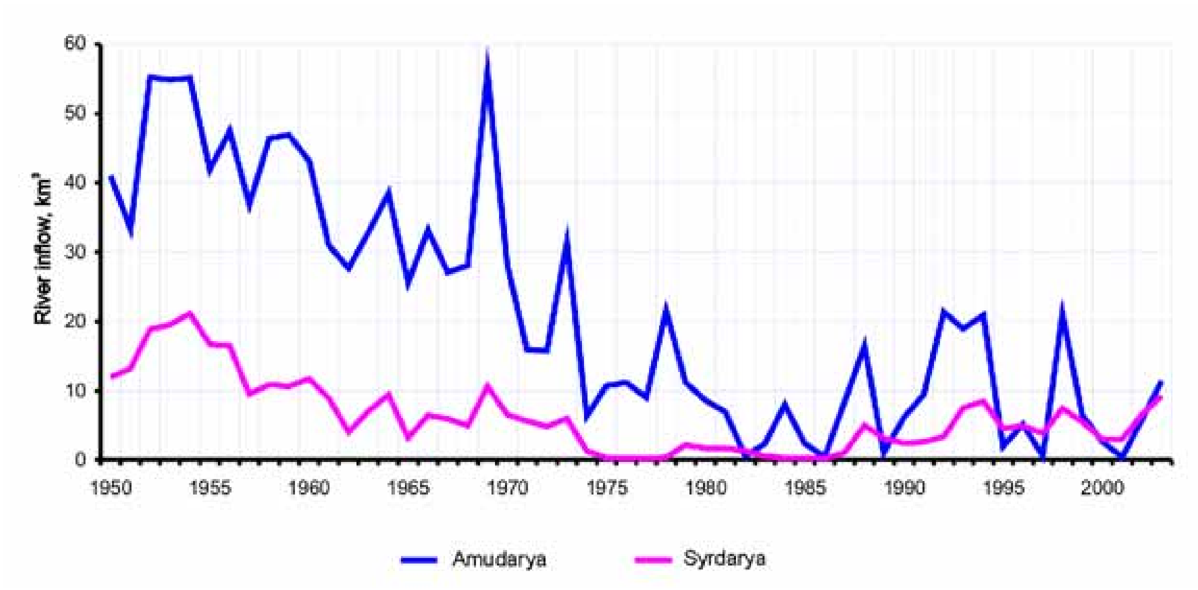

Fig.6 Dynamics of river water inflow to the Aral Sea

Since that period, we have being observing gradual drop of the sea level, and, from 1961 to 1974, a rate of level drop was 0,12-0,45 m/year. Since 1975 to 1991, the rate increased sharply and equaled 0,54-0,84 m/year. In 1992-1995, the level drop rates decreased slightly to 0,07-0,46 m/year. However, since 1996, the rate increased again up to 1,02 m/year. As a result of low-water years 2000-2001, this rate became maximum and amounted to 1,17 m in 2002.

The level drop has led to decrease of water quantity in the sea. The mean annual water volume in the sea was about 1050 km^3 in mid-XX, while now this value is rapidly decreasing and, in 2002, fell to 110,8 km^3, i.e. decreased almost 10 times. Water area has been lowering as well and, at present, the area (Big Sea) has decreased to 28 % of the initial one (Figures 7-8).

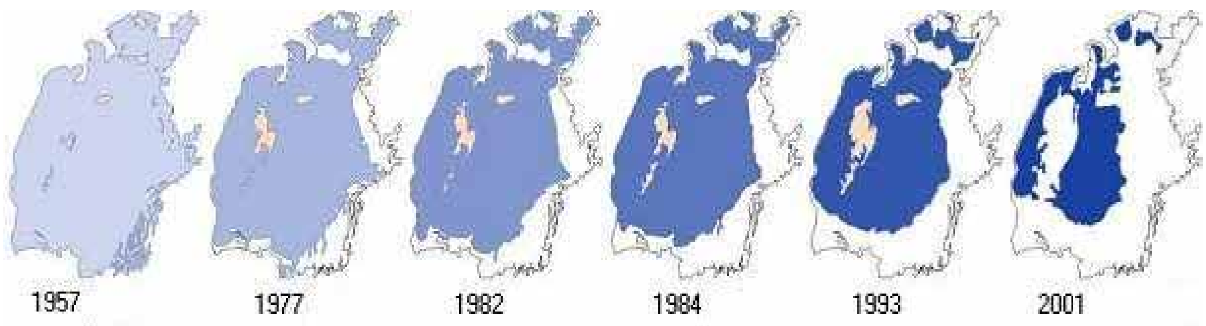

Fig.7 Dynamics of water area of the Aral Sea
Source: GRID-Arendal

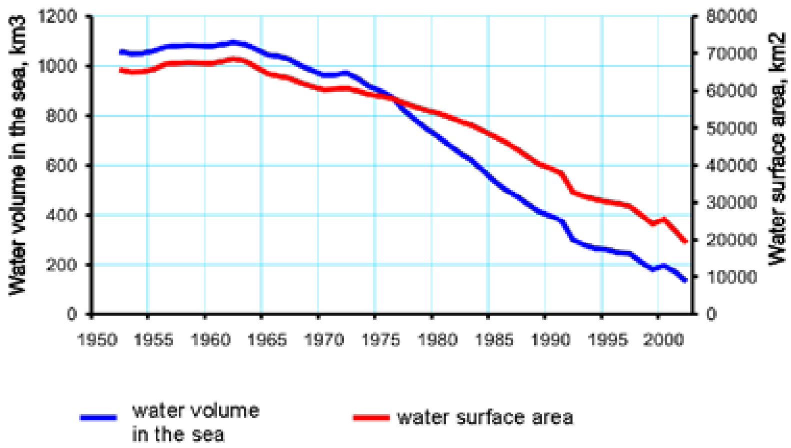

Fig 8. Dynamics of water volume in the Aral Sea and of its area

Moreover, the sea level drop was accompanied with an intensive increase of salinity in the Aral Sea. In 1950-1965, the Aral Sea was a slightly saline water body. The salinity varied from 9,74 to 10,8 %. Until 1980, the rate of salinity increase had been low but since 1981 it speeded up and equaled 1-5 % per year and by 2002 sea salinity amounted to about 75% (Fig.9).

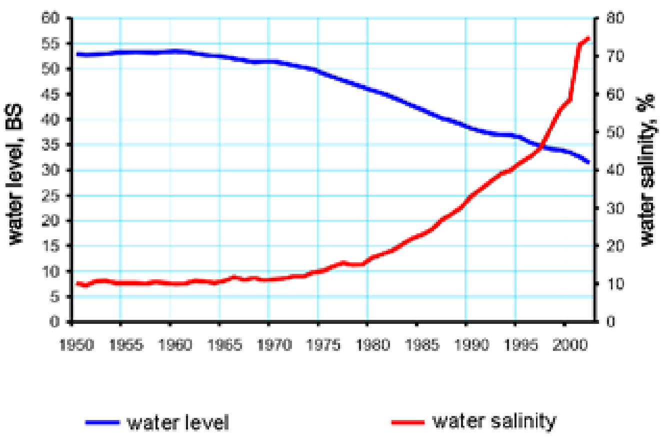

Fig. 9. Water level and salinity dynamics in the Aral Sea

The level drop has also led to occurrence of huge sandy deserts on the exposed seabed. The desertification rate varies from 162 to 2387 km^2/year. Maximum expansion of desert areas was observed in 1981-1985 (2387 km^2/year). In 1986-1995, the rates slightly decreased to about 600 km^2 a year. Since 1996, the desertification rate has increased and averaged 1787 km^2 a year in 1996-2000 (Fig.10).

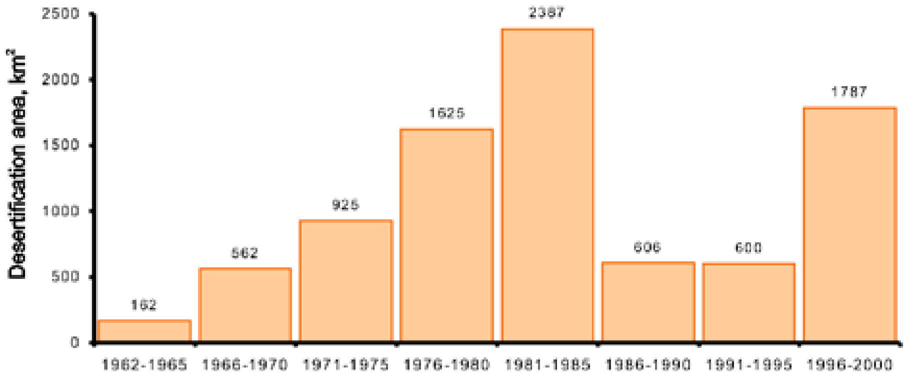

Fig. 10. Desertification rate on the exposed seabed

Nowadays, it is unreasonable to restore the former sea level at 53,0-40,0 m.

Sample calculations of SIC ICWC made for the 50-years series for the future show that, according to "Optimistic" scenario, irrigated agriculture would not suffer from shortage and inflow to the Syrdarya delta (Kazalinsk) would be 8,0 km^3/year. Inflow to Small Aral Sea is estimated to be 6,0 km^3/year, which is enough to stabilize its level at 42 m, with transferring of excess water to Big Sea (construction of dam is finished now and the Northern Sea is being filled. Inflow to delta from the Amudarya river (Samanbai station) is estimated to be 14,3 km^3/year in Optimistic scenario and it is 5,5 km^3 more than in Business as Usual scenario and 9,4 км^3 more than in National Vision scenario.

The body of the Big Aral Sea will be again divided into two components – Eastern and Western parts – with quite different bathymetric characteristics. Western part is deep, while Eastern one is shallow.

Under existing water infrastructure in Priaralie, Western part practically do not receive water and would gradually evaporate, whereas in Western part we will observe high fluctuations of the shoreline depending on inflow.

Option "Business as Usual" would maintain level at ~ 25.0 BS in Eastern part, while in Western part the level would drop to ~ 20.0 BS over the 20 years and further would continue decreasing.

"Optimistic" option leads to periodic division of the Big Sea into Eastern and Western parts, with the mean annual level at ~ 28.0 BS and dropping of water levels to ~ 25.0 BS in Eastern part and to ~ 23.0 BS in Western part.

Under such conditions it is necessary to orient towards maximum restraining of the sea level drop and to further environmental stabilization in coastal area. In other words, the first-priority measures for the near future are environmental maintenance in the area of delta lakes and bays (Fig.11).

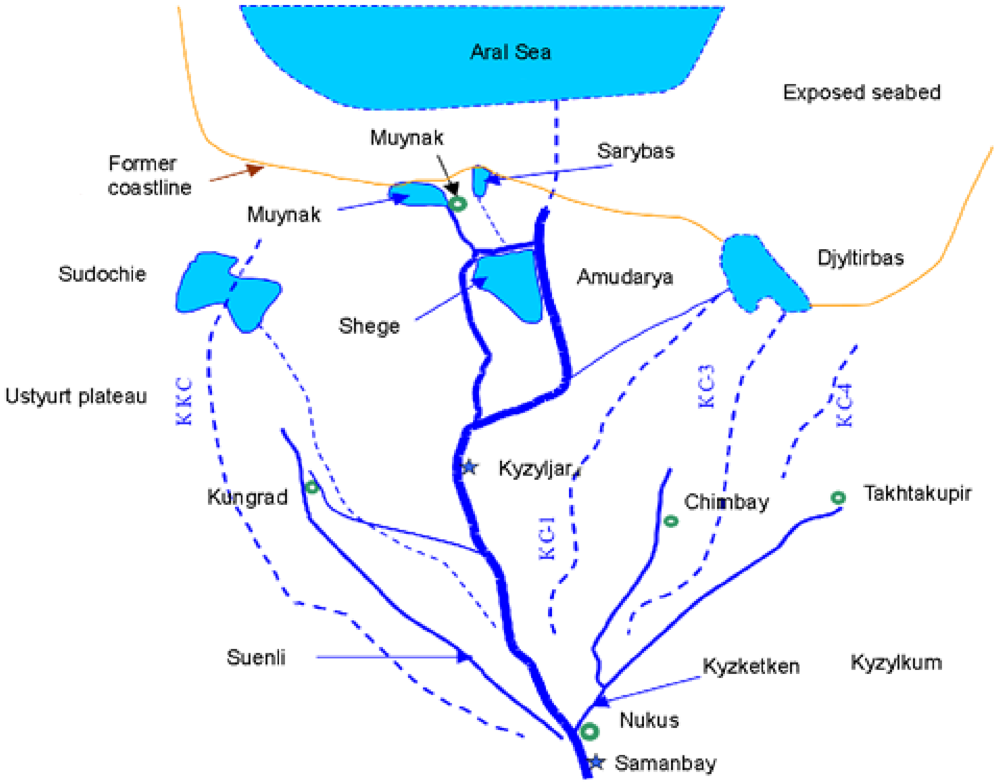

Fig. 11. Water bodies in Southern Priaralie

Analysis of long-term data shows that in 1950–60 the total area of delta lakes, for example, of Amudarya river delta, was 300 thousand ha and salinity of these lakes was not more than 1,5 – 1,7 g/l. Almost all lakes were fresh, with good water quality, and, therefore, favorable environment conditions were maintained in this region.

State of aquatic ecosystems in Amudarya delta zone completely depends on quantity and quality of river water flowing to the region. In the second half of XX century, decrease of inflow to the Amudarya delta caused degradation of all water bodies in Southern Priaralie.

Previously fresh lakes Sudochie and Karateren became saline due to small inflow of fresh river water. In low-water year 2001, salinity reached 43572 mg/l in Sudochie lake. As to other delta lakes, such as Sarybas, Muynak bay, their salinity increased to 5000 – 8300 mg/l. Actually, since 2002, state of the lakes has been improved. According to SANIIRI's measurements, water salinity varied from 3500 to 1200 mg/l in Mynak bay in 2004. Considerable desalination (to 1460 mg/l) was observed in Sarybas bay as well.

Table 2. Water quality changes in Amudarya delta lakes, according to salinity degree

Lake	Salinity, g/dm^3			Salinity class			Salinity range, g/dm^3
	1998	2002	2000	1998	2002	2000	
Shegekul	1,2	1,2	3,6	4	4	6	1,1-5
Muynak	5,1	4,8	3,8	7	6	6	3-18
Sarybas	1,4	1,6	1,6	4	5	5	1,1-3
Sudochie	n/a	1,9	43,6	-	5	10	1,6-40
Karateren	n/a	6	3,2	-	7	6	3-18

At present, many lakes of Amudarya delta exist mainly at expense of drainage and waste water from irrigated areas of Southern Priaralie.

Such delta lakes and former bays as Sudochie, Adjibay, Karateren, Djiltirbas and others depend on the flow from large collectors of Southern Priaralie, including KKS, GK, Ustyurt, KS-1, KS-3, KS-4. Drainage and waste flow from irrigated areas of Southern Priaralie averages about 1,5-2,0 km^3/year.

It may be noted that hydrochemical and hydrobiological regimes of delta lakes are quite unstable and depend on flow probability of the Amudarya river. Therefore, in order to ensure stability of those lakes, inflow should be kept at a level of 4,4 km^3/year irrespective of flow probability.

Environmental stabilization around Arnasai lake system (Syrdarya river basin)

Whereas natural lakes in Amudarya river delta have begun to suffer from water shortage, as a result of human impact, a lot of lakes that are fed by collector, drainage and waste waters have been occurred in natural sinks. An example of human environmental impact intensification is the occurrence of such lakes as Tuzkan, Aidarkul, and Arnasai that is called as Arnasai lake system in desert area in Uzbekistan. At the beginning of their formation, the lakes mainly served as natural ponds collecting drainage and waste waters from irrigated areas in Hunger Steppe.

Human impact on the Syrdarya river runoff has led to forced disposal of considerable winter flow quantity to Arnasai sinks, where previously small lakes such as Arnasai, Aidarkul, Tuzkan (Arnasai lakes). The area of these lakes began to increase rapidly and adjacent area, including irrigated agricultural lands became water-logged.

At present, Arnasai lake system accumulates waste water from Chardara reservoir and drainage and waste water from irrigated land of Nizhnesyrdarya basin administration for irrigation systems.

River water from Chardara reservoir is received in winter and spring. Usually, this lasts from the time of full filling of the reservoir till be beginning of intensive river water diversion for irrigation, i.e. from January to May, and depends on quantity of releases from Toktogul reservoir (Kyrgyzstan) (Fig.12).

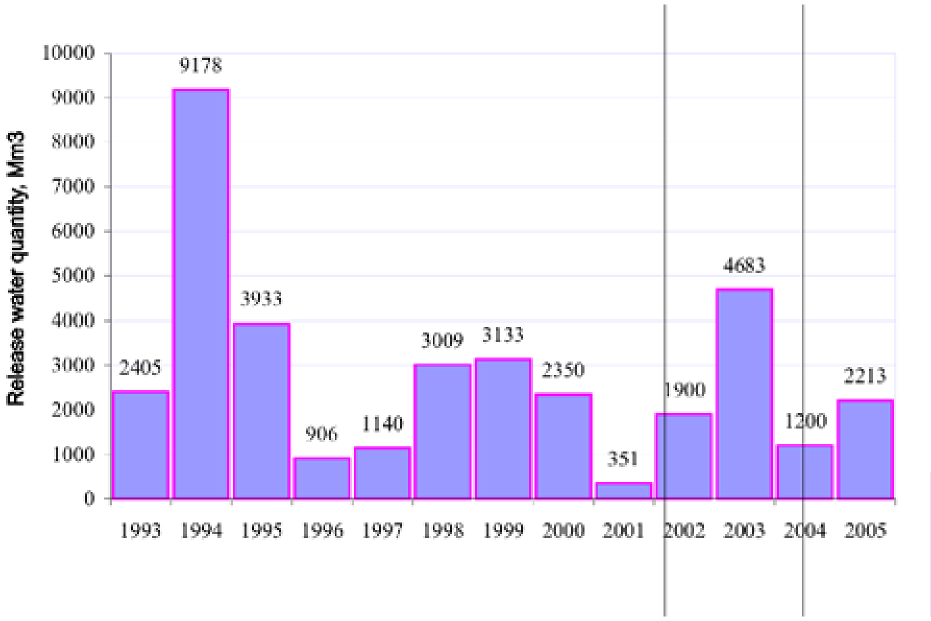

Fig.12 – Dynamics of annual river water releases from Chardara reservoir to Arnasai lake system

Drainage and wastewater inflow to Arnasai lake system, varying subject to flow probability, amounts to:

- 2,8 km^3/year in high-water years;
- 2,1 km^3/year in normal years;
- 1,5 km^3/year in low-water years;

Due to raise of water level of the lakes caused by intensive disposal of winter river flow, water quantity in the lakes and flooded area are increasing (Fig.13).

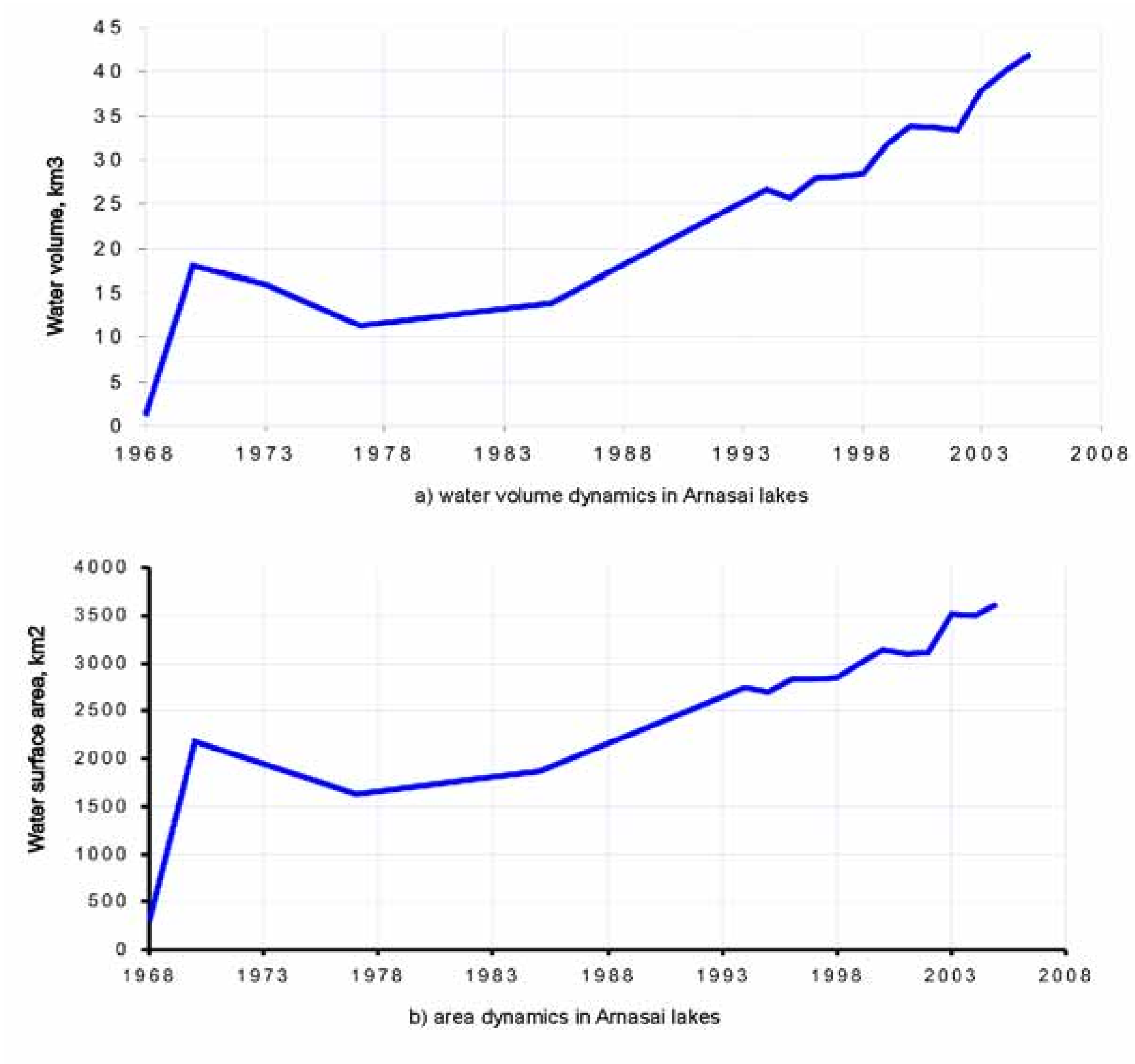

Fig. 13. Dynamics of water quantity and area of Arnasai lakes

As a result of flooding of huge areas within Arnasai lake system, Uzbekistan's economy suffers great damage. In order to prevent this phenomenon, massive efforts are needed for achievement of coordinated water policies of the riparian countries, particularly of Kyrgyzstan.

Thus, unreasoned human impact on water resources may cause more intensive desertification (which takes place in Southern Priaralie), on the one hand, and economic damage growth and biodiversity losses due to flooding of vast area (as in Arnasai lake system), on the other hand.

Current mechanisms for ensuring water supply to environment and natural complex

Water resources management and allocation in Central Asia at the regional level is under jurisdiction of the Interstate Commission for Water

Coordination (ICWC), while at national level this falls under responsibility of relevant Ministries, Departments and other Agencies.

Besides, at the interstate level, Basin Water Organizations (BWO) of Amudarya and Syrdarya are occupied these issues. 85 - 90 % of their activity mainly refers to management and allocation, as well as use of water resources. It is necessary to note that, at present, the interstate water institutions (ICWC, BWOs) do not sufficiently deal with such issues as provision of environmental releases, protection of water resources from pollution, etc. by the reason that these refer to national level, though By-Laws of the institutions include water protection. However, actually, these provisions are not fulfilled and remain on paper.

Environmental needs regarding water from Amudarya river and Syrdarya river are mainly determined by sanitary releases along the river channels, by limits of inflow to the river deltas and the Aral Sea (Priaralie), as well as by special releases (from Amudarya) to irrigation systems in Khorezm, Dashoguz, and Karakalpakstan.

In general, three types of releases are considered: *ecological*, *sanitary* along the river and *sanitary-ecological* to irrigation network of canals.

Ecological releases along the rivers are necessary to maintain natural and artificial aquatic ecosystems. As such ecosystems we can consider Priaralie systems. Arnasai lake system is not considered since its status has not been determined and the countries have not agreed yet upon its water requirements as of ecological system. There is no unique decision on environmental demand of Kazakhstan's part of Priaralie. Given problems needs special modeling as was made for Amudarya river delta.

Sanitary releases along the rivers are required to sustain rivers as water bodies of natural (environmental) and social importance, in particular to avoid deterioration of sanitary conditions and quality of river water.

Sanitary-ecological releases are made to irrigation systems of Khorezm, Dashoguz, and Karakalpakstan so that keep minimum volumes in canals, mainly for household and drinking water supply.

Limits (quotas) of inflow to Priaralie (including collector flow) and additional releases to irrigation systems are established for growing and non-growing seasons at meetings of the Interstate Commission for Water Coordination (ICWC).

There exist conciliatory documents that were approved at the meetings regarding setting of necessary inflow (ecological releases) in quantity of 3,0 km^3 for delta watering. These provisions, actually, are not fulfilled, especially in low-water years.

Major positions related to water management and protection at the national level, i.e. at the level of the Republic of Uzbekistan, are regulated by the following documents:

- Constitution of the Republic of Uzbekistan, 1992;
- Water and Water Use Law, 1993;
- Nature Preservation Law, 1992;
- Decision of the Cabinet of Ministers 1992 on Adoption of Regulation regarding Water-Conservation Zones at Reservoirs and other Water Bodies, Rivers, Main Canals and Collectors, as well as at Sources of Drinking and Household Water Supply, of Health and Recreation Functions in the Republic of Uzbekistan.

According to the Constitution, Article 55, "land, the interior, water, flora and fauna and other natural resources are the national property, subject to rational use and are under the protection of the Government".

According to the Water and Water Use Law, Article 1, objectives of the national legislation are: "regulation of water relations, rational water use for social and economic needs, water protection from pollution, clogging and depletion, improvement of the state of water projects, as well as protection of business, institutions, dehkan farms, and citizens in area of water relations".

The Article 3 of this Law sets that water is the state property and the national wealth of the Republic of Uzbekistan. This refers to: rivers, lakes, reservoirs, other surface pools and water source, canals and ponds, groundwater and glaciers.

There are also regulations on maximum permissible concentrations and other criteria for assessments.

In principle, the republic has good legislative base ensuring management and protection of water resources and regulating all aspects regarding implementation.

However, in reality, until now, environmental and natural complex matter has not been raised so urgently both in Central Asia and at national level.

At least, approximate assessments of required water for the environment and natural complex did not always represent the facts, and, finally, this has led to environmental ill-being in certain areas of Uzbekistan and, first of all, in river deltas.

The whole agricultural policy and provision of flow share for the environment depends on flow probabilities in the Amudarya and Syrdarya rivers. In high-water years, as a rule, we have excess flow which is allocated to environmental needs. The problems arise in low-water and in normal years.

In low-water years, water supply to ecological objects (inland pools, pastures and grassland, river deltas, etc.) is almost stopped. For example, in 2000-2001, Amudarya river downstream even faced the problem with drinking water supply to population.

In terms of priority and importance of keeping flow for environment, the main objective is to preserve bio-resources in Amudarya and Syrdarya deltas.

SANIIRI and Ministry of Agriculture and Water Resources estimated that to maintain good environmental conditions in Amudarya river delta, ecological flow (release) downstream of Takhiatash waterworks could be 5556,8 Mm^3/year, including 1151,1 Mm^3/year of collector waters.

Since 1991, ICWC meetings annually fix limit of sanitary-ecological releases in an amount of 650 Mm^3/year for the Amudarya downstream (within the area of Uzbekistan).

Resource-based economic approach to natural resources use, primarily of water lies in the heart of environmental and social problems in Central Asia. Under such approach, water resources (available stock, withdrawals, allocation among the states, etc.) are viewed only from the angle of supply-side. Environmental role of water resources, demands of natural landscapes and ecosystems for their preservation, as well as probable consequences of disturbance have not been considered at all. Unfortunately, such approach to water use has been dominating yet. At the same time, The Aral Sea base shows that the momentary economic benefits from extra produced rice or cotton at expense of unbalanced water use are not comparable with the ecological and social losses caused by disappearance of the sea, destruction of Prearalie infrastructure, and large-scale deterioration of people health.

This situation calls for elaboration of new reliable management mechanisms that are based on the balance of economic interests and of natural ecosystem sustainability. In this context, an essential element of any water-management activity should be ecological forecasting. This should go before development of water use projects and be based on data of regular, systematic, and reliable observations over ecosystem elements and on data from forecast models. It would be advisable to develop methods for economic assessment of the environmental component of water resources in order to consider value of aquatic ecosystems in cost-benefit analysis of water use.

National water laws and related laws should reflect water functions as a means to maintain natural ecosystems. Principle of obligatory preservation of aquatic ecosystem conditions should be laid as major provisions of such legislation.

Regional Water-Management Master Plans should be viewed as an important tool for ecosystem approach to water-related activities. Riparian countries should include ecosystem requirements both in water management plans for certain parts of watershed of transboundary water bodies and in bi- and multilateral actions plans covering the whole watersheds.

For water planning and management, the river basin should be viewed as a single complex of ecosystems since it represents a successive chain of interlinked local ecosystems from sources till estuary. This approach calls for more active and coordinated inter-governmental cooperation at all levels and for development of new effective management tools and facilities. Development of models of environmentally safe river run-off is very important. The models could be used in estimations of optimal scope of water-management activities.

The ecosystem approach to management helps to assess value and role of water resources in Central Asia in different way. First of all, this refers to flow formation zones located in Tajikistan and Kyrgyzstan, as well as to large water bodies, such as the Aral Sea, Balkhash lake, Issyk-Kul lake, Irtysh river and others. Preservation of glaciers in Kyrgyzstan and Tajikistan and rational water use in the region is a guarantee of safety and sustainable development in Central Asia and adjacent areas.

Measures undertaken for environment and natural complex conservation

Governmental agencies, such as State Committee for Nature Conservation, Ministry for Agriculture and Water Resources, and Uzbek Hydrometeorological service deal with all the issues related to environment and natural complex conservation and to aquatic ecosystems use.

State Committee for Nature Conservation is responsible for conservation of the environment and natural complex, including water resources and aquatic ecosystems, monitors water quality and sets quotas for catch of fish, muskrat and various bird species.

Ministry of Agriculture and Water Resources of Uzbekistan is responsible for observance of water use, distribution, management and protection rules. The Ministry’s scope of activities extends mainly over irrigated lands.

As was mentioned above, all natural resources, including water, are under protection of the Government. The Governmental Agencies undertake great efforts at local level to ensure observance of nature and water use laws.

In order to improve environmental conditions and water management, Uzbekistan participates in development of regional and national programs supported by international donors with share contribution from the republics.

Great activity has been carried out during last decade under the World Bank's Project "Clean Water and Sanitation", with financial contribution of Uzbekistan. Since 1999 to 2002, GEF Project was implemented together with the World Bank on construction of ecological object in the Amudarya river delta – "Restoration of Sudochie Lake".

In 1999-2002, comprehensive studies of periphyton biocenoses and zoobenthos were carried out in Sudochie lake within the framework of the WB and GEF Project "Environmental Monitoring of Sudochie Lake Wetland". Number of discovered species decreased twofold over 3-year studies (critically low-water years 2000-2002) (Talskih V.N., 2003).

Among recent on-going projects, the pilot project "IWRM in Fergana Valley" implemented under support of Swiss Development and Cooperation Agency (SDC) and the ADB's Project "Water Management in Command Zone of Amu-Zang Canal", which plans rehabilitation of pumping stations and large irrigation canals in 2005-2009 are the most important.

In 2004, through a loan of the WB and share contribution of Uzbekistan, activities on reconstruction of Southern Collector in the Republic of Uzbekistan were started. The project also includes nature conservation activities and restoration of natural pastures and grassland.

Strategy for achievement of sustainable development and poverty reduction, with focus on construction of water supply and sanitation facilities, as well as on environmental sanitation is a priority direction in Actions Plan of the Republic of Uzbekistan.

The main challenge of future sustainable socio-economic development in Priaralie is achievement of agreement between the riparian countries on amount of environmental demand for water, which is to be maintained in inflow to Priaralie in different, in terms of water availability, years.

As a result of these measures, progress has been made in area of nature conservation, though there are a lot of problems still to be solved.

Conclusion

As was mentioned above, water supply and water protection in Uzbekistan are not purely national issues but, in many respects, depend on policies of other Central Asian republics. In absence of agreement and interest of all Central Asian republics, one can't solve problems of environmental and nature preservation in the region as a whole, including in Uzbekistan.

Despite available and perfect laws on environment and nature preservation at national level (particularly in Amudarya downstream zone), this issue remains unsolved due to lack of recognition by riparian states of issue importance in terms of provision of necessary water quantity. We are observing extensive environmental deterioration that, finally, lead to socio-economic ill-being.

Current challenge is how to match the increasing demand for irrigated agriculture production and impossibility to reduce irrigated areas due to particular socio-economic importance of irrigation for the region with a need to increase environmental value of water, found and allocate necessary water quantities for deltas and rivers as independent water users. A trade-off between irrigation and nature use should be found.

This could and should be based on changes in way of thinking and methods of water use so that to improve relations between society and the nature.

Water users should orient to achievement of potential water productivity both in irrigation and in other water uses. At present, actual water productivity in grain-production farms varies from 1,3 to 2 m^3/kg of grain under potential productivity of 0,8 m^3/kg. Here we have reserves of at least 35 ... 50 % of water used to obtain the same yields. Besides, there are huge water losses due to poor management, uncoordinated water delivery at the interface between water hierarchical levels, etc. Thus, we can surely release, at least, 25 ... 30 % for the nature. And we do not need more! If we could guarantee minimum 25 ... 30 km^3 of water to the nature out of available 118 km^3, it would be sufficient to make our rivers clean and productive, instead of being runoff ditches, and to revive fish, muskrat, birds and riparian woodland in river deltas. What do we need in this context:

- transfer from supply-side to demand-side management;
- develop extension services for farmers to provide them with the tools of economic and rational water use;
- approve and strictly observe environmental demand at national and regional level;
- on this basis, restore deltas and provide stable inflow to the Aral Sea. Kazakhstan shows excellent example in this respect through the Project

of Small Northern Sea which is close to completion and the developing Project for Syrdarya delta management and improvement. Amudarya river delta is less addressed in this respect;

- apply principles of "consumer pays" and "polluter pays" everywhere;
- organize transboundary return flow management through BWOs and in-system return flow management and use through National basin administrations;
- involve stakeholders in protection of small-rivers and water-protection zones;
- establish system of water-ecological monitoring and, most of all, water quality monitoring;
- keep the public aware about transfer to hydro-ecological water management.

In order to mitigate adverse environmental conditions connected with pollution of aquatic ecosystems, we need to make a number of decisions at regional and national levels. The major points of those decisions would be:

1. Development of a long-term, consensus strategy of Central Asian republics for ensuring water for environment and natural complexes, similar to those developed at international level.

2. Raising of role and authorities of BWO "Syrdarya" and BWO "Amudarya" regarding provision of guaranteed inflow to environment and natural complexes.