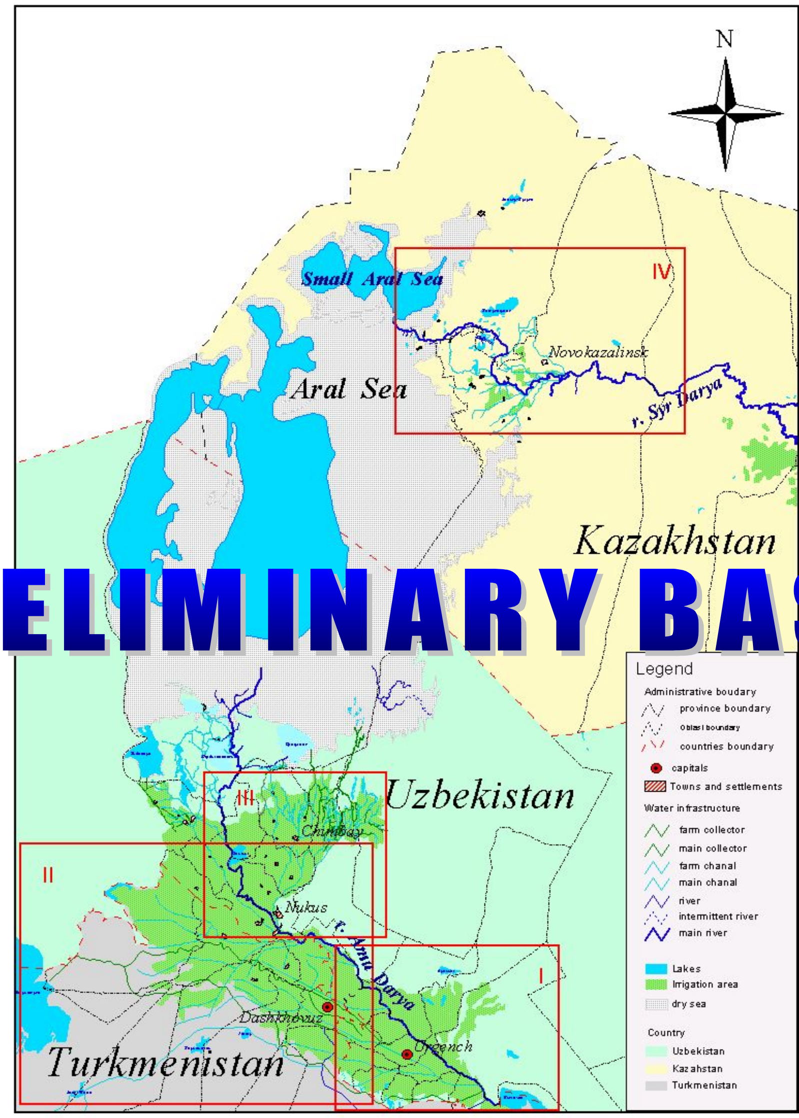
Interstate Commission for Water Coordination (ICWC)
Central Asia

Scientific Information Center of ICWC (SIC ICWC)

«TRANSITION TO INTEGRATED WATER RESOURCES MANAGEMENT IN AMU-DARYA AND SYR-DARYA LOWLANDS AND DELTAS»



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ABBREVIATIONS

WR – Water Resources
WL – Water legislation
WRM – Water Resources Management
GWP – Global Water Partnership
CWR MA - Committee for Water Resources at the Ministry of Agriculture
KMC - Karshi main canal
KR – Kyrgyz Republic
MWR – Ministry of Water Resources
ILF - International-legal framework
ASBP – Aral Sea Basin Program
RK – Republic of Kazakhstan
RT – Republic of Tajikistan
RUz - Republic of Uzbekistan
TW - Tuyamuyun waterworks
CAR – Central Asian Region
AADIC - Administration of Amu-Darya Irrigation Canals
AADIS - Administration of Amu-Darya Delta Irrigation Systems
ABPC - Amu-Bukhara pumping canal
ACCWU - Agricultural Consumer Cooperatives of Water Users
AIC - Administration for Interstate Collectors
BAIS - Basin Administration for Irrigation Systems
BAWMS - Basin Administrations for Water-Management System
BWA - Basin Water Management Authority
CAC - Central Asian Cooperation
CAWR MAWR - Central Administration of Water Resources at the Ministry of Agriculture and Water Resources
CC CPSU – Central Committee of Communist Party of the Soviet Union
CDW – Collector-drainage water
DA – Daykhan Association
ECDO – Economic Cooperation and Development Organization
ESCAP – UN Economic and Social Commission for Asia and Pacific
GDP – Gross Domestic Product
GWT – groundwater table
HLRS – Hydro land reclaiming system
IA - Interstate Agreements;
ICWC – Interstate Commission for Water Coordination
IFAS – International Fund for Aral Sea Saving
IWPC – International Water Power Consortium
IWRM – Integrated Water Resources Management
MRWR – Ministry of Reclamation and Water Resources
NAS - Northern Aral Sea
NGO – Non-governmental organization
NNO – non-governmental non-profit organizations
O&M – operation and maintenance
RSE - Republican state enterprises
SIC ICWC – Scientific Information Center of ICWC
TISA - Tedjen Irrigation Systems Authority
WC – Water Commissions
WHO – World Health Organization

WPC – Water Power Consortium
WUA – Water Users' Association
WUC – Water Users' Cooperative
WUPMP - Water Use and Protection Master Plans
WUU - Water User Union

INTRODUCTION

The lowlands and deltas of the Amu-Darya and the Syr-Darya rivers (Fig.1) suffer from an unsteady and unreliable supply of water, which has severely declined in its quality (both surface water and groundwater) from the nineties to the present. This has led to a crisis, where human health, livelihoods, economic development, and ecological sustainability are at great risk[1]. Numerous technical inadequacies only compound the danger.

As a whole, the Aral Sea Basin has institutionally precarious interstate arrangements[2] and a complicated regulatory and management framework, at both the national and international levels. At the national level, some states (Kazakhstan, Uzbekistan) made lately noticeable improvements by modifying their management framework and changing their laws. Nevertheless, the governments are still grappling with joint management of the available water resources in the Basin, staving off a close interaction towards a solution on the basis of parity and hydro-solidarity. Thus, more needs to be done to ensure a fair share of water for all inhabitants and sectors of the economy and preserve the unique and sensitive natural environment of the lowlands and river deltas.

To ameliorate the situation in the lowlands and deltas, the new independent states need to find a way to endorse water management within the Basin in a more holistic manner. At the level of water users, work has begun in all States (except Turkmenistan). This work, representing the lowest level of the management system, marks the efforts to strategically plan for reforms to transition to the Integrated Water Resources Management (IWRM). Although these are commendable beginnings, all organizations, individuals, and the entire governing - legal and regulatory - systems must learn how to do it more effectively at the national scale, as well as at the interstate level for each river basin. Governments need to improve their capacity for land and water use planning and allocation, regulation, data management and diversification of water supply sources (depending on the type of use or economic activity), as well as monitoring. Policy improvements and related laws and decision-making need to be considered at all levels of the system with stakeholders' participation.

Strengthening cooperation in water resources management between the Central Asia States to positively affect the lowlands and deltas is not easy; but it is urgently needed under the current socio-economic conditions of the region. The underlying principles of the IWRM lend themselves to this task.

[1] The Aral Sea Basin was quoted by the UN Environmental Programme as one of the most staggering disasters of the twentieth century. The Aral Sea was the world's fourth largest inland lake in 1966, covering 66,100 km^2. By 1990 the inflows have substantially declined and the salt content dramatically increased, with the Sea reaching the salt content of 30 g/l in 2000. Large areas of the Sea bed became exposed, causing great economic losses to fisheries (shrinking the annual catch from 400 000 to a mere 200 tons), affecting the environment by wind-blown sand (practically the entire Tugai forests and the muskrat population have been destroyed), and having an extremely negative impact on people's health and lives (decline in the quality of air and water for drinking and domestic use).

[2] With Kyrgyzstan being the upstream state and Kazakhstan the downstream state on the Syr-Darya and Tajikistan as the upstream, and Uzbekistan and Turkmenistan the downstream states on the Amu-Darya, conflicting situations as to the shares of water have arisen between different states, in addition to the complexity of managing the storage and river flow for two competing sectors - irrigation and energy.

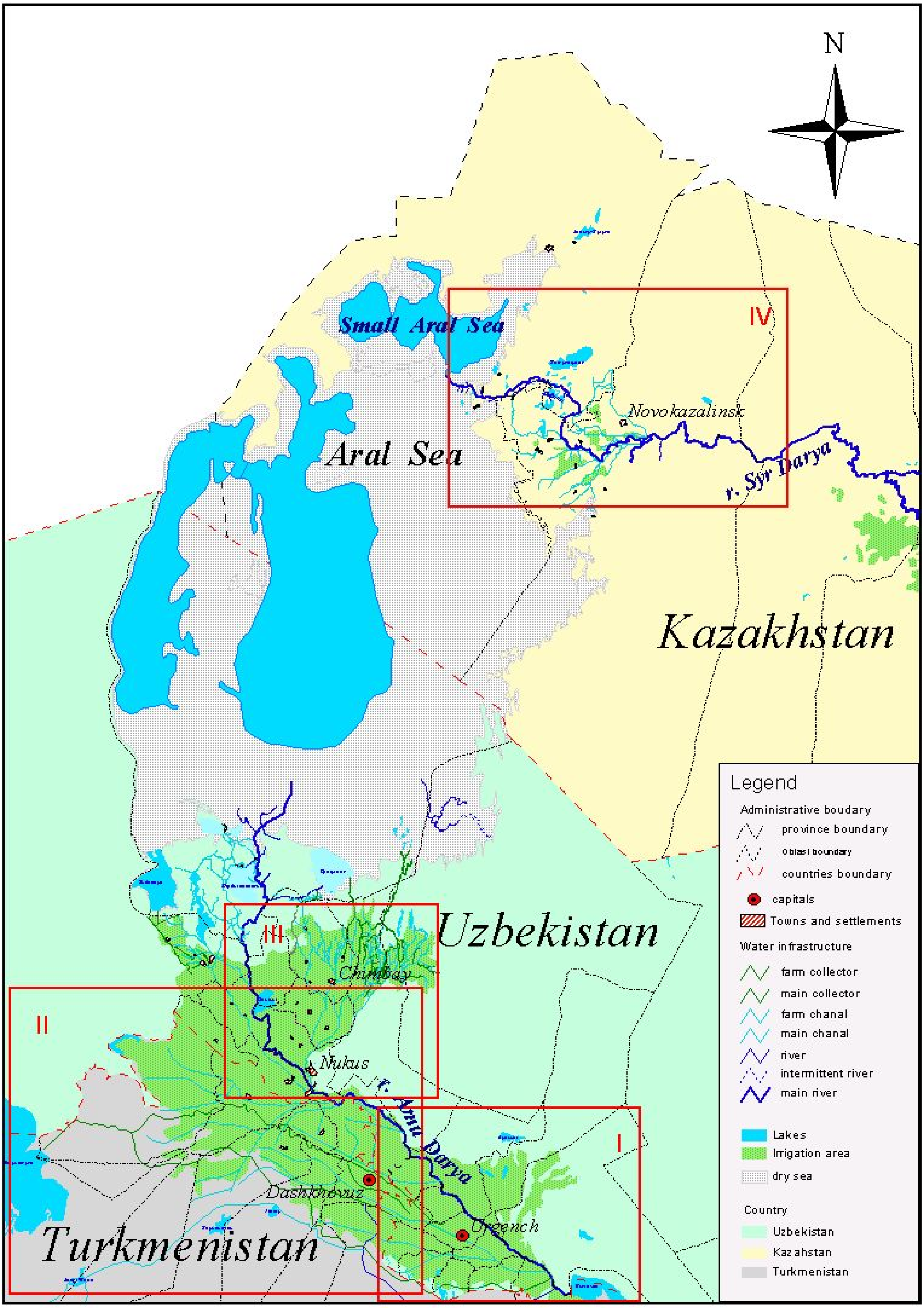

Fig. 1 Amu-Darya and Syr-Darya lowlands and deltas

PROJECT GOAL AND APPROACH

The goal of this project is to present a document on the level of preliminary study with a detailed implementation plan to support the future development of the IWRM[3], strengthen the capacity of water users, water managing associations, organizations and entities, and create water partnerships at the national and international levels, including the trans-boundary IWRM aspect. It represents a preparatory document for implementing the IWRM at the national and trans-boundary level, funded by a grant from the OESI Program of the Central Asia and Caucasus Regional Environmental Office.

The project involves the areas suffering the most from water scarcity and destruction of the environment: Dashauz province (Republic of Turkmenistan), Kzylorda province (Republic of Kazakhstan), Khorezm province and the Republic of Karakalpakstan (Republic of Uzbekistan). The project is concerned with pilot areas, typical for the affected zones, selected as small demonstration hydrographic units with the potential of expanding the aspects of the IWRM to the level of the irrigation system.

During the project duration work has been done systematically in phases - collecting a variety of technical, institutional, socio-economic and ecological data and analyzing them. The key issues have been identified and remedies proposed to make changes and steps toward IWRM, as well as desirable improvements to fulfill the economic potential, restore and sustain conditions for healthy life in the lowlands and deltas. The work was done by four national working groups, a group of regional specialists led by a project manager/coordinator, with the assistance of a foreign expert. Detailed comments were made to correct specific problems in each pilot area when analyzing the issues. Attention was paid to the institutional strengthening, cross-sectoral linkages, and elements that support a water partnership amongst the water users and integrate the public and stakeholders into the policy development process, according to the guidelines of the Global Water Partnership in the region (GWP CACENA). A plan of activities and preliminary budgets for a period of three years were prepared.

Recognizing that even the industrialized and water "rich" countries are shifting from development of new water supplies to water conservation and protection of water quality, this project strives to assess the needs for making a transition to the IWRM in the lowlands and deltas of the Amu-Darya and the Syr-Darya, as the most socially stressed zones. Up to an extent, the project is building on the experience with the Swiss-funded Ferghana Valley project, but additionally takes into account the elements of the trans-boundary water management.

The transition to IWRM in the lowlands cannot be limited (like the IWRM-Ferghana project) to a national component. There is a need to arrange all river basin management systems to establish stable, sustainable and equitable water supply at the trans-boundary level and reduce the unproductive losses at national and local levels. Also, it is imperative to increase water productivity and adopt measures to provide a guaranteed water supply for all water users and uses, including the environmental use (deltas, wetlands, ecology chain, etc.)

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[3] In an attempt to capture the process of change toward the IWRM, the project is highlighting the areas of administrative and governing structures at different water management levels that need to be reformed to manage water resources in their complexity (the entire water cycle). This includes not only the agencies, organizations or individuals, but also the framework of policies, laws, rules, relationships, linkages and elements of activities between sectors while identifying clear priorities and mechanisms that can be utilized to manage the system, incorporating all available water sources in a conjunctive manner.

The integral part of the IWRM trans-boundary component[4] for the lowlands of each river has to differ, because of the rivers specific morphology, flow regime, infrastructure, conflicts of interest between the upstream and downstream interests, as well as other factors.

[4] The trans-boundary IWRM is a newly added project component that is very relevant to other projects implemented in the region, such as ‘WEAMP-GEF’, ‘IWRM Strategic Planning’ (ESCAP), and Water-Power Nexus (World Bank).

SUMMARY

Historical experience regarding some IWRM principles, in particular pertaining to a hydrographic-unit management, had been already gathered in Central Asia during the Soviet period (1926 to 1960). Currently, there is a Swiss-funded project implementing IWRM principles in the Ferghana Valley, encompassing pilot areas on a hydrographic-unit base (canals) in three states (Kyrgyzstan, Tajikistan and Uzbekistan), from which many lessons have already been derived. That project is addressing desirable changes in legal/regulatory and management framework in these states. Also, Kazakhstan, the most progressive state in Central Asia in terms of water reforms, strives for implementation of the IWRM, by preparing a 'National IWRM and Water Efficiency Plan' (implementation from October 2004 to December 2007). The Plan is targeting different water partnerships and capacity building, but more importantly, it is putting an emphasis on providing safe drinking water to the general population and integrating the water issues into the management policies.

The IWRM, as understood in the CAR refers to a water management system that includes all available water resources and water sources, needing to be used conjunctively. The management aspects involve coordination of interests of different industries and all levels of water management hierarchy. Using a hydro-geographical unit as a basis for the management is the underlining concept and participation of water users and stakeholders in the management process is a must. As such, rational water use and reliable water supply for the population and sectors of the economy can be achieved, with viable ecological systems preserved.

The ***basic assumptions and conditions for the IWRM*** can be formulated as:

- Implementation of the IWRM principles means an effective integration of different measures toward development and management of water resources and preservation of the environment - keeping in mind the regional socio-economic development - to achieve the potential productivity of lands and water resources

- The long-term objective of the IWRM is a steady, reliable, fair and equitable water supply for all kinds of water uses, all water users, and the environment

- *Key IWRM principles*:

    - Water management should take place within the limits of geographical borders according to the morphology of a basin. Such water management allows for timely decisions and resolutions of problems without administrative interference. Governments ought to transition from direct management of water supply to regulation of the water sector. Water management organizations should have a strict mandate for completing specific functions, in accordance with clear legal framework.

    - Ensuring public participation is essential, not only for water management but also its financing, planning and development of water resources and water sub-sectors[5].

[5] Water sub-sectors are considered water supply for drinking water, irrigation, hydropower, navigation, and fisheries. The environment is valid water consumer and needs to be included as well.

- Integrated water management accounts for utilization of all kinds of water sources (surface, underground, return), taking into account the climatic characteristics (precipitation and evaporation).

- Water supply for the environment should be one of the priorities of governments

- Regarding water use, close coordination at the horizontal level - between all water users and sectors - and at the vertical level - within the hierarchy of water users - is important. It should be directed to reduction and minimization of wastewater.

- Information exchange, publicity and transparency is essential in the management process.

- Water management bodies and water users should always be directed toward water conservation and rational usage of the resources and managing losses. This can be accomplished with the establishment of a consulting service, which could also contribute to keeping infrastructure properly maintained and in good working condition.

The Central Asia Region had a prior experience with water management that was based on a hydrographic unit without administrative intervention during the Soviet period (1926-1950). It was in the systems Zerdolvodhoz, Upradik, and Kirov canal (now called Dustlick), and related to water management between provinces and between the republics, covering thousands of hectares. In the period between 1956 and 1972 the IWRM was applied to the lands of Hunger Steppe in a complex development of irrigation systems, as well as in some other systems in Karshi steppe.

These complex approaches had shortcomings, such as the absence of democratic aspects in management, lack of participation of water users, orientation only toward state financing, free use of water usage, and so on. The first steps to changes in water management were made by water users associations (WUAs), which were being created in Kazakhstan (from 1995 to 1999) and later in Uzbekistan (from 2000 to 2003). These WUAs were taking over some operational and maintenance functions that were formerly performed by large cooperative farms (kolhozes, sovhozes). However, this experience cannot be considered in the gist of transitioning to the IWRM, as it concerned only the lowest level of the water management hierarchy.

As mentioned above, with the financial support of the Swiss Development Corporation (SDC) a pilot project in the Ferghana Valley, covering four oblasts in 3 republics (Kyrgyzstan, Tajikistan and Uzbekistan), represents a 2-year experience in starting to implement the IWRM. It is has been initiated by the ICWC and the International Water Management Institute (IWMI). This project could be replicated in other zones.

Lowlands and delta areas of both rivers are the most socially depressed zones in Central Asia, similar to the Ferghana Valley, although for slightly different reasons. In the Ferghana Valley the major destabilizing factors are the intensive growth of the population and scarcity of land resources, leading to unemployment and low social status in rural areas. In the lowlands of the Syr-Darya and Amu-Darya (except the Khorezm oasis), the land is abundant but water resources are scarce. The uneven water distribution between the upstream water formation zone and the downstream areas, especially in dry years, is a key water problem. Other deficiencies are no attention and/or neglect of the ecological requirements, contributing to the degradation of the environment of the deltas. Therefore, IWRM, oriented at all system levels toward reducing losses, increasing water productivity, and creating conditions for sustainable, fair and equitable water distribution at the same time, is seen as a tool to ameliorate the situation.

Certain prerequisites for a possible forthcoming realization of the IWRM project have been fulfilled during training of officials who participated in a project initiated with financial support of ESKATO, called 'Strategic Planning for IWRM'; this was prompted by the ICWC. In the 'Strategic Planning for IWRM' it is intended to elaborate on political aspects of the implementation of the IWRM principles for the above-mentioned pilot areas. Importantly, the dissemination of various conditions for water use would aid in the struggle with poverty and ensure conditions for a reliable water supply. Both projects mentioned above provide a solid basis for implementation of the IWRM principles within the specific environment of the deltas and lowlands of the Aral Sea Basin.

First steps towards the goal have been taken during the introduction of the project, during workshops and meetings with participation of farmers, Water Users Associations' members and their leaders, as well as the local governments (hakims) and managing staff of local water and Basin Water Organizations. There seems to be a great need for considerable clarification of the IWRM concept and strategies. Therefore, capacity building amongst water managers and users, to enable them to follow up on the approach to IWRM with participation of water users and stakeholders, would be important.

The ***key points of a potential project***, besides improvements of minor infrastructure necessary for proper water distribution, maintenance and water accounting[6], would be:

- Adoption of a bottom-up approach and solid cooperation amongst the water users, including the exchange of information amongst the upstream and downstream users
- Increased emphasis on the support of WUAs and the reorganization of water management – where applicable
- Development of a permanent consultative service for farmers/water users and WUAs
- Use of earlier experience with the Ferghana Valley and other relevant projects (UN-ESCAP, INTAS/NATO) for strategic planning and interventions
- Development of close cooperation and coordination amongst the intra and interstate[7] water managers and stakeholders

The need for development of close cooperation at the inter-state level is real. Without some adjustments and compromise towards hydro-solidarity amongst the Aral Sea Basin States the reliability and adequacy of water supply in quantity and quality to the lowlands and deltas would remain in jeopardy; and the future prospect for sustained economic development, healthy life and viable ecosystems very gloomy.

The specific flows to the Aral Sea by each river to satisfy the potable water/sanitary and ecology needs were confirmed in the early nineties when the International Coordination Water Commission (ICWC) was organized (1992). However, the flows prescribed by the ICWC were not always maintained or enforced and water distribution was not carefully coordinated and regulated. As a result, the Amu-

[6] It is understood that without proper functioning of the water distributing and measuring infrastructure the IWRM cannot be realized. Nevertheless, the pilot areas were selected judiciously, so that the needs for infrastructure are minimized to provide for functional operation of the system.
[7] A newly added component will explore this aspect fully.

Darya flows into the South Aral Sea diminished to zero in some years, endangering the sustainability of life in some areas of Uzbekistan, Karakalpakistan and Turkmenistan. The Syr-Darya flows, not being regulated, have caused economic losses by numerous floods in Kazakhstan without benefiting the North Aral Sea.

Therefore, the project emphasizes the elements of cooperation, pointing out the urgent need to make water distribution within the Basin more equitable and effective for the lowlands. In addition, accountability and transparency within the allocation system, with a priority for an acceptable quality of drinking water for all, is emphasized, so that life and development in those areas can be sustained.

The experience with governing the water flow on the Amu-Darya and the Syr-Darya during the last ten years varied. The ICWC, in many ways an effective body within the IFAS structure, is composed of water sector leaders of the five States[8] and works out the arrangements and agreements for coordinating trans-boundary water supply. Unfortunately, it has not been influential in changing the fact that each country was looking out for its own interest, resulting in tension within the region.

Clearly, to ensure reasonable, beneficial, and equitable water use for all, definite improvements in water resources governance[9] within the Aral Sea Basin are needed. A system of management, built on cooperation and hydro-solidarity in all fields of development, management and conservation of water and natural resources, seems like the only path the Central Asian States must follow to improve and sustain prosperity in the region.

For this reason, the newly added component is considering the IWRM trans-boundary elements. As mentioned earlier, the main elements of the ***IWRM trans-boundary component*** for each river will differ, however, there are many common elements, including:

- ***Presence and availability*** of organizations that carry out joint management of trans-boundary waters **– *BWO Syr-Darya and BWO Amy-Darya,*** would allow setting up a definite institutional basis for developing and strengthening inter-state cooperation on basis of the IWRM principles. From this point of view, the organizational picture of trans-boundary water management could be presented as:
    - Establishment of Public Board/Council of BWO, consisting of representatives of all states and provinces located within the basin, key large water users (like hydropower stations along the river, hydrometeorology service, boards for main canals' management, representatives of deltas – formed in certain 'hydro-ecological councils for delta management)
    - Establishment of a division for water quality within the BWO would be prudent, because of the importance and peculiarities of return waters in each basin and their impact on the overall river water quality. This division would monitor water quality and perform accounting of return water; it would also prepare for the ICWC and the concerned governments suggestions for improvement measures related to water quality of watercourses and a conjunctive use of surface, return and groundwater.

[8] Afghanistan as a valid member could be joining the ICWC in the future, as their water needs grow.
[9] International experience shows that forming a River Basin Commission for each river could mean an improvement.

- Preparation of a ***set of models***, on basis of previous activities in modeling and DSS (USAID, SIC ICWC and others), referring to ***annual and prospective water management in each river basin***, taking into account the river interaction and the planning zones, would be necessary. The models would need to consider elements of water intakes, return water formation, and at the same time water productivity. On this basis, all involved - the BWO, countries, and water-using sectors - can prepare their plan of activities and assess their impact on the downstream zones and neighboring states, identifying consequences and reaching a management consensus.

- Concrete ***improvements*** are needed in the systems for water accounting and forecast of river flow, by way of ***technical equipment*** (a lot is done by WEMP and USAID) and ***sharing of information*** between Hydromet service, water organizations, BWOs and their Councils for remote sensing forecast. Along this direction it is also necessary to improve the dynamics of losses in the flow based on long-term data in separate sections of the rivers, and create accounting mechanism for available water resources.

- On the basis of all these plans, models, research and organizational activities, there should be worked out and agreed on for each river's trans-boundary management a number of ***principle documents***, such as:

    - Provision of Boards (Councils) and their participation in planning and river management
    - Estimated values for ecologic water requirements, for river, deltas, nature, etc.
    - Rules for regulation and distribution of water from the rivers depending on the type of water year, with the specifics of the water regime
    - Rules for BWO's activities during extreme water year (flood, drought, etc.)
    - Regime for operation of water reservoirs, their emptying and filling
    - Regime for financial relationships in water management between riparian countries and regulation of river flow
    - Responsibility of the States and major water users to observe and monitor conditions of operation / working regime

Along with these stipulations, special ***questions concerning*** each basin should be addressed:

for the Amu-Darya basin:

- Estimate of the river releases within the regime of filling and emptying of reservoirs
- Probable increase of water diversion of river by Afghanistan
- Account of water regime of canals in the delta concerning the drinking water supply
- Operational regime and filling of water bodies of the Priaralie

for the Syr-Darya basin:

- Coordination of the operation of the cascade of the Naryn Power plants with the needed watering of the mid and lower reaches of the river – energy/irrigation
- Prospective development of hydropower studies on the river Naryn
- Peculiarities of ice regime at the downstream of the Syr-Darya, below the Chardara reservoir
- Regime and possibilities of filling up Aidakul reservoir
- Estimate of regime and requirements of the Small Sea and Northern Priaralie

Consideration of these elements of the trans-boundary water management will allow to achieve the basis for transferring to the governments certain measures aiming at more stable water delivery to the lowlands, based on the IWRM principles.

1. OVERVIEW AND ANALYSIS OF EXISTING PROBLEMS

1.1 NATURAL AND CLIMATIC PECULIARITIES OF THE AMU-DARYA AND SYR-DARYA LOWLANDS

1.1.1 Climatic conditions

Amu-Darya lowlands

Khorezm province (Uzbekistan). The territory of Khorezm province belongs to the transit zone between the central and northern belts of Central Asian deserts, having hot summers and moderately cold winters. The average annual air temperatures are from 12.9° to 13.9° C. In summer, a relatively hot period, the average temperatures reach on the average 7.6 to 29.1° C, with an absolute maximum of 43° to 45° C. The warm period lasts about 190 to 207 days, and the frosty one from 175 to 158 days, respectively. The average monthly temperature of the coolest month - January - is from 1.2 to 3.3° C, with an absolute minimum from -16 to -18° C.

Annual precipitation is in the range of 52 to 169 mm. The storage of natural moisture in the upper levels, due to accumulation of winter/spring precipitation, is depleted by early April. The average annual relative humidity runs from 57 to 59%, with a maximum of 77 to 78% in winter months and a minimum of 38 to 47% in summer months. Northeast winds prevail throughout the year, with an average wind speed of 2 to 4 m/s and occasionally, a strong wind in summer.

Dashoguz province (Turkmenistan). Climate is characterized as severe continental, when taken as a cross-section of a day or a year. Three winter months have minus monthly average temperatures, with an absolute minimum about –35° C, and maximum +45° C. The period with minus temperatures lasts about 127 days on the average. The absolute maximum temperature is in July - about + 45° C. Annual precipitation is in the range of 110 to 116 mm. Precipitation occurs particularly in winter; and snow cover is unsteady, with snow usually coming after the third week of December. Northeast winds blow mainly in summer and winter, with maximum noted wind speed of about 29 m/s.

Republic of Karakalpakstan (Uzbekistan). As for climate, the territory can be divided into a southern and northern zone. The southern part is characterized by higher air temperature and a long warm period. In the northern zone the average annual temperature is 3 to 4º C lower and the warm period is shorter by 12 to 16 days than in the southern zone. The average annual air temperature in the delta does not fluctuate much: from +10 to +12º C. In summer the average monthly temperature is higher than +20º C, maximum temperature comes to + 43 or 44º C, and in winter the minimum is as low as -25 or -30 ºC. The warm period lasts from 200 to 230 days, and the sum of positive temperature comes to 4000° C. Precipitation is low – from 80 to 100mm/year and falls mainly in winter (29%) and in spring (42%). The maximum amounts can be noted in March and April. Snowfall is unsteady. The average wind speed is from 3.4 to 5.4 m/s, and strong winds blow especially in the spring and partly in autumn. The maximum wind speed is over 20 m/s. The index of relative humidity increases from south to north.

Syr-Darya lowlands

Kyzylorda province (Kazakhstan). Climate of Kyzylorda province is distinguished as severe continental, displaying high annual and daily amplitudes of air temperature and unstable climatic indexes during the whole year. This province has an abundance of warm and predominantly clear dry weather, with drought being a typical climatic feature. The annual amount of sunshine hours is between 2000 and 3000. The average annual air temperature fluctuates from 7 to 11º C over the entire province. The annual range of air temperature is from minus -34º C to plus +41º C. Summers are hot and long, sometimes with daily air temperatures rising to up to 46º C. Winters are moderately cool and in the south fairly warm and short; however, sometimes they are cold, and the temperature during a single day can drop to -34 to -39 ^{o}C. During severe winters the soil may freeze down to 1 m below the surface, even under snow cover. The warm periods (with average daily air temperature above 0º C) vary from 7.5 to 8.5 months.

1.1.2 Hydrogeology

Khorezm province (Uzbekistan). Hydro-geological conditions in the Khorezm province show difficulty in groundwater flow, due to very small underground gradients. Groundwater originated in the quaternary formations and its basic replenishment is connected with irrigation - seepage from canals and irrigated fields.

The dynamics of fluctuation of the ground water table is therefore closely connected with the irrigation regime. The periods of high ground water table correspond with the periods of irrigation. The highest ground water table is observed in summer and the lowest in winter. For the most part, the ground water table depth under the irrigated area is in the range of 0 to 2 m. The following are depths of ground water table, as they are found under the irrigated areas (in %):

- Less than 1 m - 47.0%
- From 1 m to 1.5 m - 36.0%
- From 1.5 m to 2 m - 12.2%,
- From 2 m to 3 m - 4.3%
- More than 3 m - 0.5%.

Dashoguz province (Turkmenistan). From the point of view of the hydro-geological structure the considered territory belongs to the southwestern artesian basin. A water-bearing layer of the quaternary deposits reveals sand, sandy loam and, rarely, clay loam deposits of the alluvial, alluvial-lake, lake and aeolian origin. In thickness the quaternary deposits range from 30 to 70 m. In regard to filtration, the quaternary water-bearing complex is characterized by significant vertical heterogeneity that is caused by varying lithological structure. The value of the coefficient of filtration for sandy-loamy-clay strata ranges from 0.003 to 0.5 m/day. Sandy-loamy deposits in the province cover large areas and have a varying thickness of as little as 0.5 to 1.0 m up to 5 to 6 m; this is typical for the territory.

The Amu-Darya forms a natural hydro-geological border of the quaternary water-bearing complex within the considered project area, and the Sarackamish depression represents the discharge zone. The slope of the groundwater table on the average is within the range of 0.0002 to 0.00044 m/m, therefore this entire province can be considered as being without drainage.

At present, the groundwater under the irrigated lands has medium mineralization – 3 to 5 g/l, and the salts are primarily sulphate-hydro-carbonate and chloride-sulphate. Near large main and/or magistral canals there are the local zones of fresher, desalted ground water (1 to 2 g/l), formed due to filtration of the canal water. The presence of such zones does not practically affect the conditions in the irrigation systems. For the last ten years average weighted value for depth of the ground water table during vegetation period was 1.5 to 2 m, as opposed to the fifties when it was 10 to 15 m. The groundwater depth is spread under the irrigated area as shown below:

- Less than 1 m - 7.0 %,
- From 1 m to 1.5 m - 9.2 %,
- From 1.5 m to 2 m - 15.2 %,
- From 2 m to 3 m - 48.8 %
- More than 3 m -19.8 %.

Republic of Karakalpakstan (Uzbekistan). In hydro-geological terms the Amu-Darya delta and lowlands epitomize a non-drainable part of the plain. According to the conditions of origin and relation to any layers of groundwater, the delta of the Amu-Darya has two different forms:

1) up to the quaternary deposits, related to mainly cretaceous sands, with thickness of water-bearing strata fluctuating from 10 to 70 m
2) groundwater in the quaternary deposits, related basically to the deposits of the Amu-Darya delta, reveal intermixed sands, sandy loam, loam and clay. The slope of groundwater table does not exceed 0.0005 m/m.

Regarding the progression of depth of the groundwater table reflecting the contours, having been classified, the area is divided (in %) as follows:

- Less than 1 m - 6.4%,
- From 1 m to 1.5 m - 0.0%,
- From 1.5 m to 2 m - 40.8%,
- From 2 m to 3 m - 20.6%
- More than 3 m - 32.2%.

Syr-Darya lowlands

Kyzylorda province (Kazakhstan). Groundwater of the tertiary-cretaceous plateau, where brownish gray soils were formed, lies in a depth of 10 to 20 m; they are brackish and slightly saline (3 to10 g/l). As for chemical composition, sulphates, chloride sulphates, and natrium-magnesium salts prevail.

In the alluvial delta and tidal delta plains of the Syr-Darya, where soils belong to hydro-morphic series (*tidal meadows, tidal marshes*), groundwater table is at depths of 1 to 6 m. Near the irrigation and drainage network the groundwater is about 3m deep. Where the groundwater table is lower than 5 m, the process of desertification may start. The degree of mineralization of groundwater is from 3 to 5 g/l, classified as brackish and 10 to 50 g/l classified as saline. Sulphates, chloride sulphates, and sodium-magnesium salts prevail.

Peculiarities of this zone are: (i) a layered structure of the thickness of water-bearing strata with a small layer of the cover deposits; (ii) hardly any slope of land surface; and (iii) difficult natural drainage of groundwater, on top of inadequate drainage and irrigation systems. This all causes a formation of unstable ameliorative processes, characterized by a seasonal return of salinization, even during one vegetation period. The salt balance, corresponding to salt accumulation, had caused an increase in unfavorable ameliorative conditions in the lowlands and a decrease in crop yields. The progression of depth of the groundwater table and the percentages of irrigated areas can be seen as:

- Less than 1 m - 0.0%,
- From 1 m to 1.5 m - 2.4%,
- From 1.5 m to 2 m - 6.1%,
- From 2 m to 3 m - 63.7%
- More than 3 m - 27.8%.

1.1.3 Soils

Khorezm province (Uzbekistan). The Khorezm province belongs to the to Low-Amu-Darya soil-climatic group, north sub-zone of the central zone of the flatlands deserts. The province is typical for having soils with difficult groundwater inflow and drainage, an unsteady regime and mandatory measures to prevent and eliminate secondary salinization of irrigated lands.

Soil cover consists of *meadows, marsh-meadows, marshes, brownish gray soils, salt marshes and sands*. *Meadow soils* are formed in conditions of constant moisture from groundwater at a depth of 1 to 2 m. The mineralized groundwater on these soils causes a constant tendency toward their secondary salinity, which, on the irrigated areas has been suppressed by annual leaching.

Marsh meadows and marshes are dispersed as small separate plots and occupy areas that are low lying. These soils also form in conditions of the constant moisture. The groundwater table is at depth from 0 to 1m below the surface. The mechanical composition of the ground varies from *sandy loam and sandy* to *clay-loam* and *clay*. Irrigated *marsh meadows and marsh* soils can be saline in three degrees - light, average and high. *Brownish gray* soils have the character of *sandy loams to sandy soils.* According to the degree of salinity, lightly saline soils prevails and highly saline are rare. *Salt marshes* area spread both by separate massifs and by spots among irrigated fields. The texture of *salt marsh* area soils vary but *sandy loams to sands* and *loam-clay* prevail.

The major part of the Khorezm province belongs to geomorphologic and hydro-geological classes VIII (39.9 % of the area) and IX (52.9 % of the area) hydro- modulus, that are to be the regions where the closely lain to the surface ground water form *lower* and *marsh-lower* types of soil. On a scale of a hundred the fertility of irrigated lands and their area (in percentages) is distributed as below, with 53 points as the weighted fertility average:

- 81 -100 points - 3%
- 61 - 81 points - 38%
- 41 - 60 points - 38%
- 21 - 40 points - 20%
- 0 - 20 points - 1%

Dashoguz province (Turkmenistan). Within the territory of the Dashoguz province the hydro-morphic soils prevail - semi-hydromorphic and automorphic soil having a smaller spread in the western and northwestern part. Almost all lands of the considered territory are saline in some degree. Soils with an average salinity prevail, but highly and very highly saline soils are significantly spread. Regarding the chemical composition, lightly saline soils relate to sulphate chloride, and calcium-sodium. Average, highly and very highly saline soils are represented by type of chloride-sulphates and sulphates types of mixed three-component cation composition.

In the contours of the irrigated area of the province the hydro-module zones are spread as follows:

- first and second hydro-modulus regions (groundwater table >3 m) - 19.8%;
- third and fourth hydro-modulus regions (groundwater table is at 2 to3 m) - 48.8%;
- fifth and sixth hydro-modulus regions (groundwater table is at 1 to 2 m) - 31.4%.

The following are the types of soil and their percentages from the total irrigated area for 2003:

- Desert clays - 20.5%
- Desert meadows - 3.6%
- Meadows and desert soils - 63.6%
- Marsh meadows - 12.3%

The share of *desert clays*, as compared with 1980, has increased by 17.2% in 2003 (in 1980 it was equal to 3.3%). The share of the meadow desert soils, if compared with 1980, decreased by 49.3%

in 2003 (in 1980 it was 52.9%). The share of the meadows and desert soils, as compared with the year 1980, increased by 45.5% (in 1980 it was 18.1%) in 2003. The share of *marsh meadows,* when compared with 1980, had increased by 12.2% in 2003.

The irrigated lands were rated on a scale of one hundred in fertility and their spread over the territory in percentages is below, with the weighted fertility average of 37 points.

- 81 -100 points - 7%
- 61 - 81 points - 25%
- 41 - 60 points - 52%
- 21 - 40 points - 16%
- 0 - 20 points - 0%

Republic of Karakalpakstan (Uzbekistan). The process of soil formation in the delta of the Amu-Darya is closely connected with climatic, hydrological, hydro-geological, ameliorative, irrigation-economy and other factors. Depending on the degree and expression of these factors, the soil-formation process and its peculiarities have been developed in time and space. The main factors are moisture and climate. Moisture content, as a factor of the soil formation process, is expressed in high water floods, an influence of groundwater close to the ground surface, and irrigation. Climate, as a powerful factor of the local soil formation process, primarily controls the high evaporation rate that is specific for the region.

The vast group of soils of the delta of today is due to the influence of climate in conditions of plentiful moisture. The soils are: *meadows, meadow marsh meadows, marshes,* and *saline marshes.* In these types of soils, in connection with various moisture content can be distinguished: (i) meadows at the initial formation stages on the territory subjected to high floods; (ii) meadow and saline marsh on the plots with underground water, both along the river and irrigation areas; (iii) irrigated meadows, marsh meadows and marsh soils, of which formation is affected not only by climate and moisture, but also by agricultural practices.

Meadows and marsh meadow type soils, developed mainly on the basis of hydro-morphic stages - new alluvial deposits – and slightly affected by a soil formation process, are: *lower alluvial* (*tugay*) soil at the initial formation stage and alluvial meadow soils. The transition stage is represented by meadow-takyr (meadow-desert clay) soils.

Meadow soils in the initial stage of formation of soils of the desert zone can be found along the Amu-Darya and its flood-water tributaries, in the low lying areas that are flooding. *Meadow soils of the desert zone* that are not irrigated spread over the territory of the right-bank of the delta. *Meadow to desert-clay soils* developed almost everywhere in the entire relief and recently their area has significantly increased.

Regarding the geomorphologic and hydro- geological conditions, the larger part of the irrigated area of Karakalpakstan belongs to the VIII - IX (35.8%) hydro-modulus classes (with groundwater influence on the soil formation process). On a scale of a hundred the fertility classes on irrigated lands are represented as below, with a weighted point of 26:

- 81-100 points - 0%
- 61- 81 points - 0%
- 41- 60 points - 17%
- 21- 40 points - 45%
- 0 - 20 points - 38%

Syr-Darya lowlands

Kyzylorda province (Kazakhstan). The territory of Kyzylorda province territory is a plain with sandy, clay deserts and deserted steppes. A mass of fertile grounds is in the Syr-Darya valley, where the presence of water and warm climate favors cultivation of warm-loving crops (rice, maize, water melons, musk melon, tomato and so on). According to ecologic-genetic features - productivity and economic value, the soil cover of the Kazakh Priaralie consists of:

- Hydro-morphic soils of the alluvial (delta) plain of the *meadows* and *marshes order*
- Semi-hydromorphic soil - *takyr (desert clay), takyr-liked* soil and *salt marsh* soil
- Sandy soil, which result mainly from the processed alluvial, delluvial-prolluvial and lake deposits
- Automorphic-zone soils of the delta - brown and brownish-gray
- Soils of the drained part of the bottom of the Aral Sea

The total irrigated available lands of the region are concentrated in the Syr-Darya delta. A change of the ecological situation in the Priaralie, connected with regulation of the Amu-Darya and Syr-Darya flow and drying up of the Aral Sea, stimulates the processes of desertification, leading to a loss of the natural potential of the soils in the delta and decrease of their biological productivity and fertility. Formation of the soil cover of the delta was influenced by:

- Hydro-geological regime of the territory
- Depth of the groundwater table and a degree of their mineralization
- Crater like relief of a waterproof bed and difficult conditions for drainage
- Limited Syr-Darya flow and intensive irrigated agriculture

An arid climate in combination with non-drainable territory caused soil salinity through the entire relief. The salt balance is intensified by salt being carried from the dry bottom of the Aral Sea balance to the delta and accumulated there. The virgin and irrigated hydro-morphic soils of the Syr-Darya delta are characterized by high salinity**.** *Meadow and marsh* soils of the Syr-Darya delta constitute the lands available for irrigated agriculture.

The high degree of salinity of the delta soil negatively impacted the melioration condition of the irrigation systems. This forced the farm economies to apply the strategy of nomadic agriculture using new arable lands for irrigation and increasing thus the anthropogenic pressure on a natural landscape.

At present the salt marshes, saline marshy meadows, and *marsh* soils, including irrigated areas, are used for animal grazing, although they could be considered as a reserve for an irrigation land fund in the region. Worsening conditions with flooding of the hydro-morphic soils of the Syr-Darya delta greatly affects the soils natural evolution. *Alluvial meadows* and *marsh meadows,* by being transformed through dry and desert stages, are increasing the area of the *saline marshes*, *desert clays (takyr-liked* soils) and sandy masses. Periodic flooding of marsh soils of the existing delta decreases to an extent the salt concentration, but only in a limited area.

At the present time in the upper part of the delta the drying up salinity process is accompanied by an active formation of meadows, degradation of the tugay soils near the riverbed, and enlargement of the *takyr-liked* soil, salt marshes and sands.

In the nineties in the middle part of the delta (Kazalinsk district), due to improvement of the flooding conditions, the process of desertification and salinization of hydromorphic soil had slightly decreased. The *alluvial meadows* and *meadow marsh* soils were on the increase, as compared with the period of the eighties. During the eighties the ecologic situation (with an almost complete lack of floods and flows to delta) was characterized by the strictest indexes of various hydro-morphic conditions, with the desert soils prevailing.

In the lower part of the delta (Aral district), where flooding and the supply of water is still low, the desertification process was and is on a large scale; the ecological situation is very tense. Therefore the process of degradation of the hydro-morphic soil continues. This can be verified by a complete transformation of *river-marsh* soils, prevailing *meadow marshes* and *alluvial meadows* with high salinity, an increase of *takyr-liked (desert clay)* soils, sand and *salt marsh* area. On a scale of hundred (points), the fertility of irrigated lands for the area and the associated distribution in percentages is below, with a weighted average of 33 points.

- 81-100 points - 0%
- 61- 81 points - 20%
- 41- 60 points - 35%
- 21- 40 points - 40%
- 0 - 20 points - 5%

1.2 ENVIRONMENTAL PROBLEMS

1.2.1 Environmental needs and peculiarities

As a whole, three types of environmental releases can be identified: (i) ecological, (ii) sanitary to rivers, and (iii) sanitary-ecological to irrigation network of canals.

Ecological releases to river deltas are necessary to water ecologically critical zones such as lake systems, wetlands, and others, to ensure sustainable functioning of these ecosystems. The releases represent either the required minimum volume in low water years or larger volumes in normal and high water years.

Sanitary releases along the rivers are required and should be guaranteed for different water availability years to sustain rivers as water bodies of natural/environmental and social importance, avoiding deterioration of sanitary conditions and quality of river water.

Sanitary-ecological releases to irrigation systems are made to keep minimum volumes in the canals, aiming mainly for securing water for household and drinking water supply.

1.2.1.1 Ecological needs of water-ecological systems

Every water-ecological system (river, canal, wetland, aquifer, etc.) may be characterized by its general *resource potential*. The potential of a river catchment may be expressed as mean annual flow, reflecting the natural conditions (undisturbed, i.e. until development and regulation of river flow). For lakes and some types of wetlands, the resource potential is expressed by mean annual water volume in the lake or wetland.

In a broad sense, the hydro-ecosystem needs may be described as water quantity and quality necessary for development and use of water resources that is environmentally sustainable. Ecological water needs may have various limits resulting from the degree of possible degradation of the hydro-ecosystem. The lowest degree may be called *the resource base* as the *ecological threshold*, below which the hydro-ecosystem is subjected to drastic, often irreversible changes.

A difference between the need for total water resources and ecological needs is a water share that may be used in part. Ideally, only a share of the resource capacity should be used, and numerous users, including agriculture, should compete for this share. Nowadays, the environmental needs are considered a priority. Therefore, when planning water allocation, the water management system should be treated as a unified ecosystem, as constituting a chain of interlinked local ecosystems.

Current environmental conditions in the Amu-Darya and the Syr-Darya downstream result from the rivers' natural volume of flow and the impact of mankind, which in the upstream and midstream intensified over the last forty years. This relates primarily to the regulation of flow by reservoirs, but also to withdrawing and/or discharging water, including drainage water and wastewater.

Ecological releases to the Priaralie to sustain the ecosystems (reservoirs, lakes, etc.) should be set upon agreements between the states on a parity basis and not be included in the water withdrawal limits. The degree of water availability in the deltas of the Amu-Darya and the Syr-Darya varies and depends on a range of factors, such as:

- flow into the deltas
- water demand and losses in the deltas (determined by the distribution set up and use of water in the deltas)

- required water releases to the Aral Sea (determined by schematic water allocation and stabilization of regime in the Aral Sea's reservoirs)

Within the socio-ecological structure of the Priaralie permanent lakes are the sites of bio-resource reproduction. They should provide favorable conditions for efficient reproduction and development of aquatic plants, fish, birds and muskrat. *The **key ecological requirements*** for the ponds and reservoirs within the Amu-Darya and the Syr-Darya deltas call for:

- maintaining a flow through in the water bodies, especially lakes, for which the only source of water is a collector-drainage network (flowage conditions are particularly important during the growing season)
- maintaining water salinity at less than 5 g/l in fish-farming lakes (this is particularly important in the spring and summer during spawning, hatching and young fish growth from April till June)
- maintaining a depth of water in lakes at no less than 1.5 m in the winter period (such depth will allow wintering of fish and access to feed for muskrat population)
- preventing a sharp drop of water levels during spawning and hatching since this would lead to dewatering of shoals and death of young fish
- preventing a sharp rise of water levels in winter time, since this may lead to formation of ice, having a negative effect on muskrats winter feeding and, under drastic changes, leading to destruction of animal cover and possibly death
- keeping available shallow water zones to maintain conditions for growth of reeds that provide cover and food for hydrophilic birds and muskrat
- long-term preservation of water areas of lakes, which form the hydro-biological regime of reservoirs and sustain food for fish and birds

The decision of the Heads of the Central Asian States (January 11, 1994), based on "The Strategy for Improvement of Socio-economic and Environmental Conditions in Priaralie", stipulates the mitigation of the consequences of the Aral Sea disaster through a construction of artificially regulated reservoirs in the location of the former seashore, in-delta lakes and bays, as well as the accompanying forest reclamation measures. Efforts toward preservation of lakes and bays and their good hydrological and hydro-chemical conditions depend completely on the water inflow into the rivers; i.e., on the water availability in the Amu-Darya at Takhiatash waterworks and the Syr-Darya at the Chardara reservoir. In this context, the Interstate Commission for Water Coordination (ICWC), while establishing limits for withdrawals from the trans-boundary rivers, sets the inflow to the Priaralie and the Aral Sea in the volume of 14.5 km^3/year, of which 10 km^3/year is from the Amu-Darya and 4.5 km^3/year from the Syr-Darya.

Amu-Darya delta

The development of irrigation in the Amu-Darya basin and the relevant increase of consumptive use have led to a sudden decrease of the inflow to the delta. In the absence of optimal water-salt exchange in the delta lakes, water quality, and likewise the ecological situations, began to deteriorate. Desiccation of the sea and the loss of natural connections with the sea bays have caused water replenishment from the sea to the delta to become lost, and the delta fully dependent on inflows from the river. As a result of the continuous decrease of the river inflow starting in 1960, the lakes have become natural evaporators, with decreased water volumes and, consequently, increased salinity.

The key factor of the hydrological state of the delta is the inflow from the Amu-Darya and, to a lesser degree, inflow from collectors that feed some lakes. In normal and high water years (when the inflow from the Amu-Darya is more than 3.0 to 4.5 billion m^3 per year), favorable conditions are created for preservation of lakes[1]. Problems would arise in low-water years and in the future, when the flow probability would decrease and drainage return flow would be reduced. At the same time, preliminary estimations show that to keep the normal water level in the delta and seashore lakes in the Uzbek part of Priaralie, the required minimum net water volume would be 5.27 billion m^3 per year (Table 1.2.1).

Table 1.2.1 Required river water discharge and flow quantity needed to sustain seashore and delta lakes
(Preliminary estimation)

Zone	Water body surface (thousand ha)	Mean annual discharge (m^3/s)	Flow quantity (km^3)
Left-bank	96.0	35.0	1.1
Amu-Darya side	122.0	99.3	3.14
Right-bank	64.7	32.4	1.03
Total	282.7	166.7	5.27

Syr-Darya delta

The Syr-Darya delta area that needs to be watered covers 69,700 ha, including 36,500 ha of lakes. The required water volume for the delta is 1.72 km^3. The total required volume including the Small Sea is 6.72 km^3 (Table 1.2.2) [2].

When the water level in the Small Sea changes, the area of unstable landscapes in the exposed seabed at the level of 42 m decreases to 31,156 ha, and at the level 48 m to an area of 83,256 ha at 48 m, respectively.

Table 1.2.2 Areas to be watered and required flow volume to sustain seashore and delta lakes
(preliminary estimation)

System	Watering area		Required water volume
	Natural system (thousand ha)	Lakes (thousand ha)	(km^3)
Aksai-Kuandarya delta	38.7	23.9	0.69
Mid-delta	23.7	7.9	0.76
Seashore delta	7.3	4.7	0.27
Total for the delta	69.7	36.5	1.72
Small Sea	206.5		5.00
Grand total	276.1	36.5	6.72

1.2.1.2 Sanitary releases

At present, the water environmental needs for the Amu-Darya and the Syr-Darya are mainly determined by the *sanitary releases* along the rivers, limits of inflow to the river deltas and the Aral Sea (Priaralie), as well as specific releases (for Amu-Darya) to irrigation systems in Khorezm province, Dashoguz province, and Karakalpakstan. The limits of the inflow to the Priaralie (including collector-drainage flow) and additional releases to irrigation systems for the growing and non-growing seasons are established during the ICWC meetings.

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[1] «South Priaralie – new outlooks», 2003, edited by V.A.Dukhovny and Joop de Schutter, NATO Science for Pease Project, SIC ICWC, Tashkent.

[2] Table origin is from the «Economic evaluation of local and joint measures to mitigate socio-economic damage in Priaralie zone», 2004, edited by V.A.Dukhovny. Final report on INTAS – ARAL - 2000 – 1059 Project, SIC ICWC, Tashkent.

The quantity of the sanitary releases for the rivers is determined by design studies (Master-plans for water use and protection[3], «Waterworks operation rules»[4], etc.), and should be justified more thoroughly, since in the last few years the river regimes have greatly changed in terms of both quantity and quality. In practice, an estimated value of 95% probability is accepted and taken as a reference point for natural flow, and also considered adequate for maintaining the *self-cleaning* processes.

Another approach is that sanitary releases may be set on the basis of minimum discharge observed in a river in its natural conditions (before flow regulation). One other approach is based on estimation of sanitary releases as 10% of river flow discharge observed over a long term. This method is widely used by the European Union and taken as a basis for establishing environmental needs for the Syr-Darya and the Amu-Darya flows[5].

Sanitary releases may be applied to improve river water quality. However, water management practices show that to achieve a considerable effect with diluting polluted water with fresh water is difficult and sometimes not possible. In this context, it is important that the river sanitary releases should be set, and also the return flow (collector-drainage and waste water) into the rivers should be limited. This would improve water quality and raise the self-cleaning ability of the waterway. Estimates of the current use of flow within the river basins show that the discharges for the Amu-Darya, which are less than the ecologically permissible (*sanitary* releases), can be observed primarily downstream in individual months with normal and low water years. *Sanitary* releases for the Syr-Darya are necessary only downstream in some months of low-water years.

1.2.1.3 Sanitary-ecological releases

Sanitary-ecological releases to the irrigation canal network are made to keep minimum water volumes in canals, which are mainly for household and drinking water supply.

Amu-Darya downstream / lowlands

Since 1991 the ICWC set a limit of the *sanitary-ecological* releases for the irrigated lands within the Amu-Darya downstream as an amount of 0.8 km^3/year (Table 1.2.3).

Table 1.2.3 Sanitary-ecological releases for irrigation systems in the Amu-Darya lowlands

Province	Irrigation system	Releases (Mm^3/year)
Khorezm	«Tashsaka»	120
	«Klychniyazbai»	30
	Total	150
Dashoguz	«Turkmendarya»	80
	«Khan-yab»	70
	Total	150
Karakalpakstan	«Kyzketken»	200
	«Suenli»	300
	Total	500
Grand total		800

[3] Plan of water-management measures in the Syr-Darya river basin up to 2000. *Composite document.* «Sredazgiprovodkhlopok», Tashkent, 1987.

[4] Toktogul reservoir operation rules. «Sredazgiprovodkhlopok», Tashkent,1988.

[5] Sorokin A.G., Nikulin A.S. 2003. Environmental needs for Syr-Darya and Amu-Darya flows: present conditions and future outlook, and climate change effect. *Proceedings of Central Asian scientific-applied conference* "Environmental sustainability and advanced approaches to water management in the Aral Sea basin". Almaty - Tashkent, p. 419-423.

In Dashoguz and Khorezm provinces, the sanitary-ecological releases in an amount of 300 Mm^3/year are mainly used to keep minimum water volumes in the systems of canals that are utilized for household and drinking water supply. In the Republic of Karakalpakstan, a share of sanitary-ecological releases is used to sustain the Priaralie's lakes that are located within the command of canals Suenli and Kyzketken, while the rest is used for household and drinking water supply.

Preliminary estimates made by the SIC ICWC show that the current drinking water needs downstream are less than half of the current releases (400 Mm^3/year). Since the population in the Amu-Darya lowlands and delta (Khorezm and Dashoguz provinces and Karakalpakstan) is less than 5 million, and household and drinking water needs are estimated by international standards to be 200 l/day per capita, the total need would be 365 Mm^3/year. However, to meet this need, water must be supplied from the river, groundwater aquifers and the Kaparass reservoir at Tuyamuyun waterworks via "Tuyamuyun-Urgench" and "Tuyamuyun-Nukus" water lines.

To define more accurately volumes of the sanitary-ecological releases, it would seem prudent to establish a *special ICWC Commission* that would address, among other tasks, the following:

i) Definition of specific zones and number of consumers who do not yet have a stable water supply system (pipeline, water-conduit wells, groundwater wells);
ii) Provision of specific data related to the canal network that can meet the drinking water supply demand from the river;
iii) Provision of specific information of the necessary volume of water for particular zones and the associated volumes supplied by canals;
iv) Determination of the time and frequency/intervals of water releases for drinking water supply via the irrigation network.

The given releases should be separate rather than constant in the course of the year. Volumes set by the Commission could be possibly corrected only in case of changes in population size or introduction of new water-supply lines or wells. In the lowlands of the Amu-Darya, a problem concerning observance of environmental needs is directly related to the problem of rational management and assessment of the available water resources with consideration for losses in the riverbed. However, the needs are maintained only in years when the flow probability is less than 50 %.

When floods occur, a share of river water in the Amu-Darya downstream is used for *emergency-ecological* releases. Those are intended for disposal of excess water in the irrigation systems, to avoid flooding and other negative effects, as well as to meet the ecological needs of lakes and depressions located at the tail ends of irrigation systems. Emergency releases depend directly on the flow rate of water in the river, water level in reservoirs, and the capacity of canals. Taking into account the status of water facilities in the Amu-Darya downstream, emergency flows downstream of the Tuyamuyun waterworks should not be more than 2500 m^3/s. Data for the irrigation system capacities in the Amu-Darya lowlands are given in the Table 1.2.4 below.

Table 1.2.4 Canal capacities in the Amu-Darya downstream (m^3/s)

Canal	Design capacity	Maximum capacity	Mean discharge in 1993	Mean discharge in 1994
«Pakhta-Arna»	440	460	60	54
«Tashsaka»	500	700	236	211
«Klychniyazbai»	240	255	58	55
«Kipchak-Bozsu»	40	45	6	6
«Kyzketken»	370	900	153	128
«Djumabai-Saka»	10	12	6	4
«Sovet-Yab»	250	300	96	97
«Suenli»	225	395	99	91

Syr-Darya downstream / lowlands

The current necessary *sanitary-ecological* releases for different sources in the Syr-Darya lowlands are assessed similarly. In the UNDP Report on Kazakhstan[6], their total value is 3.1 km^3/year. According to data of the Kazakh branch[7] of the SIC ICWC, water needs for economic-ecological sites, such as watering of old channels, depressions, lakes, animal and bird habitats, oases for population, and others, excluding the delta, are about 1.2 km^3/year; the delta watering is estimated to be no less than 2.0 km^3/year.

Domestic water needs are estimated to be about 0.1 km^3/year. From this, about 15 to 25 % of those needs are met by the river, while the rest is met by groundwater. Thus, river water withdrawal for domestic needs is small and not regarded as separate ecological release; it is included in the water withdrawal limits (together with irrigation and industrial needs).

Negative environmental effects caused by changes in the operation regime of Toktogul waterworks are counted as damages to natural systems, due to shifting summer floods to wintertime and creating low water levels in summer. Once the river channel dries up in summer, the river loses its natural drainage function, leading to a critical epidemiological situation during summer heat. Besides, *sanitary* release standards are not observed in some river reaches.

1.2.2 Effect of hydrological conditions on ecology

The general flow of the Amu-Darya and Syr-Darya was formed in a period of about fifty years, from 1911 to 1960, constituting approximately 117 km^3 annually. The river shares were - 80 km^3 from the Amu-Darya and 37 km^3 from the Syr-Darya, respectively. Out of the total annual amount, the actual inflow to the Aral Sea was about 56 km^3, with 42 km^3 from the Amu-Darya and 14 km^3 from the Syr-Darya. With the expansion of irrigated areas later, the inflow of river water to the sea has substantially decreased, practically not reaching the sea during several low water years. The decline in the inflow is shown below:

- 30.0 km^3/year (54 % of the mean annual) in period of 1961 to1980
- 16.7 km^3/year (30 % of the mean annual) in period of 1971 to 1980
- 3.5 to 7.6 km^3/year (6-13 % of the mean annual) in period of 1980 to 1998

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[6] Duskayev K., Ryabtsev A. et al. 2004. Water Resources in Kazakhstan in the new millennium. UNDP paper. Almaty, 132 p.

[7] Kipshakbayev N.K.. 2000. Optimization of water and power resources use in the Syr-Darya river basin under present-day conditions. SIC ICWC Kazakh branch. Almaty, 36 p.

The operation regimes of storage reservoirs Toktogul on the Syr-Darya and Nurek on the Amu-Darya play key roles for a long-term water supply for the economic sectors and downstream ecosystems. Both upstream reservoirs were designed for irrigation and power-generating purpose within the unified water management systems of the Amu-Darya and the Syr-Darya basins. After the Central Asian States became independent, the stability of the water management for each river basin has been regularly disturbed. This, to a large degree, has contributed to the degradation of the downstream natural systems.

The current water management system in the Priaralie is based on a residual principle and is greatly aggravated by unreliable forecast of the flow probability. This had caused poor control of the inflow of water to the delta and its distribution, affecting discharges. As such it resulted in a complete dehydration of tthe delta; or, in a sudden inflow of high water that is accumulated and can at best be utilized only from 16 to 20%[1]. Such critical situations due to poor water management were observed in the Amu-Darya basin in low water period of 2000 and 2001 and in winter floods in the Syr-Darya basin in 2003 and 2004.

Amu-Darya delta and lowlands

In the years 2000 and 2001, the flow in the Amu-Darya was the lowest in the entire history of hydrological observations. The reduction of flow started in April 2000 and continued until spring 2002. As a result of low water level, water bodies in the Priaralie have lost the continuity of flow. High natural evaporation and lack of inflow caused a complete shoaling and shrinkage of most water bodies. In the remaining water bodies, such as lakes Taily and Karateren and bays Muynak and Rybachiy, water areas and depths have suddenly decreased, causing an increase in salinity of up to 14 g/l in the bays and to 50 to 60 g/l in the lakes.

An example of the negative effect of the water deficit was the ecological situation in Sudochie wetland, the largest lake system in South Priaralie. Until 2000, the water surface of the wetland lakes was 42,000 ha, while by the end of 2001 it had decreased to a mere 6,500 ha. Increase in water salinity has caused degradation of the lakes' flora and fauna, which initially were fresh-brackish water types, but were replaced by brackish-marine species with progressive reduction of general bio-productivity. Final drying up and increases in salinity of the lakes led to loss of aquatic biota. Fish productivity in the lakes decreased from 36 to 61 kg/ha in 2000 and to 16 to 36 kg/ha in the first six months of 2001. Finally, shoaling, salination and desiccation of the lakes resulted in a total loss of the fish population. Within the area of wetlands, collector KKS has remained as the only place suitable for fish habitat. However, continuous fishing led to a complete loss of the reproductive systems of the ichthyofauna.

Until 2000, the lakes in wetland Sudochie were a unique place in terms of diversity and number of waterfowl and wetland birds, with a registered 218 bird species, of which 12 species were included in the Red Book (MSOP). During low water years, the number of wetland birds decreased from 70,500 to 2,600, and the number of hydrophilic species was reduced from 91.6% to 38.2%. As a result of the lake shoaling and drying up, all reed and cattail bushes, as sources of feed and protection for muskrat and local and migrant birds, became dry. This caused almost complete disappearance of the muskrat population, which decreased from 20-25 thousand to just a few animals in two years.

[1] «South Priaralie – new outlooks», 2003, edited by V.A.Dukhovny and Joop de Schutter, NATO Science for Pease Project, SIC ICWC, Tashkent.

Overall, a difficult environmental situation can be observed throughout the Amu-Darya delta. Only Muynak and Rybachie bays remain more preserved. However, even here the reed and cattail bushes became dry and jackals and foxes destroyed the nests of waterfowl. Fish population in the water bodies was subjected to intensive fishing by local inhabitants and numerous fishermen. As a result of low water levels in 2000 and 2001, the stable natural landscapes in the Priaralie have practically disappeared, and slowly degrading landscapes started to prevail.

The Syr-Darya delta and lowlands

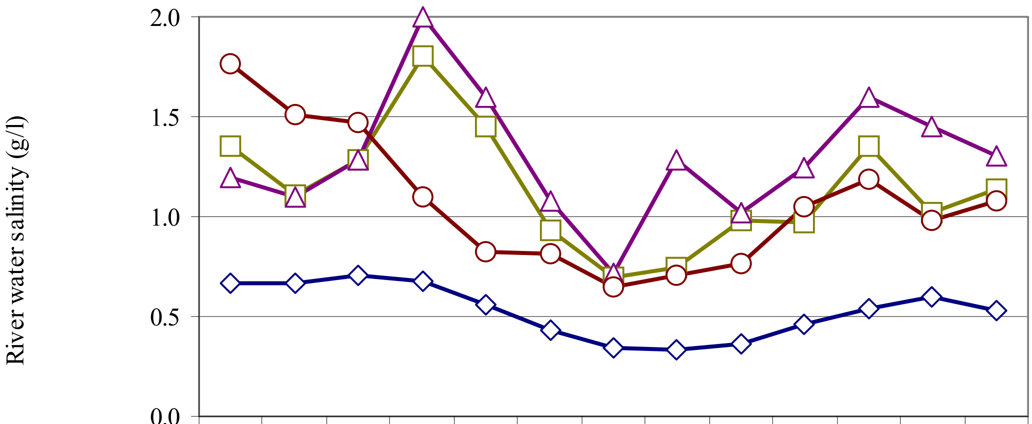
In autumn and winter 2003/2004, large water releases for generating electric energy from the Toktogul HEPS (under high water availability in the Syr-Darya) led to increased inflows to the Chardara reservoir. This had caused the reservoir's premature filling, forced releases, and consequently, uncontrollability of the river flow, especially in the downstream zones. As a result, engineering structures and protective dams in the Kyzylorda province (lowlands and delta) were damaged or destroyed and settlements were flooded. The damages were assessed at about US $2 million.

1.2.3 Effect of hydrological conditions on water quality

Accordingly with the changes in the hydrological regime considerable changes in the quality of river water have taken place. Increases of highly mineralized discharges and wastewater have led to a substantial increase in water salinity and deteriorated sanitary conditions of the river water.

Amu-Darya lowlands and delta

The environmental changes related to the decreased inflow to the delta were also reflected in the deterioration of drinking water quality - due to the increase in salinity and reduction of groundwater inflow. The main culprit in *water quality* deterioration in the Amu-Darya downstream was a discharge of *return water* in the midstream, causing a *soil salinization* process and aggravating the composition of soils. The water salinity dynamics in Amu-Darya downstream is shown in Fig. 1.2.1 below.



	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	I-XII
1960-63	0.67	0.67	0.71	0.68	0.56	0.43	0.34	0.33	0.36	0.46	0.54	0.60	0.53
2000	1.35	1.11	1.28	1.80	1.45	0.93	0.70	0.75	0.98	0.97	1.35	1.02	1.14
2001	1.20	1.10	1.28	2.00	1.60	1.08	0.72	1.28	1.02	1.25	1.60	1.45	1.30
2002	1.76	1.51	1.47	1.10	0.82	0.81	0.65	0.71	0.76	1.05	1.19	0.98	1.08

Month

Fig.1.2.1 Water salinity (monthly and annual mean) in the Amu-Darya river (Samanbai section)

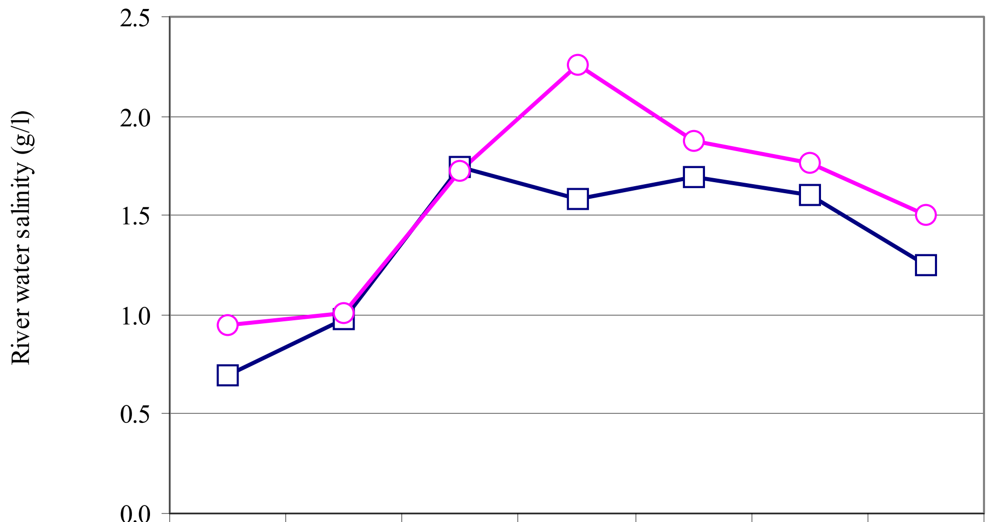
The Table above shows that in low water years 2000 and 2001 the mean annual salinity in the Amu-Darya was in a range of 1.14 to 1.30 g/l, while the mean monthly value in April 2001 was as high as 1.8 to 2.0 g/l. The salinity increased 2 to 2.5 times when compared to the 1960's. The increase in river pollution through discharges of domestic sewage and highly mineralized collector/drainage water aggravated the environmental and socio-economic conditions both downstream and midstream.

A similar picture can be observed in the Syr-Darya midstream and downstream.

Syr-Darya lowlands and delta

Before the regulation of the river flow, the water salinity in the river downstream varied and changes in water availability had little effect on the salinity values. The dissolved solids content was 0.6 to 0.7 g/l, and water had a hydro-carbonate calcium character. Intensive irrigated agriculture in the sixties caused an increase of water salinity to 1.1 g/l during the seventies (Fig. 1.2.2.)[7]. The main cause of *water quality* deterioration in the Syr-Darya downstream was a discharge of *return waters* from the Ferghana Valley and in the river midstream. Water deterioration also affected the *irrigation norms* (they increased) and the process of soil *salinization,* leading to serious degradation of lands, loss of soil fertility, reduction of crop yields and quality of agricultural production.

The water quality within Syr-Darya downstream *does not meet requirements of drinking water supply* and fisheries. While the salinity upstream is no more than 0.3 to 0.5 g/l, after the river leaves the Ferghana Valley, the salinity rises to 1.2 to 1.4 g/l. Further downstream, the water salinity reaches 1.4 to 1.6 g/l in the Chardara section and 1.6 to 2.0 g/l in Kyzylorda, and finally 1.7 to 2.3 g/l in Kazalinsk.



	1960	1970	1980	1985	1990	1995	1999
Kyzylorda	0.70	0.98	1.74	1.58	1.69	1.60	1.25
Kazalinsk	0.95	1.01	1.72	2.26	1.87	1.76	1.50

Year

Fig.1.2.2 Water salinity (mean annual) in the Syrdarya river (Kyzylorda and Kazalinsk sections)

[7] Kipshakbayev N.K.. 2000. Optimization of water and power resources use in the Syr-Darya river basin under present-day conditions. SIC ICWC Kazakh branch. Almaty, 36 p.

1.2.4 Environmental changes within the river deltas

Amu-Darya lowlands and delta

Due to the shrinking[8] of the Aral Sea, the degradation of natural systems of the Priaralie can be observed in:

- reduction of lake areas in the Amu-Darya delta to 26,000 ha from 400,000 ha in 1960
- drop in groundwater level to 8 m below the surface (depending on the distance from the seashore)
- erosion in riverbed to depth of 10 m
- transfer of salt and dust up to distance of 500 km, having a load of 0.1 to 2.0 t/ha
- changes in soil cover - hydromorphic soil area decreased from 630,000 to 80,000 ha
- increase in solonchak (salt-marsh) areas from 85,000 to 273,000 ha
- reduction of reed area from 600,000 to 30,000 ha (or 20 times)
- reduction of tugai forest areas from 1,300,000 to 50,000 ha (or 26 times)
- changes in climate within a band of 150 to 200 km
- decline in fish productivity from 40,000 to 2,000 t (or 20 times)

Resulting economic damage was estimated as US$115 million/year and the social damage about US$28.8 million/year.
According to Novikova's data[9], the natural inflow to the delta and the Aral Sea had begun to decrease even before the beginning of the sea level drop, i.e. before 1961. This is evident from statistical data. From 1932 to 1960 the mean inflow to the delta was 41 km^3/year. The flooded area covered more than 2,800 km^2 and the actual lake area was 820 km^2. During the early sixties, essentially from 1961 to 1965, the inflow had decreased to 30 km^3/year and submersed and lake areas were reduced to 2,100 and 790 km^2, respectively.

According to the remotely sensed observations during the last couple of decades, the area of lakes in the Amu-Darya downstream had noticeably changed:

- normal water year 1984 - 70.2 km^2
- high-water year 1997 - 120 km^2
- low-water year 2000 - 26 km^2

As a consequence, the tugai forest areas were dramatically reduced. Between 1987 and 1993, the Ministry of Water Resources of Uzbekistan started to work toward the improvement of water supply to the delta. Reservoirs, such as Mezhdurechenskoye, Muynak, and Rybachie, were constructed and several systems, such as Karadzhar, Dumalak, Shegie, etc., were watered. Revival of the delta had started to be observed during this period. As a result of these temporal measures, the area of watered land in the Amu-Darya delta had increased to 300 km^2. Unfortunately, these efforts were sharply reduced after the merging of the Ministry of Water Resources and the Ministry of Agriculture in Uzbekistan. The main regulator of the Mezhdurechenskoye reservoir with the temporary dike broke, and, as a result, the capability to regulate the inflow to the delta became considerably limited.

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[8] "Assessment of socio-economic consequences of the Aral Sea shrinkage", 2001, edited by V.A.Dukhovny, INTAS/RFBR – 1733 Project, SIC ICWC, Tashkent.
[9] Novikova N.M, Kuzmina J.V., Dikareva T.V, Trofimova T.U. Preservation of the tugai bio-complex diversity within the Amu-Darya and Syr-Darya deltas in arid condition // Ecological research and monitoring of the Aral sea delta, Book2, UNESCO 2001, P.155-188

Due to the shortages of water, the fish and muskrat catch was reduced. Fishing used to be the key economic sector in the Muynak district - in its coastal zone and in the Amu-Darya delta, and over 80% of production came from the fishing industry. The largest catch was estimated in 1958 as 24,400 t, including 56% of the most valuable fish species (bream, barbell, etc.). In 1984, the catch amounted to only 2,460 t (decreased approximately 10 times), and was further reduced to 1,970 t in 1994.

In the early sixties, the entire area of lakes in the delta covered over 300,000 ha. Fish catch in the lakes was in a range of 5,500 to 6,000 t/year. Only in Sudochie Lake, covering an area of 40,000 ha, the annual catch was between 1,200 and 1,500 of fish. Unfortunately, a sudden decline in the inflow from the Amu-Darya to the Aral Sea caused an increase in the river hydraulic gradient. All delta lakes were left without water and lost their fishing value. To compare, if taking the total fish catch from 1960 to 1965 as a favorable period (16,000 to 22,500 t caught annually), the annual relative loss could be estimated as 16,620 ton for the period between 1980 and 1990 and 17,550 ton for the period between 1990 and 2000.

Vast shallow lakes and bays have dried out. Out of 300,000 ha of delta and seashore lakes, only about 100,000 to 110,000 ha of lakes were preserved during the normal water years. The lakes area had decreased to 20,000 to 25,000 ha in low water years (e.g., 2001) while the salinity had increased, resulting naturally in the loss of their economic value. By January 1, 2004, the muskrat population had completely disappeared. The fish catch had dropped to a mere 400 to 500 t/year. A majority of the lakes, which were located in irrigated lands, have dried up. The area under pastures and hay land has also decreased.

From 1960 to 1968, the area of tugai forests that created specific microclimate and performed anti-erosion, anti-deflation, relief-formation and other functions, was 300,000 ha. Due to desiccation of large areas of the delta, the area of tugai forest decreased to about 25,000 to 30,000 ha (Treshkin S., Bakhiyev A., 1995). At present, the tugai vegetation is spread only within the Amu-Darya channel and in some active flow paths. As for the presence and survival of bushes, typically growing were various kinds of tamarisks (*Tamarix,* which now can be found in a reduced area and at different stage of degradation.

Wetland vegetation in the Amu-Darya delta is represented by form of cattails *(Typha*), reed *(Phragmites australis), Ceattophyllum* and, to a lesser degree, by pondweed *(Potamogeton),* primarily found in a zone with excessive watering. Due to a sharp reduction of wetlands, the composition of wetland vegetation species and their areas have also changed. Reed formations are the most widespread vegetation species in the periodically flooded zones and delta lakes. According to U.Turemurator et al. (1968), the total area of reeds in the Amu-Darya delta in the sixties was about 500,000 ha. At present, according to data (cosmic imaging), the reed area is not larger than 70,000 ha. Typically, the reed area in the irrigated zone has recently decreased due to the reduction of rice-growing areas. The overall reduction of the reed area poses great damage to livestock farming.

The strongest desertification factor is the development of an aeolian process and transport of salt and dust from the exposed seabed and the surrounding desert areas. According to SANIIRI research[10], the soluble salt content in these deposits is in a range of 5 to 30%. Hence, it is understandable that in the process of blowing dust and salt for a distance of up to 3 km, wet aerosols

[10] Rasakov R.M., Kosnasarov K.A. Dust and salt transfer from the exposed bed of the Aral Sea and measures to decrease its environment impact. NATO ASI Series. № 112. 1996 b. P. 95

may occur on higher grounds with precipitation. During 1971 to 1975, under lower degree of desiccation of the Aral Sea, the amount of ions in precipitation was 20 to 70 mg/l, but by 1985, it had increased to 100 to 300 mg/l. Thus the average of salt falling with precipitation was from 150 to 300 kg/ha.

A drop in the sea level by more than 23 m, occurring as a result of reduced river inflow, brought about dramatic changes both in the areas of the Amu-Darya downstream and in the delta. This led to a loss of a significant part of bio-resources and desertification of most of the Priaralie. Ecological conditions were aggravated by deterioration of water quality in the Amu-Darya, due to discharges of highly saline and polluted collector/drainage waters.

Syr-Darya lowlands and delta

The specific problems of the North Priaralie can be summarized as in footnote[2] (also below):

- Lack of efficient management of water resources and their monitoring in the river delta
- Extremely low volume of the Syr-Darya water flowing into the delta and the Aral Sea between late April and early May, when the demand is higher (1.5 to 2 km^3), resulting in an interruption of flow
- Change in the origin of erosion (due to the drop of the sea level), leading to deep erosion and scouring of the Syr-Darya riverbed within the distance of 145 km
- Continued intensive desertification of the Priaralie (delta drying out, groundwater levels drop, sea salinity increase, climate deterioration)
- Discontinuance of delta flooding and exposure of the seabed for more than 100 km, leading to: (i) substantial reduction of fish-lake areas (more than 4 times since 1957 to 1997); (ii) decrease of fish catch from 9,000 to 10,000 to 2,000 t; (iii) reduction of flood plain 3 times in the Kazalinsk district and 10 times in the Aralsk district, causing decline in productivity of hay land and pasture, thus undermining the economics of agriculture
- Degradation of the most economically valuable meadow soils, their drying up and salinization (the area of alluvial-meadow soils decreased from 20% in 1955 to 12% in 1997 within the delta area, while marshes decreased from 52.6 to 25%, and the solonchak area increased from 21.2 to 40%)
- The dust-salt storms reaching from the source up to 30 to 50 km, while the general effect extending 300 to 500 km is carrying up to 50,000 to 70,000 t of salt per year
- Environmental changes reflected in the existence of different species of animals and birds, particularly of those connected with the aquatic biota;
- A high degree of pollution associated with discharge of salts, biogenic and organic matters, and pesticides, leading to salinization of soil, deterioration of the aquatic life conditions in the river, lakes and the sea, and unsuitability of river water for drinking.
- Socio-hygienic problems connected with an inadequate supply of suitable water quality for drinking, lack of sewerage system, and uncontrolled emergency discharges of polluted urban and rural sewage waters into the river.

According to remotely sensed observations, the changes during last several decades have negatively impacted the lake areas within the Syr-Darya downstream, so that the *lake areas have declined* from 517.73 km^2 in 1960 to 450 km^2 in 1982 and 252.5 km^2 in 2000. In 2001, there was an increase in the lake areas to 353 km^2.

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[2] «Economic evaluation of local and joint measures to mitigate socio-economic damage in Priaralie zone», 2004, edited by V.A.Dukhovny. Final report on INTAS – ARAL - 2000 – 1059 Project, SIC ICWC, Tashkent.

Wetlands in the Syr-Darya delta are evaluated for *ecosystem sustainability,* to provide a basis for fisheries and forage production, which is a necessary condition for viability of life for the population in the Aralsk and Kazalinsk districts, Kyzylorda province. Because of changes in the hydrological regime and due to excessive mowing, plant communities were rearranged and tidal marshes became endangered. Since 1960, the reed areas have decreased 6 to 7 times and their yields have dropped to a level of grassland yields in inter-fluvial plains. The areas of reed grass, licorice, and motley grass communities were reduced to 70 to 75%.

In the sixties, the tugai forests occupied 21,300 ha in the Syr-Darya delta. Tugai forests were formed on alluvial-meadow soils, with the water table at 1 to 3 m below the surface, creating a specific microclimate by decreasing temperature and increasing humidity. In the Aralsk and Kazalinsk districts the tidal-marsh terraces and natural levees extended along both banks of the Syr-Darya and its branches from 300 m to 3 km wide bands.

In the lower part of the delta the desertification process was and still is observed over a large scale and the ecological situation seems critical. As before, the watering conditions in the lower delta (Aralsk district) need to be improved, to keep the hydromorphic soils from degrading. This is evident by a complete transformation of flooded marshy soils and the prevalence of meadow-swampy and alluvial-meadow soils that are drying up and are highly saline, as well as the expansion of takyr-like soils, sands and solonchaks.

As a result of the sea desiccation, the area of hydro-morphic soils was reduced from 630,000 ha in the early fifties to 80,000 ha at present. During the same period, the total area of solonchaks had increased from 85,000 ha (7%) to 273,000 ha. In the future, expansion of sandy-desert soils, takyr, residual and takyr-like solonchaks is likely to be expected. Resulting from the wind activity, the humus content in the soil declined from 3 to 4% to 0.5 to 0.6%. Activation of the aeolian process and dust and salt transfer from the exposed seabed to the adjacent areas is one of the key factors of desertification in Priaralie.

In water management terms, the most negative causes of environmental tension are: unsatisfactory control over the hydrological regime of the Amu-Darya delta, poor control of flow, and discontinued flooding of the delta. The operation of the Amanotkel waterworks slightly restrains the erosion rate in the river channel. However, during an emergency situation in 1996, the maximum depth of the riverbed erosion was 0.95 m/year. Should the operation of the Amanotkel waterworks cease, the process of leveling of the river slope would take place and the riverbed erosion would be activated at the rate of 2.3 m/year.

Deep erosion has made the former channels within the delta disappear and the groundwater level drop, particularly within the boundaries of the lower floodplain in the Aralsk district. Along with the riverbed erosion the groundwater within the Syr-Darya delta drops, as a consequence of the drop in the sea level and reduction of filtration losses from irrigation water, particularly river water.

The main lake systems in North Priaralie are Kamyshlibash, Akshatou, and Aksai-Kuandarya, watered through five separate canals and the Primorskaya lake system. In the period from 1988 to 1997, most canal locks were destroyed by a spring ice drift and backwater from the lake systems.

The Government of Kazakhstan together with the local authorities took measures to diminish the environmental crisis in the Kazakh part of the Priaralie and constructed the Amanotkel and Aklak waterworks (1975 to 1976) and the Kokaral dike (1988). That way, they succeeded in alleviating some ecological stress in the North Priaralie. However, since the rupture of the Kokaral dike in 1999 and of Aklak waterworks in 2002, all ecosystems that were restored have practically become lost. The next lowering of water level in the river has caused that a significant portion of water accumulated in the lake systems went back into the river and left to the sea. This has greatly exacerbated the regional socio-economic and environmental problems. Should the current hydrological regime in the Syr-Darya delta and North Priaralie continue, the environmental situation would become unsustainable, and applying of adequate measures urgently necessary.

It must be noted that unstable environmental conditions in the South and North Priaralie are aggravated by many economic and socio-hygienic problems, which are associated with irrigated agriculture, unauthorized water intakes, saturation of cropping patterns by rice, and uncontrolled discharge of domestic sewage and agricultural waste water.

During the last few years a problem related to the trans-boundary character of the Amu-Darya and the Syr-Darya occurred. It highlights the disadvantages of the lands located within the river deltas, making them prone to suffer the most from water shortages. Thus the territories of Northern Karakalpakstan, Dashoguz province in Turkmenistan and Kyzylorda province in Kazakhstan find themselves in difficult conditions. The breach of the release schedules, water pollution and under-supply of water to habitat, nature, and national economies are typical problems that need to be overcome. Therefore, enormous institutional, technological and other measures are needed to prepare for a transition toward integrated water management. These measures will need to spell out clearly the priorities for water for ecology and drinking water supply.

1.3. SOCIO-ECONOMICAL PROBLEMS

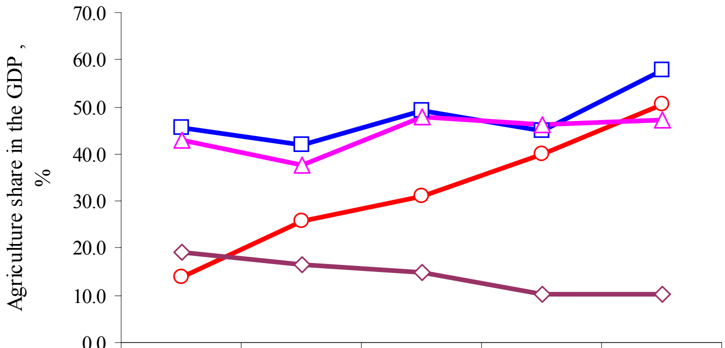
1.3.1 Historical prospective

The prosperity of Central Asia was closely connected with irrigated agriculture from ancient times. Within the Aral Sea Basin about 60% of the rural population is currently working in the agrarian sector, thus its efficiency and productivity have a special meaning for the well-being of people of the region.

Irrigation continues to play a significant role in the socio-economical development of the states of Central Asia, particularly in Kazakhstan, Turkmenistan and Uzbekistan. From the 2003 Gross Domestic Product (GDP) the share of irrigated agricultural production counted in Kazakhstan for 11%, Turkmenistan 27%, and Uzbekistan 33%, respectively. In Uzbekistan, Tajikistan, and Turkmenistan the agricultural production, specifically cotton adds up from 20 to 40% of the export.

In the area of lowlands considered by the project (except Kyzylorda province) the relative significance of agricultural production has been traditionally higher than the national average for the last five years; below it is shown for 2003 and for the last 5 years in Figure 1.3.1.

- Khorezm province (Uzbekistan) 57. 7%
- Dashoguz province (Turkmenistan) - 47.3 %
- Karakalpakstan (Uzbekistan) - 50.4%
- Kyzylorda province (Kazakhstan) - 10.1%



	1999	2000	2001	2002	2003
Karakalpakstan	13.7	25.8	31.1	40.0	50.4
Khorezm province	45.7	42.0	49.2	45.0	57.7
Dashoguz province	42.9	37.7	47.8	46.2	47.3
Kyzylorda province	19.1	16.5	14.8	10.1	10.1

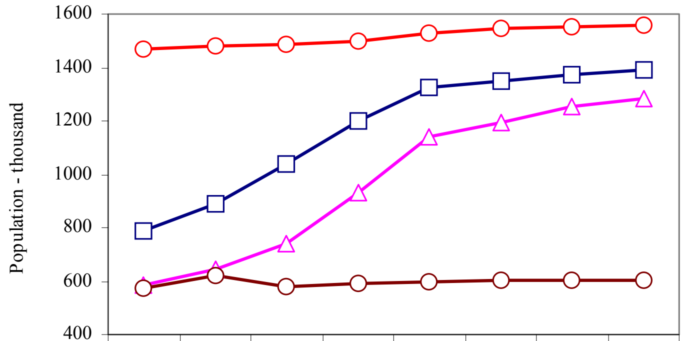
Fig. 1.3.1 Agriculture share in the GDP in the lowlands

Owing to favorable living conditions, the oases within the lowlands (Khorezm and Dashoguz), taking up only a small part of the entire basin, were the center of civilized development in ancient times. The rest of the lands, to be productive, needed complex expensive ameliorative measures, including not only drainage and land leveling, but also improvements of the soil structure. The difficult situation, compounded by a water deficit, has been causing many disagreements, not only between the CA states but also within each state and mainly in the area of lowlands, where there is an uneven demographic load and unreliable water supply. Under such conditions, the states, if considered separately, do not have a real economic possibility to realize large-scale projects to relocate population, create additional work, and rehabilitate or develop new water infrastructure. The main socio-economical problems, which manifest themselves particularly in the lowlands and deltas of the Amu-Darya and Syr-Darya are:

- Sharp decrease of agricultural productivity to 50% (as compared with the year 1990)
- Intensified influence of the aggravated ecologic situation on the conditions of agricultural lands, fisheries, marshes and wetlands
- Intensified influence of the low-water years on the socio-economic situation

1.3.2 Demographics of the lowlands

The total population in the project provinces of the lowlands associated with the Amu-Darya (Khorezm province of Uzbekistan, Dashoguz province of Turkmenistan and Republic Karakalpakstan - part of Uzbekistan) and of the Syr-Darya (Kyzylorda province of Kazakhstan) counts for 4, 845,600 people (Fig. 1.3.2). More than 60% of the total population – over 2,950,200 people – live in rural areas (Table 1.3.1), with agriculture as the main source of income.



	1980	1985	1990	1995	2000	2001	2002	2003
Khorezm province	788	891.4	1039.2	1198.4	1326.4	1350.1	1371.8	1393.4
Dashoguz province	583.4	644.9	738	930.1	1141.9	1196.7	1252.2	1284.7
Karakalpakstan	1469	1480	1487	1498	1527	1543.3	1554.8	1560.6
Kyzylorda province	573.4	619.3	580.1	590.9	599.6	600.7	603.8	605.4

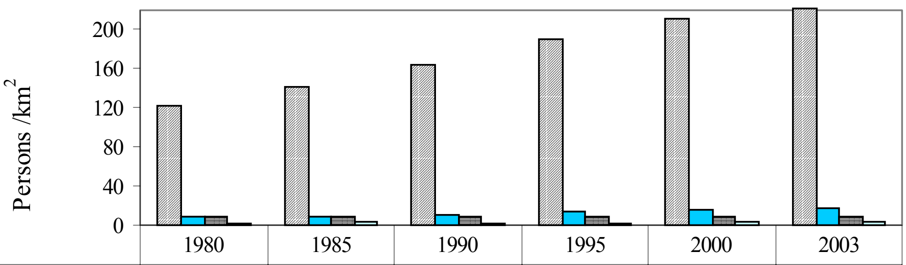
Years

Fig. 1.3.2 Total Population in Project Provinces

Table 1.3.1 Relationship between rural and urban population

	1980		1985		1990		1995		1999		2000		2001		2002		2003	
	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%	Thous. men	%
Amu-Darya lowlands																		
Khorezm province																		
Total population	788.0		924.8		1061.6		1198.4		1301.2		1326.4		1350.1		1371.8		1393.4	
Urban population	157.0	*20*	204.2	*22*	251.4	*24*	298.6	*25*	314.0	*24*	317.1	*24*	319.0	*24*	320.1	*23*	321.2	*23*
Rural population	631.0	*80*	720.6	*78*	810.2	*76*	899.8	*75*	987.2	*76*	1009.3	*76*	1031.1	*76*	1051.7	*77*	1072.2	*77*
Dashoguz province																		
Total population	583.4		644.9		738.0		930.1		1102.4		1141.9		1196.7		1252.2		1284.7	
Urban population	170.5	*29*	200.4	*31*	241.2	*33*	293.1	*32*	359.4	*33*	372.3	*33*	388.2	*32*	409.7	*33*	445.6	*35*
Rural population	412.9	*71*	444.5	*69*	496.8	*67*	637.0	*68*	743.0	*67*	769.6	*67*	808.5	*68*	842.5	*67*	839.1	*65*
Karakalpakstan																		
Total population	1469.0		1480.0		1487.0		1498.0		1503.0		1527.0		1543.3		1554.8		1560.6	
Urban population	922.0	*63*	856.8	*58*	787.7	*53*	722.5	*48*	724.2	*48*	738.4	*48*	757.8	*49*	764.1	*49*	766.2	*49*
Rural population	547.0	*37*	623.2	*42*	699.3	*47*	775.5	*52*	778.8	*52*	788.6	*52*	785.5	*51*	790.7	*51*	794.4	*51*
Total for Amu-Darya lowlands																		
Total population	**2840.4**		**3049.7**		**3286.6**		**3626.5**		**3906.6**		**3995.3**		**4090.1**		**4178.8**		**4238.7**	
Urban population	1249.5	*44*	1261.4	*41*	1280.3	*39*	1314.2	*36*	1397.6	*36*	1427.8	*36*	1465.0	*36*	1493.9	*36*	1533.0	*36*
Rural population	1590.9	*56*	1788.3	*59*	2006.3	*61*	2312.3	*64*	2509.0	*64*	2567.5	*64*	2625.1	*64*	2684.9	*64*	2705.7	*64*
Syr-Darya lowlands																		
Kyzylorda province																		
Total population	573.4		619.3		580.1		590.9		598.5		601.2		600.7		603.8		606.9	
Urban population	357.7	*62*	412.8	*67*	349.0	*60*	361.4	*61*	360.9	*60*	363.8	*61*	360.6	*60*	360.5	*60*	362.4	*60*
Rural population	215.7	*38*	206.5	*33*	231.1	*40*	229.5	*39*	237.6	*40*	237.4	*39*	240.1	*40*	243.3	*40*	244.5	*40*

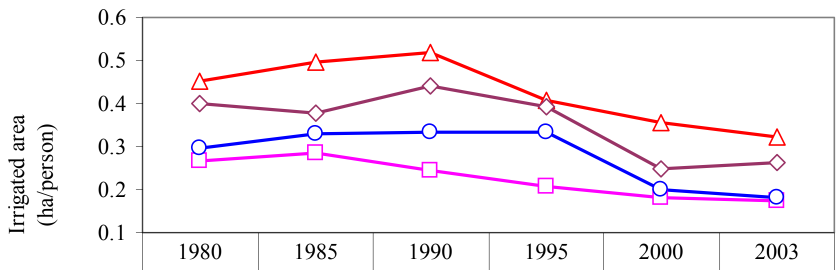
The highest density of population (221 people/km^2) is in Khorezm province, similar to the most densely populated Ferghana valley (Fig. 1.3.3). In Khorezm and Dashoguz provinces the population density has a tendency to further increase; at the same time, this index is decreasing in the provinces directly bordering on the Aral sea (Karakalpakstan and Kyzylorda province).



	1980	1985	1990	1995	2000	2003
Khorezm province	121.5	141.5	164.9	190.2	210.5	221.2
Dashoguz province	7.9	8.7	9.9	13.4	15.4	17.3
Karakalpakstan	8.87	8.94	8.98	9.05	9.22	9.42
Kyzylorda province	2.5	2.7	2.6	2.6	2.6	2.7

Fig. 1.3.3 Population Density in Project Provinces

The maximum share of rural population is in Khorezm (76.9%) and Dashoguz provinces (65.3%), while the minimum is in the Kyzylorda province (40.4%), as shown for over last twenty years in Table 1.3.1. In 2003, compared with the year 1980 the rural population decreased only slightly in the Khorezm and Dashoguz provinces, and at the same time increased in Karakalpakstan from 37.2% to 50.9% and in Kyzylorda province from 37.6% to 40.4%, respectively.
Accordingly with the high population density, the lowest value of an irrigated area per one person (Fig. 1.3.4) is in the Khorezm province[1].



	1980	1985	1990	1995	2000	2003
Khorezm province	0.27	0.28	0.24	0.21	0.18	0.18
Dashoguz province	0.45	0.49	0.52	0.41	0.36	0.32
Karakalpakstan	0.29	0.33	0.34	0.33	0.20	0.18
Kyzylorda province	0.40	0.38	0.44	0.39	0.25	0.26

Fig. 1.3.4 Irrigated area in ha per person in project provinces

The increase in the 2003 population if compared with 1980 (Table 1.3.2.) is the highest in Dashoguz (120.2%) and Khorezm (76.8%) provinces, but in Karakalpakstan and Kyzylorda province it is insignificant.

Table 1.3.2 Increase of 2003 population in the areas bordering the Aral Sea compared with the year 1980

Years	Measure units	Khorezm province	Dashoguz province	Karakalpakstan	Kyzylorda province	Total
1980	thous.persons	788	583.4	1 469	573.4	3 413.8
2003	thous.persons	1 393.4	1 284.7	1 560.6	605.4	4 844.1
Increase	thous.persons	605.4	701.3	91.6	32.0	1 430.3
	%	176.8	220.2	106.2	105.6	141.9

[1] Influence of low-water years 2000 and 2001 on these indicators is shown in section 1.5.1

The birth rate, if compared with the year 2000, in all provinces (except Turkmenistan) has decreased; this was mainly caused by a migration of young people out of these areas.

The most important factor of population growth is its natural increase (Fig.1.3.5), although the balance of the increase is not positive in all provinces.

a) Birth rate

	1995	2000	2001	2002	2003
Khorezm province	29.2	25.1	24.0	22.3	22.5
Dashoguz province	30.0	34.0	35.0	36.0	41.0
Karakalpakstan	23.8	24.0	21.7	21.8	21.5
Kyzylorda province	26.4	21.1	20.3	20.5	21.0

b) Death rate

	1995	2000	2001	2002	2003
Khorezm province	6.0	5.2	4.9	4.9	5.0
Dashoguz province	7.0	7.0	6.0	6.0	7.0
Karakalpakstan	5.7	5.6	5.9	5.9	6.0
Kyzylorda province	8.8	7.5	7.4	7.5	7.4

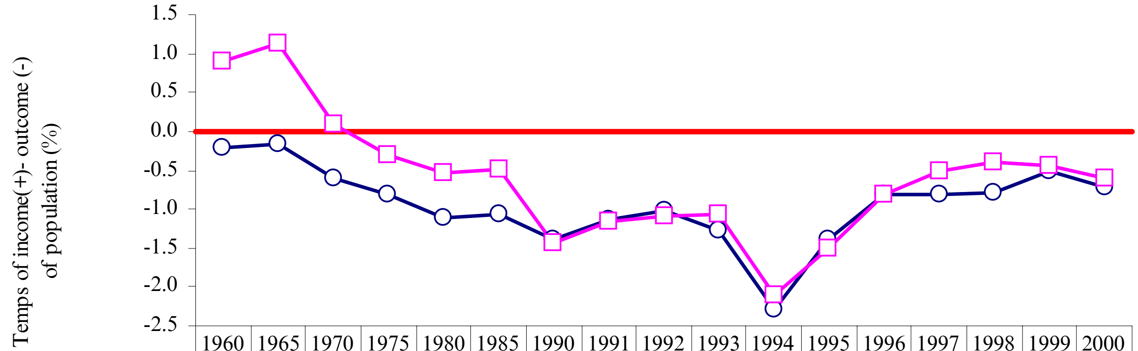
c) Natural increase

	1995	2000	2001	2002	2003
Khorezm province	23.2	19.9	19.1	17.4	17.5
Dashoguz province	23.0	27.0	29.0	30.0	34.0
Karakalpakstan	18.1	18.4	15.8	15.9	15.5
Kyzylorda province	17.6	13.6	12.9	13.0	13.6

Fig. 1.3.5 Population growth (a - birth rate; b - death rate; c – natural increase)

1.3.3 Migration

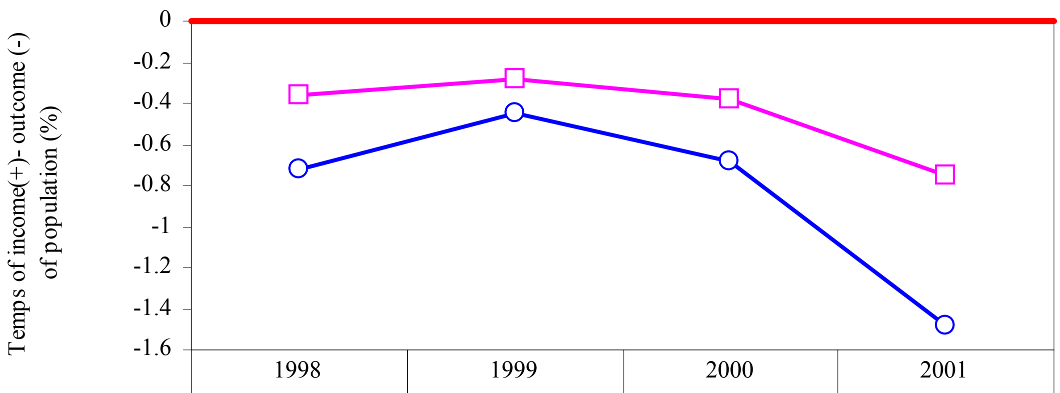
During the last ten-year period (1993 to 2002) approximately 117,100 people left the Kyzylorda province. A negative migration balance for this period came to 56,100 persons (Fig.1.3.6), of which 15,100 people were from the Aral and Kyzylorda districts.



	1960	1965	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Khazakhstan Priaralie	-0.21	-0.17	-0.60	-0.82	-1.11	-1.07	-1.38	-1.14	-1.02	-1.27	-2.29	-1.38	-0.81	-0.82	-0.79	-0.52	-0.72
Kyzylorda province	0.89	1.12	0.09	-0.30	-0.54	-0.48	-1.43	-1.16	-1.09	-1.06	-2.12	-1.51	-0.81	-0.50	-0.41	-0.44	-0.61

Fig. 1.3.6 Migration process in Kyzylorda province and area bordering the Aral Sea in Kazakhstan

A similar picture has been seen during the last few years in Karakalpakstan and especially in those zones bordering the Aral Sea (Fig. 1.3.7)



	1998	1999	2000	2001
Uzbekistan Priaralie	-0.72	-0.45	-0.68	-1.48
Karakalpakstan	-0.36	-0.28	-0.38	-0.75

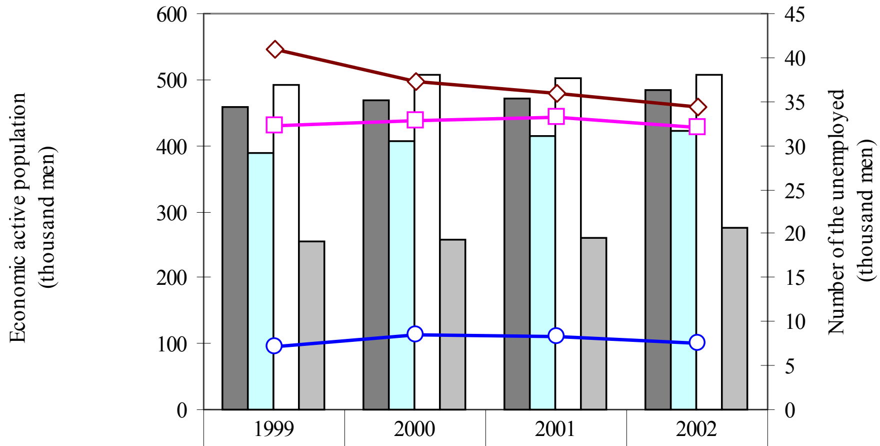
Fig. 1.3.7 Migration process in Karakalpakstan and area bordering the Aral Sea in Uzbekistan

The total damage from migration in the Uzbek Priaralie bordering upon the Aral Sea[2] for a period between 1970 and 2001 was estimated as US $20.4 million, and average annual damage as US $0.4 million[3], respectively. In Kazakhstan the damage in the area bordering upon the Aral Sea due to migration for the same period was estimated as US $20.65 million, and average annual damage as US $1.1 million.

The maximum indicator for the economically active population in Karakalpakstan, as well as for other project zones is shown in Fig.1.3.8. This Figure also shows maximum unemployment levels. For example, in the Kyzylorda province, due to loss of activities connected with the drying up of

[2] There are no data about migration in Dashoguz district of Turkmenistan.
[3] Here and further damage data was taken from the projects:
"Evaluation socio-economic consequences from ecological calamity – the getting dry Aral", 2001, edited by V.A. Dukhovny, project INTAS/RFBR – 1733, SIC ICWC, Tashkent.
«Economic evaluation of local and joint measures on reducing socio-economical damage in the zone bordered upon the Aral», 2004, edited by V.A. Dukhovny. Final project report INTAS – ARAL - 2000 – 1059, SIC ICWC, Tashkent.

the Aral Sea, unemployment was due to a dramatic decrease of activities like navigation, fishing, fish processing, etc.). The total damage from loss of these activities or their reduction has come up to US $70 million annually.

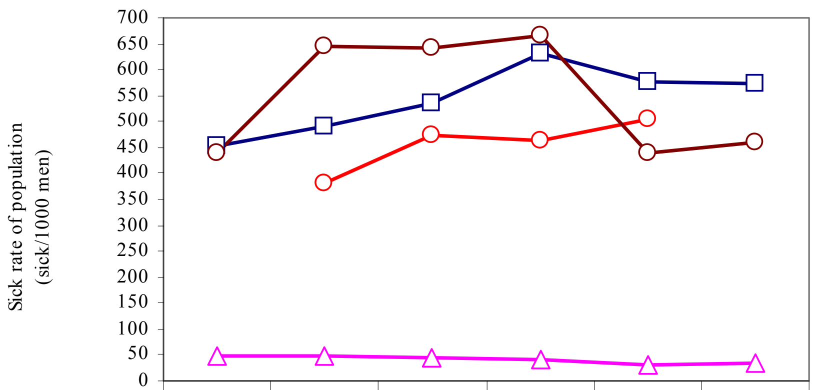


	1999	2000	2001	2002
Khorezm province	458.5	469.7	472.1	483
Dashoguz province	388.6	406.4	414	422.4
Karakalpakstan	490.7	506.5	502.9	507.9
Kyzylorda province	254.7	257.3	259.9	275.3
Khorezm province	32.3	32.8	33.2	32.1
Dashoguz province				
Karakalpakstan	7.2	8.5	8.4	7.5
Kyzylorda province	41	37.2	36	34.4

Years

Fig. 1.3.8 Economically active population and the unemployed in the lowlands

Sick rate indicators, especially in Karakalpakstan and Khorezm province, considerably exceeded the World Health Organization norms and average republican indexes (Fig. 1.3.9). This was caused by the aggravated ecological situation in the delta of the Aral Sea and intensified by the socio-economic difficulty of the region.[4] Damage from increased sick rate and aggravating life conditions came to US $2.1 mln/year in South Priaralie and to US $1.3 mln/year in North Priaralie.



	1995	1999	2000	2001	2002	2003
Dashoguz province	453	492	535	632	577	573
Karakalpakstan	49	47	43	40	32	33
Khorezm province		380	475	462	505	
Kyzylorda province	438	645	642	666	438	459

Years

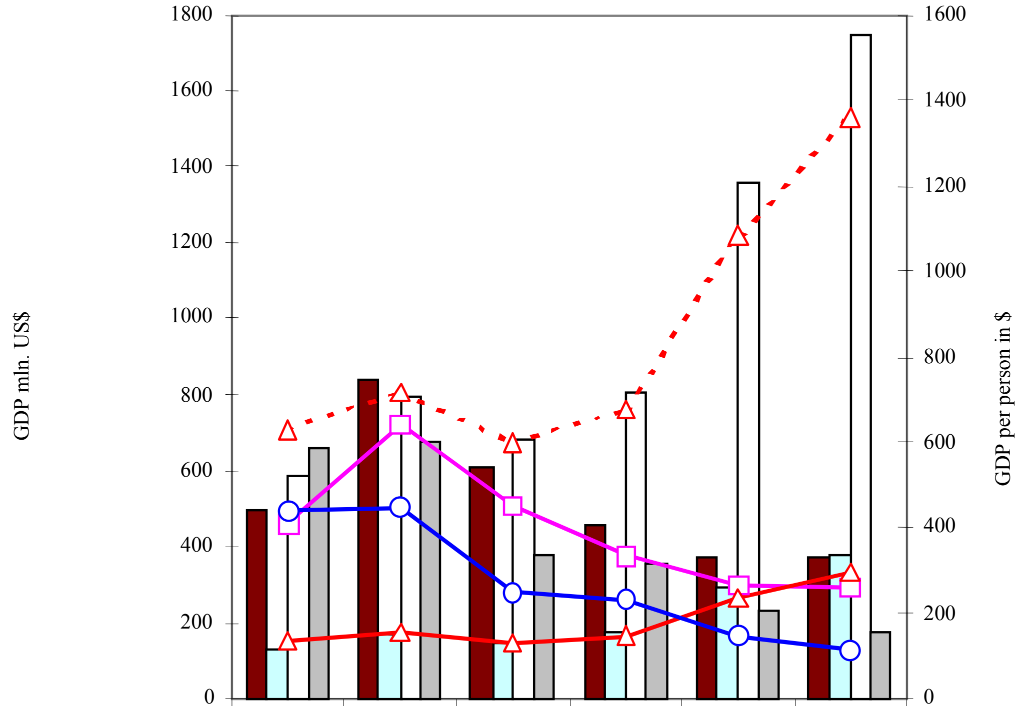
Fig. 1.3.9 Sick rate of population in the lowlands

[4] Low sick rate of population in Dashoguz province cannot be explained with reliable information. Probable sick rate level should be approximately the same as in the Khorezm province and Karakalpakstan.

1.3.4 Macroeconomic indicators

The Gross Domestic Product (GDP) in Khorezm province and Karakalpakstan was on the increase until 1999, but after that it was decreasing. A similar tendency can be seen for the volume of GDP per one person (Fig.1.3.10a). In the Dashoguz province a tendency of increasing the GDP and specific volumes of GDP per one person is noted.

The GDP per person was lowest in Karakalpakstan and Khorezm province of Uzbekistan, where the decreasing tendency took place between 1999 and 2003, especially in Karakalpakstan; it is also shown in Fig.1.3.10a below.



	1995	1999	2000	2001	2002	2003
Khorezm province(mln.$)	495.0	841.6	606.1	454.3	369.9	369.2
Dashoguz province**(mln.$)	126.5	171.5	148.4	174.9	294.4	378.2
Dashoguz province*(mln.$)	584.5	792.4	685.4	807.9	1360.0	1747.4
Karakalpakstan(mln.$)	658.1	672.3	378.8	356.7	232.1	175.8
Khorezm province($/men)	408.3	640.6	452.9	333.8	267.5	263.2
Dashoguz province**($/men)	136.0	155.6	129.9	146.1	235.1	294.4
Dashoguz province*($/men)	628.4	718.8	600.2	675.1	1086.1	1360.2
Karakalpakstan($/men)	439.0	447.3	248.1	231.1	149.3	113.0

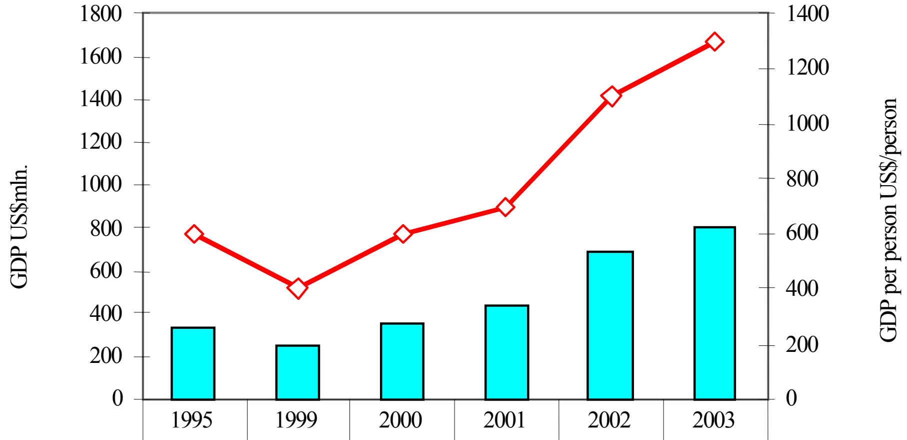
Years

Fig. 1.3.10 a Dynamics of GDP and GDP per person

(*Dashoguz province estimated by market rate of US $; **Dashoguz province estimated by official rate of US $)[5]

In the Kyzylorda province the GDP was decreasing from 1995 to 1999, but after that - from 2000 - it had increased, and continued to 2003 (Fig 1.3.10 b). Accordingly, a stable increase was marked in GDP per person at that time.

[5] Market value and official rates of the US$ vary up to 4.62 times of the value.

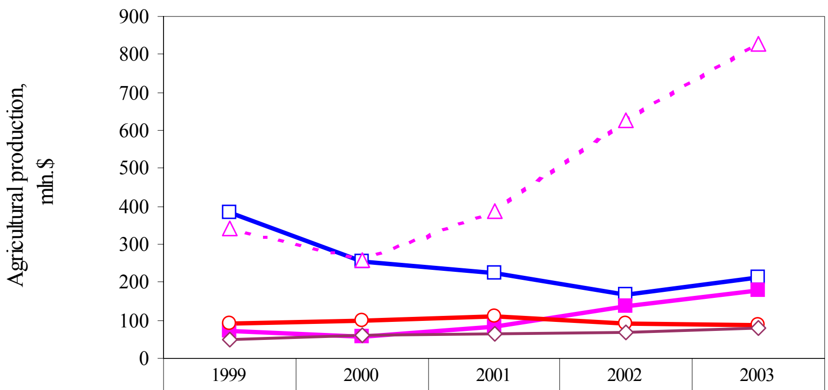


	1995	1999	2000	2001	2002	2003
Kyzylorda province(mln.$)	336.0	254.8	359.5	434.9	683.2	795.9
Kyzylorda province($/men)	600.0	400.0	600.0	700.0	1100.0	1300.0

Years

Fig. 1.3.10 b Dynamics of GDP for Kyzylorda province and GDP per person

An increase of agricultural production was noted only in the Dashoguz province of Turkmenistan[6] and Kyzylorda province of Kazakhstan (Fig. 1.3.11). Livestock breeding dominated part of the agricultural income in Dashoguz province. In Karakalpakstan and Khorezm province during the low water years 2000 and 2001; during the last two years a decrease in the agricultural production due to lower crop yields was also noted. This was a result of factors like depression of the rural population ("broken heart" syndrome), disbelief in obtaining higher crop yield and effectiveness of growing crops, and also a decrease in livestock. In addition, there was an influence of decreased prices at the world market and the system of the state dictating the purchase price for raw cotton and wheat (Uzbekistan and Turkmenistan); that system for the purchase price for rice was valid until 2003.



	1999	2000	2001	2002	2003
Khorezm province	384.5	254.6	223.7	166.3	213.1
Dashoguz province(official course)	340	258.5	386.4	628.4	826.7
Dashoguz province(market)	73.7	56.0	83.7	136.2	179.1
Karakalpakstan	92.3	97.7	110.9	92.9	88.6
Kyzylorda province	48.6	59.4	64.4	69.3	80.2

Fig. 1.3.11 Dynamics of agricultural production

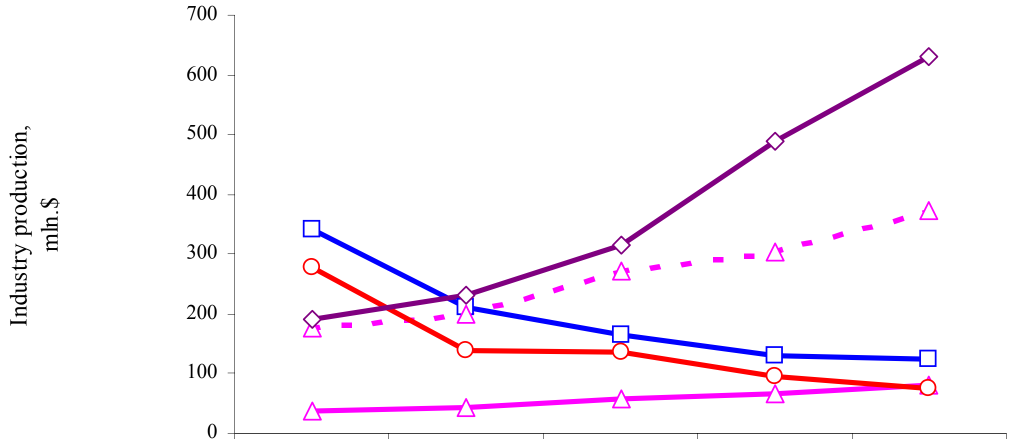
[6] This is official information, but at the same time, there was a considerable decrease of yield for cotton as the main crop (Refer to Figure 1.5.9).

Although the forecast of Organization for Economic Cooperation and Development (OECD) in the report «Agricultural Economy Prospects for 2002 to 2007» said that world prices for agricultural production would gradually increase as compared to the existing low prices, the near future may see an accelerated economic increase. An increase in population purchase capacity would improve the situation at the world agricultural market in the period 2002 to 2007. This is caused by an increasing demand for food products and their import to developing countries as compared to an increased consumption in developed countries. An increased volume of livestock production and forage grain would be more significant than crop production. According to the forecast, prices for oil, forage and oil seeds (correspondingly on 13.2 and 11%) would grow quickly. During the forecast period prices of wheat would increase by 8.5%, and beef by 6%. More significant increase of crop yields is foreseen, rather than expansion of arable lands.

The share of agriculture in GDP in all considered project zones, except Kyzylorda province, during the last few years has substantially increased (Fig. 1.3.11). This tendency proves the heightened importance of agricultural production as seen within the Khorezm and Dashoguz provinces and Karakalpakstan. Industry production process sharply decreased in Karakalpakstan and Khorezm province of Uzbekistan during the last few years. It was caused by a common decrease of industry production in the Republic (Fig. 1.3.12). Increasing the industrial production process in Kyzylorda province is directly dependent on mineral availability and exploitation, and also on state support of small and mid-size business.

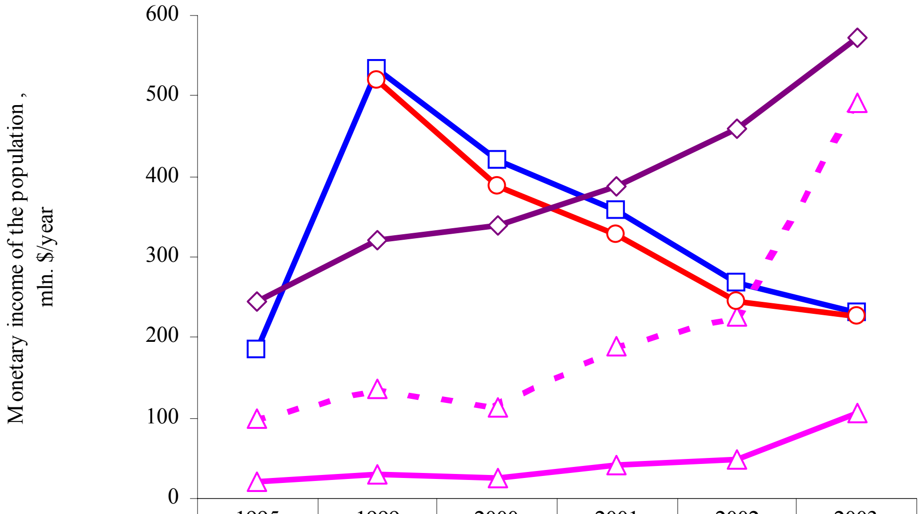
1.3.5 Population income and expenditures

Monetary income and expenditures of the population in Dashoguz and Kyzylorda provinces have been steadily increasing. At the same time, in Khorezm province and Karakalpakstan the tendency is a decrease (Fig.1.3.13 and Fig. 1.3.14).



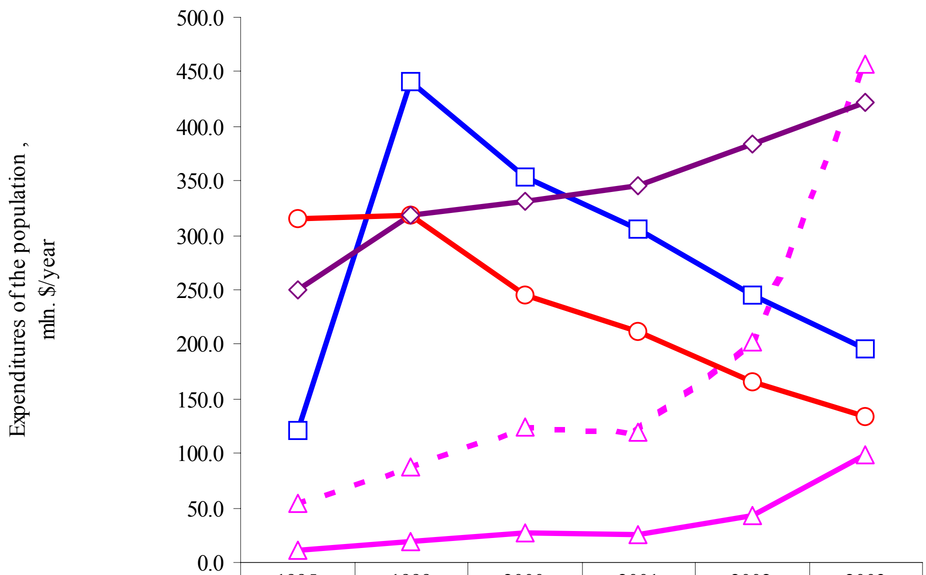
	1999	2000	2001	2002	2003
Khorezm province	342.1	211.2	164.1	130.3	123.5
Dashoguz province(official course)	176.7	198.6	271	304.9	373.9
Dashoguz province(market)	38.3	43.0	58.7	66.1	81.0
Karakalpakstan	276.3	139.1	135.1	95.9	76.5
Kyzylorda province	190.8	231.3	314.0	489.9	630.0

Fig. 1.3.12 Dynamics of industrial production in mln. US$



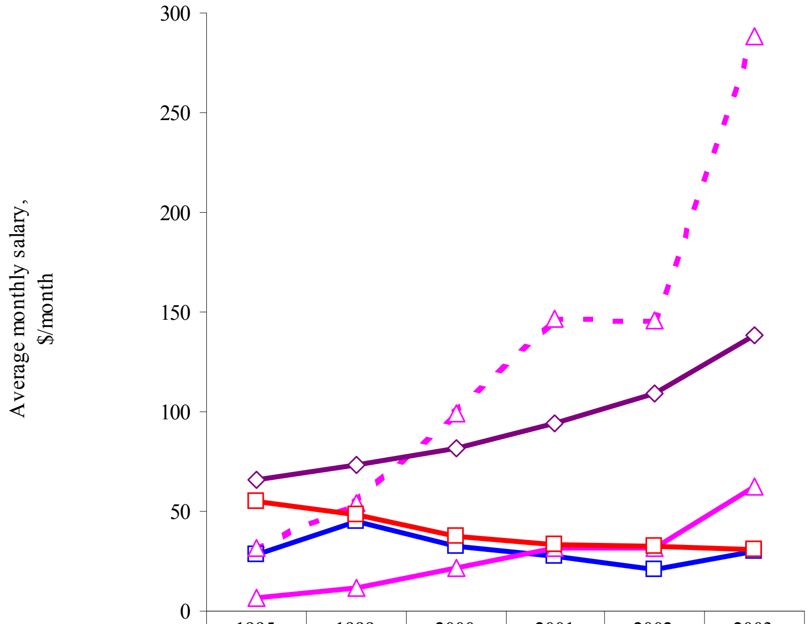
	1995	1999	2000	2001	2002	2003
Khorezm province	185.1	533.8	419.3	356.8	267.8	229.7
Dashoguz province(official course)	98.9	136.2	112.7	188.2	225.5	491
Dashoguz province(market)	21.4	29.5	24.4	40.8	48.9	106.4
Karakalpakstan		519.5	388.4	327.2	244.2	225.2
Kyzylorda province	244.5	320.0	339.4	387.4	459.6	573.3

Fig. 1.3.13. Monetary income of the population in the lowlands



	1995	1999	2000	2001	2002	2003
Khorezm province	121.8	440.7	354.2	305.5	245.1	196.6
Dashoguz province(official course)	54.6	87.7	124.4	119.6	201.5	457.6
Dashoguz province(market)	11.8	19.0	27.0	25.9	43.7	99.1
Karakalpakstan	315.4	317.9	244.7	211.1	165.4	134.2
Kyzylorda province	250.4	318.5	331.7	345.9	384.2	421.5

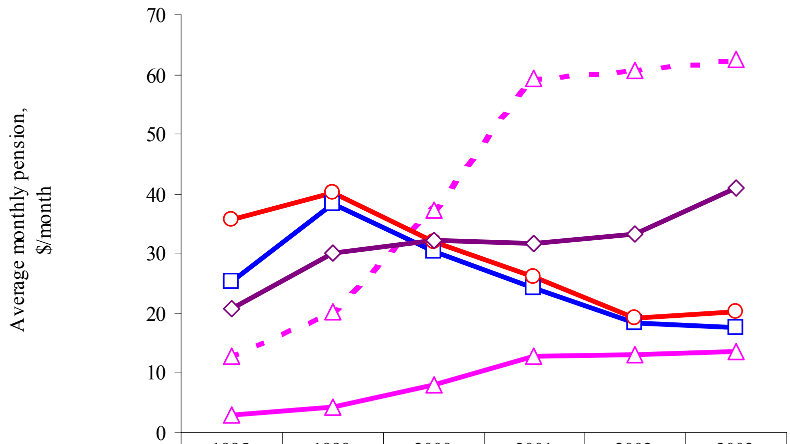
Fig. 1.3.14 Expenditures of the population in the lowlands



	1995	1999	2000	2001	2002	2003
Khorezm province	28.7	44.8	32.5	27.4	20.6	30.0
Dashoguz province(official course)	31.4	53.8	99.1	146.9	145.8	288.5
Dashoguz province(market)	6.8	11.7	21.5	31.8	31.6	62.5
Karakalpakstan	54.6	48.5	37.5	33.3	32.6	30.5
Kyzylorda province	65.8	73.1	81.6	94.3	109.6	138.3

Fig. 1.3.15 Salaries in the lowlands

As shown above in Figure 1.3.15, the average salary in the Khorezm province and Karakalpakstan remained low (Fig. 1.3.15). Similar situation was with pension, as shown below in Fig 1.3.16.



	1995	1999	2000	2001	2002	2003
Khorezm province	25.3	38.3	30.2	24.3	18.2	17.5
Dashoguz province(official course)	12.9	20.2	37.2	59.3	60.6	62.6
Dashoguz province(market)	2.8	4.4	8.1	12.8	13.1	13.6
Karakalpakstan	35.6	40.2	31.9	26	19.2	20.1
Kyzylorda province	20.7	30.2	32.3	31.7	33.2	41.0

Fig. 1.3.16 Monthly pension payments in US$

1.3.6 Food consumption and production process

A decrease of food consumption per person during the last ten years has occurred due to the worsening socio-economic situation in all states of Central Asia, but especially in the lowlands and deltas of the Aral Sea Basin. The zone bordering upon the Aral Sea is marked by the most difficult socio-economic conditions in Central Asia. Based on data collected in 1995 by the World Bank, the national income per person is more than 1.5 to 2.5 times lower than the national average, and often below the living minimum.

The disproportion in income is first of all reflected in the use of basic foodstuffs. Comparatively low level of food consumption in Karakalpakstan is caused not that much by shortage of foodstuffs, but more so by low incomes that limit the population purchasing power. As it can be seen in Fig.1.3.17, consumption of basic products is lower in Karakalpakstan than in Uzbekistan (in its entirety).

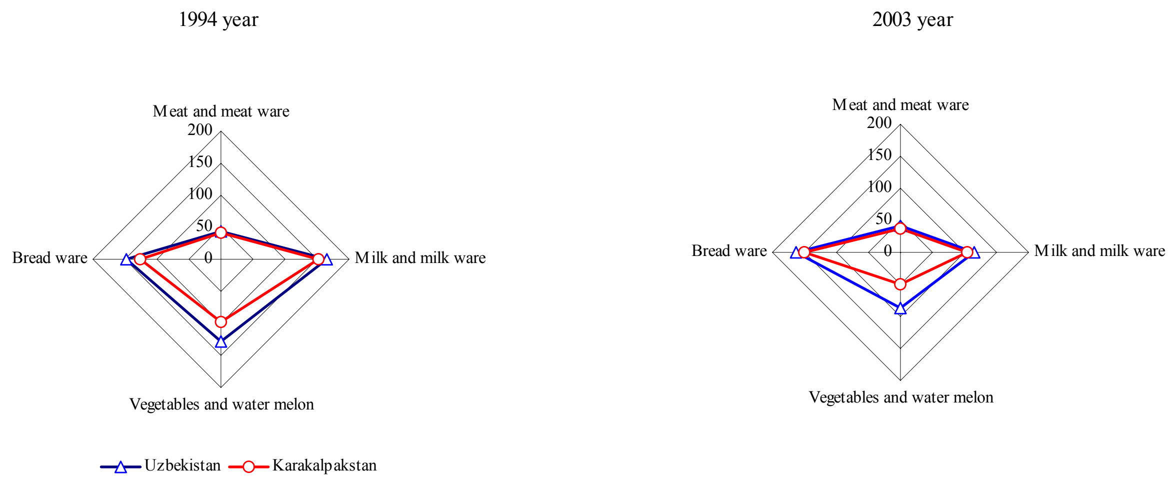


Fig. 1.3.17 Comparison of food consumption in Uzbekistan and Karakalpakstan (kg/person/year)

The same situation takes place in Kyzylorda province (Fig. 1.3.18.), although in the last couple of years, the tendency is toward an improvement.

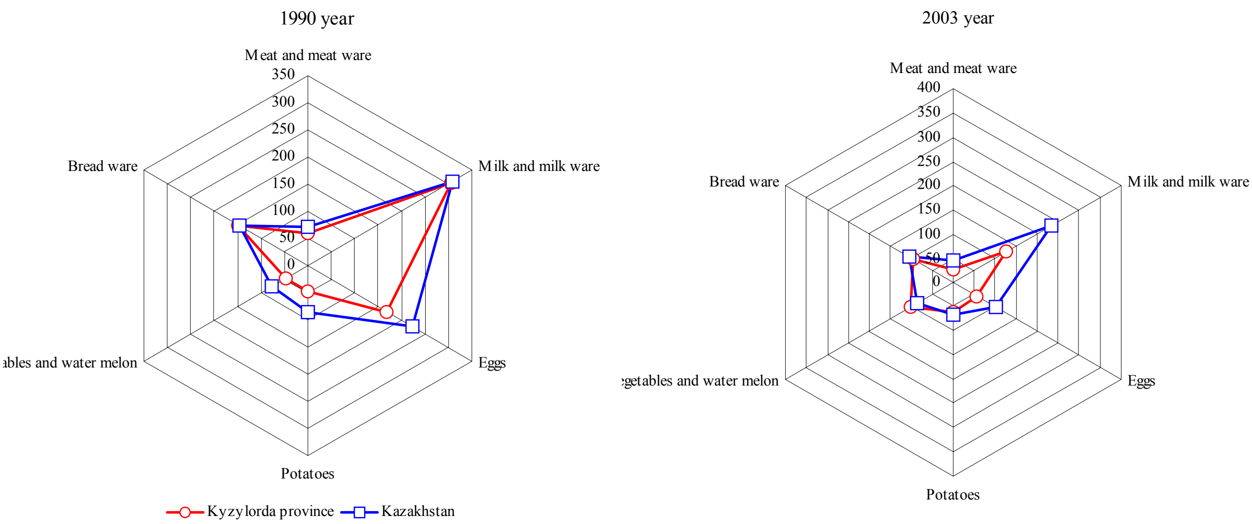


Fig. 1.3.18 Annual food consumption per person in Kazakhstan and Kyzylorda province (kg/person/year)

The food consumption of the population of the lowlands, besides vegetables, watermelon and bread, does not correspond with the physiological norms. A significant part of the population does not have an adequate amount of protein and vitamins. At the same time, according to the norms there should be food self-sufficiency in the lowland zones, except Karakalpakstan (Fig. 1.3.19), where the supply is: for cereals 60% of the norm, meat 74%, eggs 65%, and potatoes 63%. The supply of potatoes is lower than the norm practically in all provinces of the lowlands.

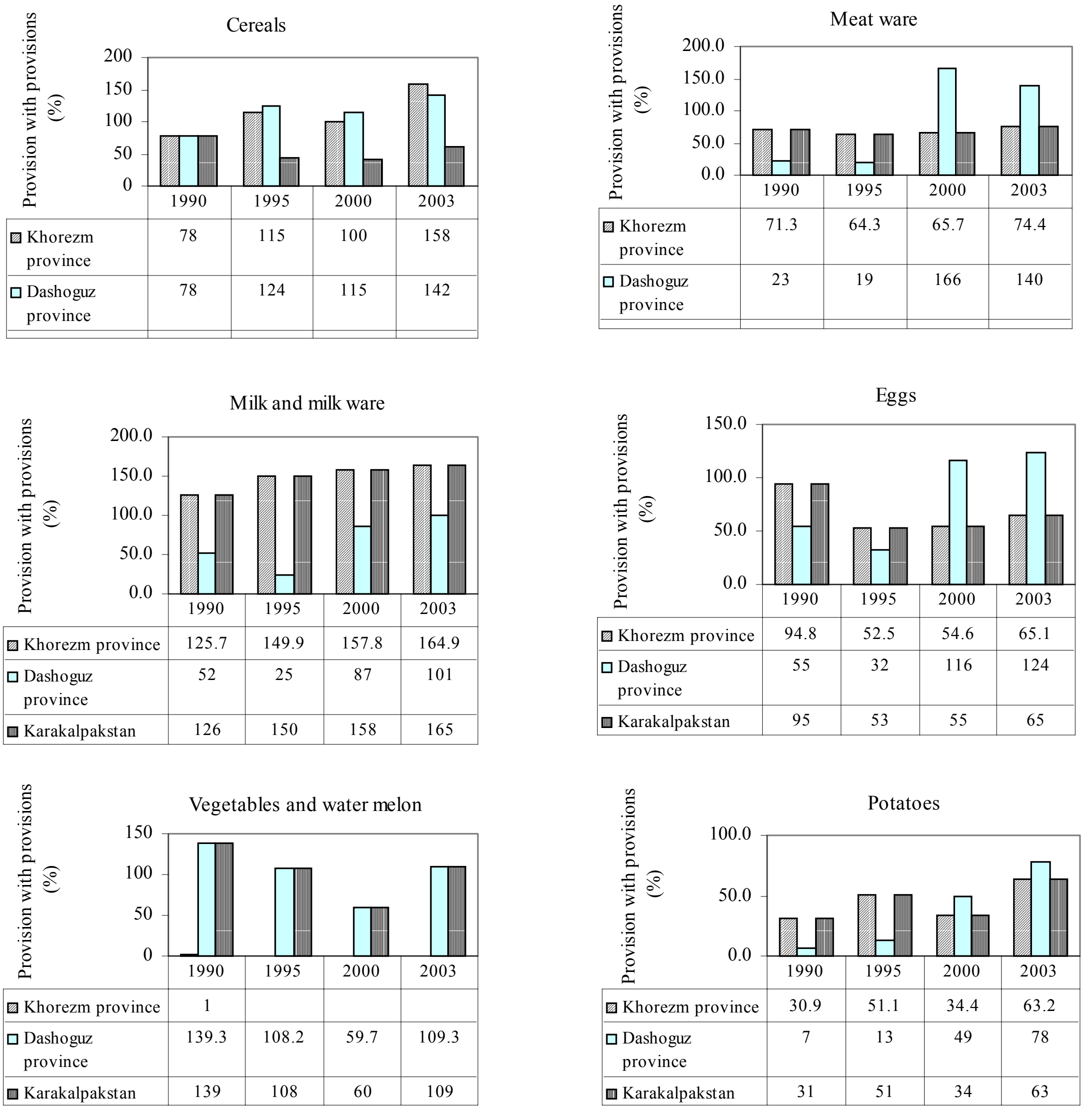


Fig. 1.3.19 Production of foodstuffs and associated demand

1.3.7 Poverty

There is no doubt that poverty is the main rural problem in Central Asia, with 80 to 90% of the people living in rural areas. Nevertheless, results of household questionnaires in Turkmenistan and in the Uzbek part of the Ferghana valley (where there is no water problem) show that rural households are in absolute terms only in a slightly worse situation (Table 1.3.3) than the urban poor[2].

Table 1.3.3 Breakdown of poverty*

Republic	Average Income ($/day)		Average income for the poor ($/day)		Average difference ($/day)	
	Urban	Village	Urban	Village	Urban	Village
Turkmenistan	9.8	5.7	1.8	1.6	0.3	0.5
Uzbekistan	6.5	4.1	1.6	1.4	0.5	0.8

[2] Irrigation in Central Asia. Social, economic and ecologic aspects, 2003, World Bank.
* Poverty level = below minimum of $2.15 per a day

An average indicator of expenses per day for the rural poor is about US $1.5, as compared with US $1.6 for the urban poor. The poverty threshold is US $2.15/person/day, thus a difference of US $0.59 for the urban and US $0.69 for the rural poor. The data have to be interpreted carefully, because prices in urban areas are significantly higher than in the villages. From this it may be concluded that the difference between the rural and urban daily outlay would disappear if a corresponding price correction would be applied (Table 1.3.4).

Table 1.3.4 Breakdown of levels of population by well-being

Republic	Share of population (% of total)		Poverty level (% of local population)		Share of the Poor (% of all poor)	
	Urban	Village	Urban	Village	Urban	Village
Turkmenistan	43	57	3	10	17	83
Uzbekistan	24	76	11	25	12	88

The percentage of population that lives below the poverty level varies by the countries. For instant, there are 25% of the rural poor in Uzbekistan, and in Turkmenistan there are only 10% of the poor in rural areas. Nevertheless, the poverty strikes mainly rural areas. Taking the average of the whole Aral Sea Basin, between 70 and 90% people live in poverty, 5 to 25% are in an 'average' well-being, and 2 to 10% are 'rich'. The rural poor are engaged by 10 to 20% more in agriculture, and their households have frequently one more person than the 'non-poor'. There is also a lower probability (5 to 10%) that the rural poor would have a middle or high education than the not so poor households (Table 1.3.5).

Table 1.3.5 Characteristics of poor and 'not-poor' rural households

Republic	Main engagement of head of family in agriculture (% of total in each category)		Family members		Head of family has high education (% of total in each category)	
	Not-poor	Poor	Not-poor	Poor	Not-poor	Poor
Turkmenistan	52	71	6.2	7.8	14	8
Uzbekistan	54	60	6.4	6.3	13	8

It is obvious that for the most part the households have various sources of income, but practically all obtain a significant portion of their food from the house plots. Farmers do not receive fair payment (price) for their work and products they produce. That has led to their incapability to fulfill proper operation and maintenance of irrigation and drainage infrastructure, as well as frequent lack of motivation to produce more effectively. This, in turn, has led to an unsatisfactory management of lands and water, and consequently brought on the low level of agricultural production.

The states with large irrigated areas (Turkmenistan, Uzbekistan) are keeping the command system for production of the key agricultural crops (cotton and wheat) and control the prices, purchasing, processing and marketing of agriculture production. Agricultural income represents the main income source for some states. However, only a small part of it returns to the rural regions (resource base) and becomes available for maintenance and rehabilitation of the production systems. This creates a 'negative spiral', as the systems become progressively worse, and people are losing motivation to work, so that the ecological degradation of lands and water resources continues.

The main problems and causes of poverty in rural areas are: unemployment, delayed payments of salary, poor access to means of production and technology, intensified water deficit, varied degrees of soil salinity and an unsatisfactory condition of drainage systems.

1.4. WATER MANAGEMENT SYSTEM PROBLEMS

1.4.1 Key areas of water use and needs to overcome associated problems

The problems in water management are tied to the last decade when unsound management practices created socio-economic crisis conditions and dangerous environmental situations in the lowlands of both rivers, as well as in the Aral Sea Basin. The Amu-Darya and Syr-Darya downstream zones became troubled by social and environmental tension and by a certain *loss of control over water resources*. This was apparent during the extremely low water years 2000 and 2001.

The *key areas of water use (*such as drinking water supply, irrigated agriculture, environment) need urgently improvements and *the associated problems* need solutions. The important needs are related to:

- Improving the efficiency of water supply systems, with priority for potable water
- Meeting environmental water needs at the interstate and national levels
- Preventing inequitable water allocation among the states, irrigation systems, canals and raising level and stability of water supply
- Rehabilitating agricultural production

Addressing these needs as one package, in the context of all water users affecting the entire irrigation system and the downstream areas, would work the best. Water conservation, improvements to land and water productivity as well as water quality can be seen as the focal points of the package, with attention paid to:

- Wise review of the cropping patterns and crop rotation
- Unbiased and transparent evaluation of the available water resources for various years and cycles, in terms of flow probability (present and future)
- Adjustment of water use norms
- Combining use of all available water sources - river, return/drainage water and groundwater
- Removal of limitations regarding technical aspects of water management
- Compliance with clear rules for water distribution at the interstate and national levels
- Implementation of water-rotation schedule and reduction of organizational losses

It is understandable that implementing the IWRM at all levels of water management as a package of reforms will take time, since *setting clear priorities in use of water resources is a process* that needs to be developed as a composite. This process needs to overcome many negative trends -decline of agricultural production, environmental degradation, life and health threatening situations, manpower drain, rigid old establishment, and others.

1.4.1.1 Water sources

Amu-Darya lowlands

Stream flow for the Amu-Darya lowlands is evaluated as an inflow to Tuyamuyun waterworks (TMW). The estimated annual indicators of water regime in the Amu-Darya upstream of the TMW are given in terms of years with different flow probability in Table 1.4.1. Operational reserves of groundwater used mainly for drinking water supply[1,2] on annual basis are 1.03 km^3 in Khorezm province, 0.2 km^3 in Dashoguz province, and 1.3 km^3 in Karakalpakstan. Permissible volumes of

[1] Water and land resources use and management strategy. WARMAP Project. Sub-project 2a. Material of Uzbek National Group. Tashkent, 1995.

[2] Water and land resources use and management strategy. WARMAP Project. Sub-project 2a. Material of Turkmen National Group. Ashgabad, 1995.

the annual withdrawal for groundwater are 0.12 km^3 for Khorezm province, 0.1 km^3 for Dashoguz province, and 0.19 km^3 for Karakalpakstan.

The use of groundwater for economic needs is declining from year to year. For example, the total groundwater extraction in Khorezm province in 2003 was only 0.017 km^3, which represents approximately 1.5% of the operational reserve.

Table 1.4.1 Water regime for the Amu-Darya upstream of TMW for different annual probability (mm^3/year)

Indicator	Flow probability	
	90%	50%
Resources in the Vaksh river (inflow to Nurek waterworks)	16 860	19 830
Stream flow in the Vaksh river – Tigrovaya balka	14 680	17 640
Stream flow in the Pyandzh river – Lower Pyandzh	28 165	32 875
Resources in the Amu-Darya river – upstream the Karakum canal	48 860	58 735
Inflow to TMW (Amu-Darya downstream)	21 685	31 000

Syr-Darya lowlands

General picture of the long-term probability fluctuations in major rivers within the Syr-Darya basin such as *Naryn, Karadarya, and Chirchik* in the upper watershed is shown as an *inflow from these rivers to the upstream reservoirs* Toktogul, Andizhan, and Charvak (Table 1.4.2).

Table 1.4.2 Inflow to Toktogul, Andizhan, and Charvak reservoirs from 1910 to 1993 (km^3/year)

Years	Toktogul reservoir	Andizhan reservoir	Charvak reservoir	Total
1910-1924	11.82	3.99	6.94	22.75
1925-1951	10.60	3.71	6.12	20.43
1952-1973	12.83	4.13	6.92	23.88
1974-1986	10.20	3.19	5.57	18.96
1987-1993	12.20	4.20	6.60	23.00

Estimated annual volumes of water in the Syr-Darya lowlands for different flow probabilities[3,4] are given in Table 1.4.3 below.

Table 1.4.3 Water resources within the Syr-Darya basin for different annual flow probability (Mm^3)

#	Indicator	Flow probability	
		90%	50%
1	Water resources in the basin, of which:	31290	37880
	- Naryn river (inflow to Toktogul waterworks)	8470	11450
	- Karadarya river (inflow to Andizhan waterworks)	2360	3830
	- Chirchik river (inflow to Charvak waterworks)	4600	6490
2	Inflow to Chardara waterworks	8800	14490
3	Arys river stream flow	200	470
4	Total stream flow in Syr-Darya downstream (2+3)	9000	14960

Flow in the Syr-Darya downstream is recorded at gauging stations Kokbulak, Chardara, Koktyube, Kazalinsk, and Karateren. Gauging station Kokbulak is located at the border between Uzbekistan and Kazakhstan. Station Chardara is located at the tail reach of Chardara reservoir, while station

[3] Sorokin A.G., Tuchin A.I., etc. 2003. Environmental conditions in Amu-Darya and Syr-Darya downstream and need for ecological releases. In “Ecological releases”. Publications of ICWC Training Center. Issue 1, Tashkent, pp. 50-72.
[4] Sorokin A.G. 1994. Scientific report under ICWC scientific program. Section 01.04. SPA SANIIRT. Tashkent, 295 p.

Koktyube is set at the boundary between Southern Kazakhstan and Kyzylorda provinces (at place of intake to Kelintyube main canal). The gauging stations Kazalinsk and Karateren are placed at the delta border and in river outlet (inflow to Aral), respectively.

In the period of 1995 to1999, the average annual flow[5] at these stations amounted to: 17.45 km^3 - Kokbulak; 15.95 km^3 - Chardara; 15.56 km^3 - Koktyube; 5.34 km^3/year - Karateren. Discharge to Arnasai equaled 2.33 km^3/year for that period of time.

The use of groundwater in the Kyzylorda province counts for about 10% of the operational reserves. For example, the actual groundwater abstraction for 1995 was 71 Mm^3 (194,500 m^3/day). The operational reserves of groundwater in the province are formed by 24 places of origin, providing a capacity of 1,973,000 m^3/day.

1.4.1.2 Water use patterns

Amu-Darya lowlands

Water consumption patterns in the Amu-Darya lowlands vary by provinces. In the province of Khorezm, agriculture consumes 97.3 to 97.5% of all water diverted, urban use only 1.7 to 2%, and fisheries 0.7 to 0.8%. Irrigation is the main water consumer in Dashoguz province, accounting for 97% of total diversion. Water consumption patterns in Karakalpakstan are less stable and depend to a large degree on the type of water year and volumes of water supplied to lowlands. Between 1980 and 2002, the following percentages/shares of water were distributed to water using sectors and environment in Karakalpakstan: irrigation - 10.6 to 24.5%; drinking water supply - 0.49 to 0.55%; delta - 0.0 to 12.2%; and the Aral Sea - 0.0 to 61.2%.

Syr-Darya lowlands

The analysis of water consumption among the sectors showed that household and drinking water supply in urban and rural areas, industry, fisheries, and livestock watering consumed 6.5% of total water diversion, and irrigated agriculture and watering of hayfields accounted for 93.5%. Water shortages were from a great extent compensated for by use of *return flow*, portion of which was discharged into rivers. The return waters constitute *collector-drainage* waters (CDW) from irrigation and wastewater from the industry and municipal economy, with the largest share formed by CDW (e.g., 92% in 1990 and 90% in 2000). Return flow in the downstream of the Syr-Darya increased with time; from 1970 to 1990 it increased over 10 times, reaching 2.3 km^3/year.

1.4.1.3 Water distribution system

Amu-Darya lowlands

Khorezm province *(Uzbekistan)****.*** Lands in Khorezm province are irrigated from the interstate main (shared with Turkmenistan) and provincial canals (Pitnyak-arna, Urgench-arna, and Daryalyk-arna).

Dashoguz province *(Turkmenistan).* Water to Dashoguz province is delivered through the Khorezm province and Karakalpakstan via a network of canals (Shavat, Gazavat, Klychbai, Kipchak-Bozsu, Khan-yab, and Djumabaisaka), with main intake structures on Uzbek territory.

The Republic of Karakalpakstan *(Uzbekistan).* River water to Karakalpakstan is delivered through an in-stream reservoir at Tuyamuyun waterworks (TMW) via the Right-bank canal, as well as

[5] Kipshakbayev N.K. 2000. Optimization of water and power resources use in the Syr-Darya river basin under present-day conditions. SIC ICWC Kazakh branch. Almaty, 36 p.

through the intake structures downstream of the TMW, national canals Pakhta-Arna, Naiman, Kyzketken, Suenli, and others, as well as interstate canals Klychbai and Kipchak-Bozsu.

This system of canals was designed during the Soviet period for simultaneous water supply to users of the above provinces, aiming at an equitable water distribution and minimum losses. Lately, the *efficiency of joint canal management had declined.* This was caused on one hand by severe water shortages in the downstream zone (due to improper water management within the Amu-Darya river basin as a whole), and on the other by a loss of management control as well as large water losses due to efforts to separate and establish independent intakes (*hydro-egoism*). The year 2000 was marked by such efforts, having water to Dashoguz province delivered from the Palvan-Gazavat irrigation system first and then from the Shavat system. This resulted in problems with water intake at the inter-farm network in the Khorezm province and decrease of water level in some sections, backwater conditions and losses in others. With the completion of the Dashoguz canal branch (Turkmenderyasy), the supply pattern for the Dashoguz province will change to more independent intake from the in-stream reservoir at TMW.

Syr-Darya lowlands

Kyzylorda province** (Kazakhstan).** Downstream of the Chardara reservoir, lands suitable for irrigation can be found in a narrow strip along the Syr-Darya. The largest irrigation schemes that take water from the river are:

- *Kzylkum scheme,* located on the left bank of the river; water is delivered via *Kzylkum main canal,* which takes water from the left-bank outlet from the Chardara reservoir; the canal is 50 km long and has a carrying capacity of 200 m^3/s.
- *Togusken scheme,* located along the left bank of the river, north of the Kzylkum scheme; irrigated from *Kelintyube main canal,* which is 78 km long and has a head flow rate of 50 m^3/s; water is diverted directly from the Syr-Darya.
- *Yanykurgan scheme* located on the both sides of the Syr-Darya; the irrigated lands are mainly on the left bank and water is delivered via *Chiely* main canal, which is 20 km long and has a head discharge of 90 m^3/s, and *Sunakat* canal, 30 km long with head discharge of 20 m^3/s. Both canals take water directly from the river.
- *Kyzylorda scheme* located along downstream of the Syr-Darya, in district Kzyl-Orda; water intake is from Kyzylorda waterworks. The lands on the left-bank are irrigated by the Kyzylorda main canal, which is 81 km long and has a head flow rate of 210 m^3/s; the canal flows through the center of the scheme and is managed from both sides. At the tail end, the canal is divided in two – the right branch has a flow rate of 95 m^3/s and the left one 42 m^3/s, respectively. Irrigation of lands associated with the right branch takes place via two canals – left bank main canal (discharge rate 44 m^3/s) and Aitek canal (discharge rate 50 m^3/s).
- *Kazalinsk scheme,* located within the Syr-Darya downstream, takes water from Kazalinsk waterworks, which are located 32 km upstream of Kazalinsk town. The waterworks facility consists of a (water-lifting) dam with a discharge capacity of 1000 m3/s, left and right bank intake structures with flushing galleries and a single-span fish lock, left bank (100 m^3/s) and right bank (85 m^3/s) head regulators. Left-bank systems are fed by water through the main canal of 51.2 km in length and 60 m^3/s discharge rate, while the right-bank ones take water from the main canal that is 19.5 km long and has discharge rate of 30 m^3/s, and from Baskar canal with discharge rate of 15 m^3/s.

Besides this, water from the Syr-Darya is distributed within the delta (downstream of Kazalinsk town) and along the river channel via pumps to secondary canals.

1.4.1.4 Water disposal system

Amu-Darya lowlands

In 1970, the collector-drainage and wastewater/sewage network within the Amu-Darya lowlands was discharging into various water receivers, namely:

- the Amu-Darya river at Tuyamuyun-Chatly section - 0.18 km^3/year
- Sarykamysh lake - 2.28 km^3/year
- Kattashor lake - 0.09 km^3/year
- Sudochie lake and the Aral Sea - 0.51 km^3/year
- canals in Karakalpakstan - 0.25 km^3/year

By 1980, the discharge into Sarykamysh had almost doubled (5.5 km^3/year), and in Sudochie lake and the Aral Sea tripled (1.6 km^3/year). Discharge to other water bodies showed almost no change or minor increase, as shown below in Table 1.4.4.

Table 1.4.4 Dynamics of drainage and collectors water from 1985 to 1995 (km^3/year)

Water receiving body	1980	1985	1990	1995
The Amu-Darya river at Tuyamuyun-Chatly section	0.17	0.55	0.50	0.51
Collectors in Karakalpakstan	0.41	0.28	0.30	0.31
Sarykamysh lake - from Dashoguz province	1.10	1.18	1.16	1.40
Sarykamysh lake - from Khorezm province	4.10	3.46	2.93	4.05
Kattashor lake	0.09	0.08	0.10	0.01
Canals in Karakalpakstan	0.32	0.19	0.03	0.03
Sudochie lake and the Aral Sea	1.58	1.55	2.21	1.70

During the recent low water years the volume of CDW decreased proportionally to the volume of water supplied to 1 ha. According to the data of the National Desert Institute in Turkmenistan, volume of drainage water formed in the Turkmen part of the Priaralie increased seven times (from 0.31 to 2.21 km^3/year) over the last 35 years. CDW from irrigated lands in Dashoguz province are disposed via the main collectors Ozerny, Daryalyk, Doudan, and a system of collectors of the Central Kunyaurgench Collector and others, into the Sarykamysh depression. Drainage flow from Khorezm province is also discharged into this depression via Dashoguz province.

Current CDW volume from Dashoguz province varies from 1 to 2.2 km^3/year. Transit flow volume from Khorezm province is 2 to 3 times larger than the one from Dashoguz province. In 2000, Turkmenistan started to construct a lake called 'Golden age Lake'. This will improve environmental conditions in both Turkmenistan and the Priaralie, and beneficially affect downstream water quality, because of ceased discharge of CDW at the right bank of the Amu-Darya in mid-stream.

Syr-Darya downstream

According to data for period of 1987 to 1997, the entire river basin for the Syr-Darya takes approximately 10 km^3/year (ranging from 8.8 to 11.7 km^3/year) of CDW, including 1.1 to 1.6 km^3/year from Kazakhstan, of which 0.55 to 0.91 km^3/year flows from irrigated schemes in Southern Kazakhstan province.

1.4.2 Water use indicators

Assessment of water use in the ***Amu-Darya lowlands*** is given for the following areas:

- Dashoguz province, Turkmenistan,

- Khorezm province, the Republic of Uzbekistan,
- The Republic of Karakalpakstan, Uzbekistan.

Major water consumers:

- in Dashoguz province - irrigated agriculture
- in Khorezm province - agriculture, municipal economy, and fisheries
- in Karakalpakstan - agriculture, drinking water supply, Priaralie delta, Large Aral Sea

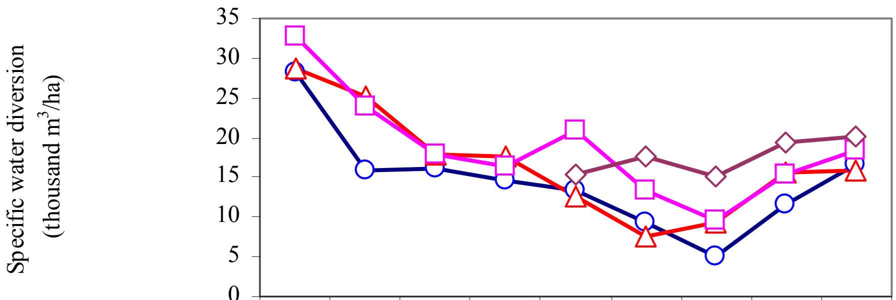
Assessment of water use in the ***Syr-Darya downstream*** is given mainly for:

- Kyzylorda province
- Southern Kazakhstan province

Key water consumers are agriculture, drinking water supply, industry, Priaralie and Small Aral Sea

1.4.2.1 Retrospective review

The comparison of the specific water diversions for the Amu-Darya and the Syr-Darya lowlands in Figure 1.4.1 below shows that by 1990, after the ICWC established withdrawal limits, the diversions decreased 1.7 times on the average. At the same time, when comparing diversions at the province and farm level, the efficiency of water delivery through the main and inter-farm systems to water users was low. The efficiency of those systems is between 60 and 70%. Table 1.4.5 shows an example of data for the Dashoguz province.



	1980	1985	1990	1995	1999	2000	2001	2002	2003
Karakalpakstan	28.2	15.9	16.0	14.5	13.3	9.3	5.1	11.6	16.5
Dashoguz province	28.6	25.2	17.8	17.6	12.6	7.6	9.4	15.5	15.9
Khorezm province	32.7	23.8	17.9	16.5	20.9	13.4	9.5	15.4	18.4
Kyzylorda province					15.3	17.6	15.1	19.5	20.0

Fig.1.4.1 Specific water diversion at province boundaries

Table 1.4.5 Volume of water diverted to Dashoguz province and at farm boundaries

Water-management year	Diversion to the province (km^3)	Diversion at farm boundaries (km^3)
1986-1987	4.57	3.65
1987-1988	6.26	4.74
1988-1989	6.4	4.73
1989-1990	4.9	3.46
1990-1991	5.9	3.9

Amu-Darya downstream

Actual water use in the period from 1986 to 1990 by sectors of the economy in Dashoguz and Khorezm provinces is shown in Table 1.4.6. Water use dynamics for Karakalpakstan is given in a separate table (Table 1.4.7), since there the water use sectors differ from those in Dashoguz and Khorezm provinces.

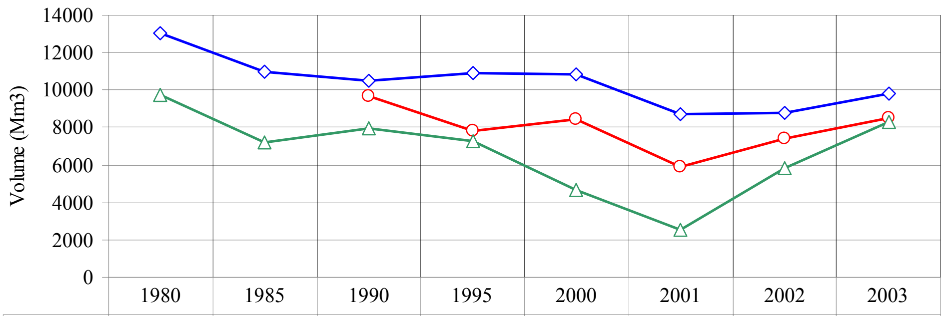
Table 1.4.6 Water use by sectors of the economy in Dashoguz and Khorezm provinces (Mm^3/year)

Sector	Year	Total water used	surface water share	groundwater
		Dashoguz province		
Household and drinking water supply	1986	9.6	-	9.6
	1990	14.7	9.6	5.1
Agriculture	1986	10.3	0.9	9.4
	1990	27.0	2.7	24.3
Industry	1986	0.1	-	0.1
	1990	0.5	-	0.5
Fishery	1986	-	-	-
	1990	-	-	-
Irrigation	1986	4 487	4 487	-
	1990	5 734	5 734	-
Other needs	1986	1.5	1.5	-
	1990	17.8	17.8	-
		Khorezm province		
Household and drinking water supply	1986	28.9	-	-
	1990	59.0	-	-
Agriculture	1986	62.2	-	-
	1990	38.0	-	-
Industry	1986	7.9	-	-
	1990	9.2	-	-
Fishery	1986	40.0	-	-
	1990	121.7	-	-
Irrigation	1986	4 529	-	-
	1990	5 052	-	-

Table 1.4.7 Water use by sectors in Karakalpakstan (km^3/year)

Water user	1980-2002
Drinking water supply	0.16 – 0.18
Irrigation	3.5 – 8.0
Fishery (including delta)	0 – 4.2
Pastures and grassland	0 – 0.3
Industry	0.02 – 0.025
Inflow to the Aral Sea	0 – 20

Figure 1.4.2 shows historical data for use of surface water in Karakalpakstan, showing the severe undersupply during the low water years 2000 and 2001.



	1980	1985	1990	1995	2000	2001	2002	2003
Plan	13071	11002	10491	10883	10850	8728	8801	9842
Limit			9651	7790	8470	5929	7388	8485
Actual	9724	7217	7943	7265	4642	2565	5811	8282

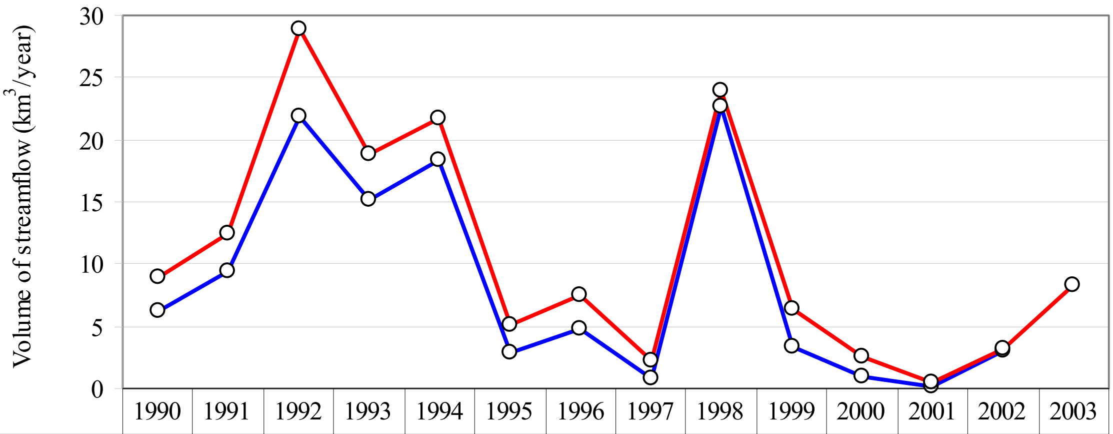
Fig. 1.4.2 Water diversion dynamics for Karakalpakstan in the period from 1980 to 2003: plan, limit, actual

Calculated stream-flow losses in the Amu-Darya downstream are given in Table 1.4.8.[6] below.

Table 1.4.8 Stream-flow losses in Amu-Darya downstream over 1970-2001

Period (hydrological year, season)	Losses at Darganata-Samanbai section, km^3
1970 – 1979	2.5
1980 – 1989	4.1
1990 – 1999	4.5
1999 – 2000, of which:	3.4
-non-growing season	0.8
-growing season	2.6
2000 – 2001, of which:	2.7
-non-growing season	0.5
- growing season	2.2

Figure 1.4.3 shows the dynamics of flow into the Aral Sea from the Amu-Darya for 1980 to 2002.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Kyzyldjar section	6.19	9.4	21.91	15.11	18.39	2.82	4.83	0.72	22.59	3.29	0.92	0.09	3.1	
Samanbai section	9	12.5	28.9	18.8	21.7	5.1	7.5	2.2	23.9	6.4	2.6	0.4	3.2	8.23

Year

Fig. 1.4.3 Amu-Darya stream flow at Samanbai and Kyzyldjar sections for period of 1990 to 2003

[6] Sorokin A.G. 2002. Integrated water resources management: computer models for decision support. Proceedings of conference dedicated to 10th anniversary of ICWC "Water resources in Central Asia". Almaty-Tashkent, pp. 121-129.

Syr-Darya downstream

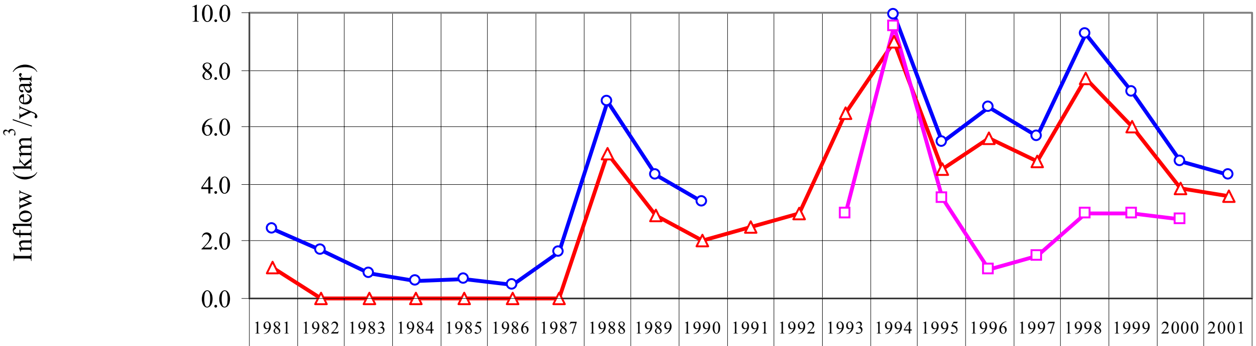
From 1995 to 1999 the water use in the Kazakh part of the Syr-Darya basin[7] averaged 9.05 km^3/year, with river water share of 8.7 km^3/year (96.2%) and groundwater use of 0.35 km^3/year (3.8%). For the same period, diversion to the Kyzylorda province averaged 5.09 km^3/year (56.2%). The share of industrial and household-drinking water supply for cities and district centers was not very large, as shown in Table 1.4.9 below.

Table 1.4.9 Dynamics of household-drinking and industrial water use (Mm^3/year)

Water use	Source	1995	1999
Household-drinking water supply	Surface water and groundwater	23.09	22.55
	Groundwater	8.92	10.76
Industry	Surface water and groundwater	84.37	35.48
	Groundwater	37.10	12.50

Consumptive water use for fisheries (ponds and fish hatchery located along the river channel) averaged 139 Mm^3 between 1990 and 1994 and 158 Mm^3 in 1995. Later, these amounts have decreased. Over the last 25 years, besides supplying water to delta and hayfields at the amount of 1 to 2 km^3/year, approximately 1.6 km^3/year of water was used to fill the old river channels, depressions, lake sinks and others (economic-environmental sites).

Before the intensive irrigation development in the early sixties, the Syr-Darya delta had been receiving up to 4 or 5 km^3 annually. After that, water volume to the delta was sharply reduced[8,9,10] (Fig.1.4.4), which was lately aggravated by the power-oriented operation regime of Toktogul reservoir. As V.A.Dukhovny[11] stated, before 1991 the winter releases were to be 2.7 km^3 and summer releases in range of 8.5 to 9.5 km^3. After 1991, releases in winter increased to 7.2 km^3 and in summer, when water is needed for massive watering of agricultural crops, they were correspondingly reduced.



	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Inflow to delta	2.4	1.7	0.9	0.6	0.7	0.5	1.6	6.9	4.3	3.4				9.9	5.5	6.7	5.7	9.2	7.2	4.8	4.3
Inflow to the sea	1.1	0.0	0.0	0.0	0.0	0.0	0.0	5.1	2.9	2.0	2.5	3.0	6.5	9.0	4.5	5.6	4.8	7.7	6.0	3.9	3.6
Discharge into Arnasai													3.0	9.5	3.5	1.0	1.5	3.0	3.0	2.8	

Fig. 1.4.4 Inflow to delta, Aral Sea and outflow to Arnasai depression

Since it was impossible to pass huge volumes of water through the Syr-Darya downstream of the

[7] Kipshakbayev N.K. 2000. Optimization of water and power resources use in the Syr-Darya river basin under present-day conditions. SIC ICWC Kazakh branch. Almaty, 36 p

[8] Ratkovich D.Ya. 1992. Problems of water supply in the Aral Sea basin in view of environmental needs. Water resources, № 2. pp. 12-21.

[9] Karlykhanov A.K. 2002. Water quality and public health. Proceedings of conference dedicated to 10th anniversary of ICWC “Water resources in Central Asia”. Almaty-Tashkent, pp. 255-256.

[10] Vagapov R.I.,Popova I.A. 2004. Ways to solve water management problems in Syr-Darya downstream. Magazine «Water sector in Kazakhstan», #2. Almaty.

[11] Dukhovny V.A. 2004. The Syr-Darya river – what are the reasons for concern? Magazine «Water sector in Kazakhstan», #2. Almaty.

Chardara reservoir in winter, Arnasai depression was used to absorb the excess water. During the last decade, more than 30 km^3 of water was evacuated into Arnasai. This, in turn, had caused a range of flooding problems for the low-lying areas in Uzbekistan.

As the SIC's computations show, losses in the Syr-Darya downstream vary subject to annual and seasonal flow probabilities (Table 1.4.10).

Table 1.4.10 Losses in the Syr-Darya downstream subject to annual flow probability

Model year	Flow probability, %	Annual losses, km^3	Losses in growing season, km^3	Losses in non-growing season, km^3
1984	90	1.9	1.4	0.5
1987	50	3.3	2.4	0.9

1.4.2.2 Existing use of water resources

Amu-Darya lowlands

In the Amu-Darya lowlands, issues related to the environmental water needs are directly related to rational water management and assessment of the available water resources, considering the in-stream losses. However, those needs can be met only in years during with flow probability higher than 50 %. Water shortage dynamics for provinces for low water years 2000 and 2001 may be traced from national reports shown in Table 1.4.11 below. Data for 2003, which was not a low water year are given for comparison.

Table 1.4.11 Water shortage in provinces in low-water period 2000 and 2001

Indicator	Republic, province	Unit	2000	2001	2003
Water diversion limit	Khorezm	billion m^3	4.55	4.19	4.69
	Dashoguz	billion m^3	6.5	6.5	6.5
	Karakalpakstan	billion m^3	8.47	5.93	8.49
Actual diversion	Khorezm	billion m^3	3.32	2.26	4.70
	Dashoguz	billion m^3	3.1	3.5	6.5
	Karakalpakstan	billion m^3	4.64	2.57	8.28
Specific diversion	Khorezm	thousand m^3/ha	13.4	9.5	18.4
	Dashoguz	thousand m^3/ha	7.7	9.4	15.5
	Karakalpakstan	thousand m^3/ha	9.3	5.5	15.3
Water shortage (limit minus actual)	Khorezm	billion m^3	1.23	1.93	0
	Dashoguz	billion m^3	3.40	3.00	0
	Karakalpakstan	billion m^3	3.83	3.36	0.21

Syr-Darya lowlands

The water intake from various water sources for the economic sectors of the Kazakh part of the Syr-Darya basin is estimated at the level of 1994 as 11.32 km^3, of which volume the surface water accounted for 10.43 km^3 (92.1%), groundwater for 0.46 km^3 (4.1%), and collector-drainage and domestic sewage water for 0.43 km^3 (3.8%).

Besides irrigation, household-domestic and industrial needs, river water is also used for fisheries, environment, and flooding of hayfields. The current consumptive use by the fisheries is 60 Mm^3, while watering of hayfields/grassland takes 130 to 140 Mm^3 per year. Water supply to the economic-environmental sites located in the Syr-Darya floodplain (old channels, lowland, lake sinks, wildlife habitat areas, livestock watering places, oases) depends on the year's availability of water. Water use efficiency for those uses is generally low (losses exist), but the guarantee of water (approximately 1.6 km^3 of water are needed) is also low, no more than 50% [5]. The current annual water consumption by the delta is estimated to be 1 to 2 km^3.

1.4.2.3 Water use perspective

The national goals and limitations can be expressed as three development scenarios:

- 'Business as usual', where development is based on potential capacity of local water sources
- 'Optimistic scenario', which anticipates: i) achieving land productivity of 80%, ii) regional integration, iii) water conservation and guaranteed inflow to natural systems, primarily to the Priaralie
- 'National vision', as future development based on national strategies (GEF Project, sub-component A-1)

Each scenario entails a management strategy of the existing and future reservoirs - including operation of reservoirs, HEPS and their cascades working in power and/or irrigation-power modes. Estimated flows for the lowlands of the Amu-Darya and Syr-Darya are shown in Table 1.4.12[12].

Table 1.4.12 Downstream inflow and averages of water salinity for the Amu-Darya and Syr-Darya for different scenarios by seasons (non-vegetation X-III, vegetation IV-IX) and annual (hydraulic year X-IX) for 2000 to 2050

Scenario	Indicator	Unit	X-III	IV-IX	X-IX
Syr-Darya river - inflow to Chardara reservoir					
«Business as usual»	Stream-flow	km^3	9.60	5.41	15.01
	Salinity	g/l	1.00	0.85	0.94
«Optimistic scenario»	Stream-flow	km^3	8.51	7.18	15.69
	Salinity	g/l	0.85	0.79	0.82
«National vision»	Stream-flow	km^3	9.51	4.95	14.46
	Salinity	g/l	1.02	0.90	1.08
Amu-Darya river - inflow to TMW (Darganata)					
«Business as usual»	Stream-flow	km^3	10.01	19.90	29.91
	Salinity	g/l	1.45	0.89	1.08
«Optimistic scenario»	Stream-flow	km^3	9.45	24.63	34.08
	Salinity	g/l	1.25	0.70	0.85
«National vision»	Stream-flow	km^3	9.94	19.39	29.33
	Salinity	g/l	1.63	1.03	1.24

1.4.2.4 Perspective water demand

Today, every state in the CAR is striving for sustainable economic growth and social development and for maximum satisfaction of water demand of consumers. This needs to be achieved through water conservation, increase of land and water productivity, O&M of the irrigation and power infrastructure, and optimization of cropping patterns (rather than development of new agricultural land). The states are also searching for benefits from possible integration of riparian countries and improvements to land and water productivities. Nevertheless, joint proposals for the key issue - *how to ensure water supply for future generations* - have not been yet been properly addressed.

[5] Kipshakbayev N.K. 2000. Optimization of water and power resources use in the Syr-Darya river basin under present-day conditions. SIC ICWC Kazakh branch. Almaty, 36 p.

[12] Eingorn F.Ya., Sorokin A.G. 2004. Water resources in the Aral Sea basin, dynamics of their use and perspectives. In report "Drainage in the Aral Sea basin aimed at sustainable development strategy". SIC ICWC, Tashkent, pp. 8-22.

Amu-Darya lowlands

The estimated volume for *Karakalpakstan* for a short-term (until 2010) is 5.62 km^3/year, including 3.74 km^3 for the growing season (compare with 8.3 km^3/year used in 1999 and 5.2 km^3/year in 2004). For a long term it would be 5.9 km^3/year, according to the National report.

Drainage flow is estimated to be 1.4 km^3/year until 2010 and 1.6 km^3/year in a long-term (as compared to 3.1 km^3/year in 1999 and 1.4 km^3/year in 2004). Irrigated areas are expected to grow under changes of cropping patterns and increased effectiveness of land and water use.

Depicted from the National Report, the following points out the changes in the irrigated areas during the past decade: for 1999 - 486,400 ha, 2004 - 395,200 ha, 2010 - 484,100 ha. The long-term outlook was also provided as a growth of the irrigated area up to 500,000 ha.

Water demand in *Turkmen zone* of the Amu-Darya downstream will remain practically unchanged.

The problem of the interstate water allocation for the lowlands of the Amu-Darya may become more complex in the future in view of possibly increased water demand by *Afghanistan*. Currently, the country has an adequate water reserve to meet the total water demand (not exceeding 2.0 km^3/year). However, Afghanistan may need a larger water share to cover the future socio-economic development in its northern part, therefore considerably changing the flow patterns in Pyandzh and Amu-Darya rivers. If the water management within the Amu-Darya basin in the near future will become inefficient, *same problems as in the Syr-Darya* basin may occur, since the diversion to Afghanistan may increase up to 6 or 8 km^3/year. This would require adding new capacity (Rogun, etc.) for reservoirs operating at HEPS.

Ecological needs of the Amu-Darya zone in the Priaralie, regarding only the filling of water bodies[3] of the South Priaralie, are estimated to be 0.7 km^3/year. To sustain these water bodies and compensate for evaporation and filtration on annual basis, the inflow should be kept at about 2 km^3/year. To fill up the system of reservoirs as much as 1.7 km^3/year is needed, of which about 1 km^3/year are the compensatory losses. It should be noted that only a part of the Amu-Darya flow downstream of Takhiatash that is designated to sustain the ecosystem of South Priaralie is used by the system, while the rest transits to the Aral Sea.

Volume of diversion depends on the probability of the flow/water year. For example, in low water years, when the flow volume in the Amu-Darya is no larger than 3 km^3/year at Samanbai station, 40 to 45% of this flow should be diverted to the Priaralie. In an average water year the flow is about 6 to 7 km^3/year, and 20 to 22% of this should be diverted. In a high water year the diversion should be about 10%. For sustaining of lakes and reservoirs, releases along the Syr-Darya at Samanbai section should not be less than 5 km^3/year. Given estimate does not affect the probable options for stabilization of water level in the eastern and western parts of the Large Sea.

Syr-Darya lowlands

According to recent data[3], the demands of the Syr-Darya delta are estimated as 1.7 km^3/year for an average water year, in addition to 3 km^3/year for sustaining of the North Aral Sea. As shown by the Kazgipovodkhoz[13], and accordingly with a long-term water balance of the lowlands of the Syr-Darya, estimated water needs in the delta change with the water year (flow probability P, %) and

[3] Sorokin A.G., Tuchin A.I., etc. 2003. Environmental conditions in Amu-Darya and Syr-Darya downstream and a need for ecological releases. In “Ecological releases”. Publications of ICWC Training Center. Issue 1, Tashkent, pp. 50-72.

[13] Syr-Darya river and Northern Aral Sea regulation project. Summary note. Kazgiprovodkhoz. 1999. 18 p.

the operation regime of the Naryn-Syr-Darya cascade of reservoirs (i.e. irrigation or power-oriented flow to Chardara reservoir). This is depicted in Table 1.4.13 below.

Table 1.4.13. Design water use in Syr-Darya delta (km^3/year)

	Average	P = 20%	P = 50%	P = 70%	P = 90%
Irrigation flow	1.310	1.652	1.357	1.080	0.865
Power-oriented flow	1.267	1.566	1.331	1.199	0.810

To reduce the drying-up of areas in *northern part of the Aral Sea* and create more favorable conditions for natural systems in the Priaralie, it is necessary to stabilize the water level in the Small (Northern) Sea. Calculations show that about 3 to 4 km^3 per year are needed to keep the water level at 42 m (as shown by modeling efforts of the SIC). This is achievable under all three probable development scenarios within 3 to 5 years, with a slight difference in time. However, the water surface area of the sea at this level is a subject of criticism by ecologists, because of flooding of coastal zones. Stabilization at 47 m is possible only for the optimistic scenario, after 2020. It would include 8 km^3/year going to the delta and 6 to 7 km^3/year to the sea. In any event, the Small Sea should be separated from the Large Sea using a cofferdam with regulator in Bergh Strait.

1.4.2.5 Water use

Amu-Darya lowlands

Accordingly with the 'national vision' scenario, the annual stream-flow in Amu-Darya at Samanbai section would average 3.9 km^3/year and water salinity would be about 1.55 g/l for the period of 2005 to 2025. Delta inflow fluctuates considerably (from 0.2 to 8.6 km^3/year), because of limitations due to the regulating capabilities of reservoirs, which practically operate as seasonal regulators: Nurek reservoir, in power-oriented regime; Tuyamuyun and intra-system reservoirs as irrigation compensators. At the Samanbai section, the maximum annual average value of mineralization is 3.0 to 3.5 g/l, while the minimum is 1.0 g/l (as calculated by SIC ICWC).

In the 'optimistic' scenario, the average annual stream-flow at the Samanbai section would be 12.65 km^3/year, which is 6.0 km^3/year larger than in the scenario 'business as usual', and 8.8 km^3/year larger than that in the 'national vision'. The average water salinity would be 0.95 g/l. The volumes for water diversion by Uzbekistan (Table 1.4.14) were computed using a long-term model and include water for irrigation as well as *sanitary-ecological releases*[12].

Table 1.4.14 Modeled diversion by provinces (average for forecasting period) and irrigation water salinity in development scenarios for Uzbekistan

Province	Indicator	Optimistic	National vision
Khorezm	Stream-flow (km^3/year)	4.13	5.32
	Salinity (g/l)	0.89	1.21
Karakalpakstan	Stream-flow (km^3/year)	6.49	9.64
	Salinity (g/l)	0.99	1.50

Computations made by the SIC (A.I.Tuchin) using the *Large Aral* model show that in the future the Sea will be divided into two parts, Eastern and Western part. Inflow to the sea (under existing water management infrastructure in the Priaralie) in 'business as usual' scenario shows that water level in the Eastern part would be kept at 25 m and water level in the Western part would drop to 20 m by 2025. The optimistic scenario shows periodical merging and separation of the Large Sea at the mean long-term level of 28 m.

[12] Eingorn F.Ya., Sorokin A.G. 2004. Water resources in the Aral Sea basin, dynamics of their use and perspectives. In report "Drainage in the Aral Sea basin aimed at sustainable development strategy". SIC ICWC, Tashkent, pp. 8-22.

Syr-Darya lowlands

In the 'national vision', due to winter releases the inflow to delta (Kazalinsk) would be kept at 4.0 km^3/year for period 2005 to 2025, indicating sharp fluctuations of up to 5.5 km^3 in the non-growing season and to 0.1 km^3 in the growing season, and the salinity fluctuations from 1.2 to 2.2 g/l (SIC's computations). According to the 'optimistic scenario' for the same period, the flow to the delta is estimated as 7.9 km^3/year and the average annual salinity around 1.0 g/l.

Efficient operation of reservoirs in the Syr-Darya basin would make it possible to meet demands of the economic sectors and to smooth the maximum peaks in the rivers, as well as raising minimum discharges as the required standards for sanitary-ecological releases. To do that, calculations show that the reservoirs, primarily the Toktogul, should be operated in the irrigation-power regimes developed by the ICWC. Modeled diversion to the Kyzylorda province (average for forecasting period) and mineralization of the irrigation water for two scenarios[12] are shown in Table 1.4.15.

Table 1.4.15. Modeled diversion in the Syr-Darya downstream for the long-term, according to Kazakhstan development scenarios (km^3/year)

Province	Indicator	Optimistic	National vision
Kzyl-Orda	Stream-flow (km^3/year)	4.33	5.14
	Salinity (g/l)	1.17	1.47

1.4.3 Water availability and water distribution uniformity

1.4.3.1 Appraisal of water security and distribution uniformity for the lowlands in dry years

Amu-Darya downstream

Utilizing data from the national reports, indicators of water availability in provinces are provided in Table 1.4.16 below. The indicators were calculated as a ratio between the actual diversion at province boundaries to: i) the diversion limit for the given year; ii) to the diversion delivered water in 2003; and iii) to the planned/requested diversion.

Table 1.4.16 Water availability indicators in the Amu-Ddarya downstream (based on national reports)

Indicator	Province	Unit	2000	2001	2003
Water availability	Khorezm	%	73	54	100
(actual/limit for given year)	Dashoguz	%	48	54	100
	Karakalpakstan	%	55	43	98
Water availability	Khorezm	%	71	48	100
(actual / limit for year 2003)	Dashoguz	%	48	54	100
	Karakalpakstan	%	55	30	98
Water availability	Khorezm	%	57	49	88
(actual /plan)	Dashoguz	%	39	44	87
	Karakalpakstan	%	43	29	84

In 2001 the water flow in the Amu-Darya lowlands was slightly lower than in 2000, resulting in lower water availability (actual/limit for given year) by 19% in Khorezm and by 12% in Karakalpakstan. At the same time, in Dashoguz province, water availability increased by 6% from 2000 to 2001. Comparison of water availability in provinces for growing seasons 2000 and 2001

[12] Eingorn F.Ya., Sorokin A.G. 2004. Water resources in the Aral Sea basin, dynamics of their use and perspectives. In report "Drainage in the Aral Sea basin aimed at sustainable development strategy". SIC ICWC, Tashkent, pp. 8-22.

based on ICWC data shows that this indicator had decreased only in Khorezm (Table 1.4.17).

Table 1.4.17 Water availability indicators in Amu-Darya downstream

Province	Unit	Growing season 2000	Growing season 2001
Dashoguz	%	45.4	53.6
Khorezm	%	64.2	53.4
Karakalpakstan	%	42.7	43.5

Despite the fact that the water availability in Karakalpakstan slightly increased in 2001, that one for its northern zone located at the tail part decreased. Assessments of water availability for the northern zone in Karakalpakstan provided by different sources for 2000 to 2001 are different, but they all agree that the drought was more critical in 2001 than that in 2000. Moreover, water supply for the whole basin for growing seasons 2000 and 2001 did not differ greatly (according to ICWC data), as water supply in the growing season 2001 accounted for 95.6% of that in 2000). In the growing season 2000 the water shortage (difference between the established diversion limit and actual diversion) amounted to 11.1 km^3 or about 30% of the limit in the basin (Table 1.4.18).

Table 1.4.18 Water shortage distribution among riparian countries, for 2000

Country	Shortage (km^3)	Shortage (% of limit)
Tajikistan	0.7	11
Turkmenistan	4.6	30
Uzbekistan	5.7	37
Basin as a whole	**11.0**	**30**

Water shortage distribution is related to the location within the river basin, as shown in Table 1.4.19 below.

Table 1.4.19 Water shortage distribution between river reaches for 2000

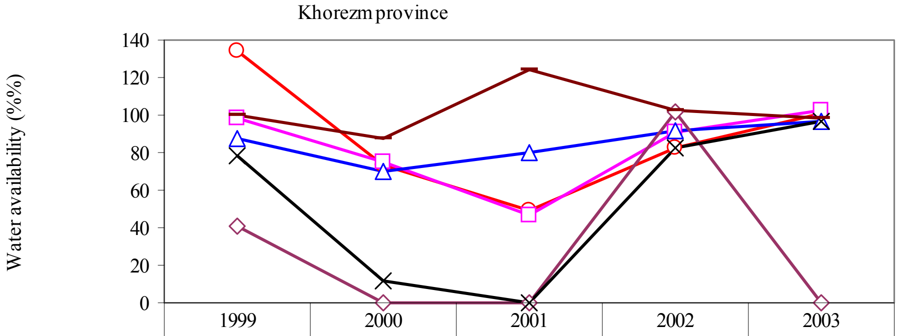
River reach	Shortage (km^3)	Shortage (% of limit)
Upstream	0.7	11
Midstream	2.7	17
Downstream	7.6	52
Basin as a whole	**11.0**	**30**

The uneven water distribution in terms of location within the river basin can be observed at the national level as well; it is shown in Table 1.4.20 below. The data demonstrates the critical drought conditions of the lowlands and downstream of the Amu-Darya during the growing season 2000.

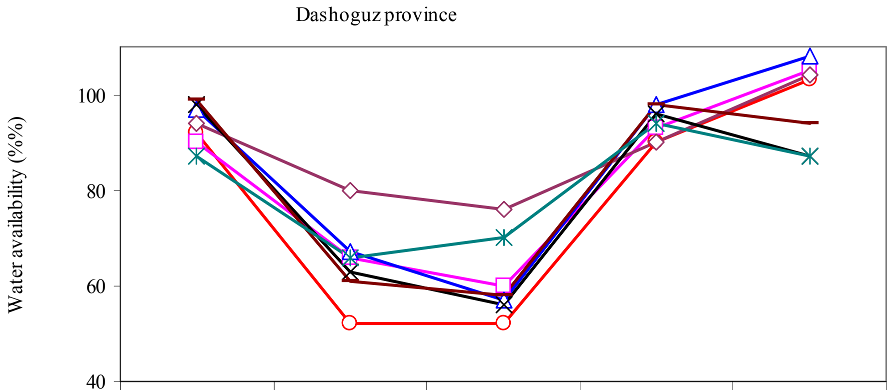
Table 1.4.20 Water shortage distribution at national level for 2000

Republic, river reach, province	Shortage (km^3)	Shortage (% of limit)
Turkmenistan		
Midstream	1.8	17
Dashoguz province	2.8	55
Republic as a whole within Amu-Darya basin	**4.6**	**30**
Uzbekistan		
Midstream	0.8	15
Khorezm province	1.2	36
Karakalpakstan	3.7	59
Republic as a whole within Amu-Darya basin	**5.7**	**37**

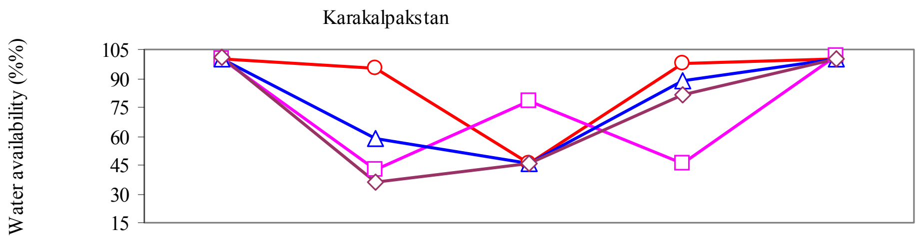
Also, water availability (actual/limit for a given year) for irrigation systems within the given provinces significantly varies during dry years. The Figure 1.4.5 indicates the unevenness of water distribution for different canals/irrigation systems. In Dashoguz province, the largest values of this indicator were reported for Dashoguz branch canal, which has an independent water intake from the in-stream reservoir of TMW, while the lowest values were observed for the interstate canal Shavat (the difference was 17% in 2001).



	1999	2000	2001	2002	2003
Tashsaka	134	74	49	82	101
Kilichbai	98	75	47	90	102
Pitnakarna	87	70	80	92	97
Urgencharna	41	0	0	101	0
Daryalykarna	78	12	0	82	97
pumping from the river	100	88	124	102	98



	1999	2000	2001	2002	2003
Shavat	92	52	52	90	103
Gazavat	90	66	60	93	105
Klych-Bai	97	67	57	98	108
Kipchak-Boz-Suv	94	80	76	90	104
Jumabai Saka	98	63	56	96	87
Khan Yab	99	61	58	98	94
Turkmen-Derya	87	66	70	94	87



	1999	2000	2001	2002	2003
Pakhtaarna	100	95	46	97	100
Suenli	100	42	78	46	101
Bozatou	101	58	46	89	100
Kyzketken	101	36	46	81	100

Fig.1.4.5 Water availability (compared to limit) in main canals in Amu-Darya downstream

In the Khorezm province, the highest (124% in 2001) water availability was observed when water was directly taken from the Amu-Darya and the lowest (zero) was reported for the Urgench-Arna canal. As for the Tashsaka system, water availability amounted to 74% in 2000 and 49% in 2001.

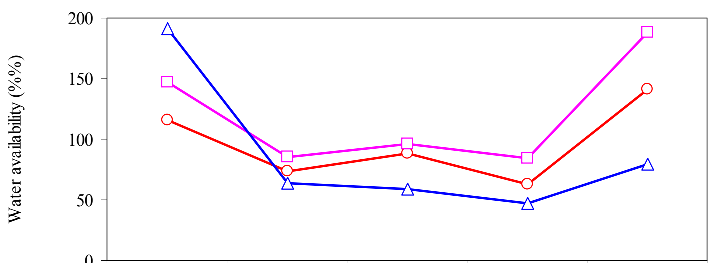
Depending on water flow, uniformity of water distribution varies between seasons and months. The *stability of water supply* drops sharply in dry years, which is evident from deviation of the monthly water supply coefficients (from the average ones); the deviation increases in the growing season. Non-uniform water distribution along the river and the canals is reported in cases where upstream water users have an advantage versus the downstream ones. As an example for 2000 - the water availability in canal Pakhtaarna was 95.1 %, while in canals Bozatou and Suenli only 58.4% and 42.2%, respectively.

Low reliability on water forecasts and evaluations of the available water resources, lack of data for actual stream flow and current shortages in the basin, lack of assessments for damages caused by latest water shortages are the key destabilizing factors leading to a loss of water management control in the basin during the growing season 2000. These factors also provoked situations leading to occurrence of above-limits diversions. Such water supply situations had almost catastrophic consequences in downstream zone. Inefficient system of control over water use, lack of the appropriate economic instruments and legal liability elements greatly aggravated the situation.

Syr-Darya downstream

Starting in 1994, summer water releases for the Syr-Darya became to a large extent dependent on the supply of electric power, fuel, and gas bartered from Kazakhstan and Uzbekistan to Kyrgyzstan. This, leading to a reduction of a guaranteed water supply for irrigated agriculture in downstream areas, created shortages during growing season, as well as losses of flow in the wintertime. More than 30 billion m^3 were discharged into the Arnasai depression during the autumn/winter power-oriented releases from the Toktogul reservoir in the last decade. Due to such an operation regime, the entire lowlands and natural systems, besides irrigated agriculture, greatly suffered

Water availability in the Kyzylorda province is very unstable, during both dry and wet years. Amongst the key issues are unsound water management practices upstream of the Chardara reservoir, negative impact of the Toktogul waterworks, and -to greatest extent- the uncoordinated actions of the states. Water availability for the lowlands provinces for an identical period differs for individual months, but it is almost the same for the entire year (the difference was minor - 0 to 2% for 1991 to 1994). The Fig 1.4.6 shows the diagram of water availability in pilot sites located in Kazalinsk district.



	1999	2000	2001	2002	2003
RMC	116	74	88	63	141
LMC	147	85	96	84	188
Baskara	191	64	59	47	79

Year

Fig.1.4.6 Water availability (as compared to limit) in main canals of Kazalinsk waterworks

1.4.3.2 Strategy for improvement of water availability under conditions of water shortage

Water intakes and diversions from the trans-boundary rivers in Central Asia are based on limits established by the ICWC for various water users for growing and non-growing seasons. When calculating the water shares, the ICWC considers the confirmed inflow to the delta and the Aral Sea as water for independent water users. The percentages (shares) of water flow for different users (inclusive the Aral Sea) are established for every 10-day period, on an accrual basis and accordingly with the remainder of the established limits. The BWOs Amu-Darya and Syr-Darya, being the executive bodies of the ICWC, are allowed, upon an agreement with the Ministries of Agriculture and Water Resources, to adjust the established limits within 10%. When the water flow becomes lower than estimated, the diversions by states are proportionally reduced throughout the river basin (as decided by the ICWC). Such a scheme allows for more or less successful regulation of the interactions between the states, joint water use and management within the region. Everything is coordinated through BWOs. Nevertheless, the practice shows that under complex water conditions (with water shortages caused by natural or artificial factors) more flexible and 'early agreed-on' water distribution system would be required. The need is to distribute water amongst the users in proportion to the remaining water volume on an accrual basis.

When a water diversion is higher than the limit under already existing water shortage, a complex situation downstream arises, making the water shortage more intensified. Naturally, it is logical that the next water delivery for those who overdrew would be reduced with the advantage for those who received less water earlier. The volume overdrawn and its follow-up compensation may differ, depending on the duration of the water shortage, the crop cultivated, irrigation characteristics and crop responses to water stress. In some cases, late irrigation, even with a larger amount of water may not bring the expected yields. One can determine the minimum correction period (5 to 10 days), as the time during which the water situation does not considerably change but may need an operational correction.

Analysis of negative effects caused by low water conditions in the Amu-Darya and Syr-Darya lowlands in the early 2000 showed that water shortage problems need to be solved at the basin level in its entirety. Also, taking into account the time without breaking the natural cycle of water years into seasons and without selecting only the critical periods (growing-season phases) would be important for the analysis.

The *main attention* should be given to the analysis of natural (here the estimate of forecast reliability is crucial) and artificial shortage, resulting from an uncontrolled diversion, incorrect evaluation of the available water resources (including losses), inadequate management (mainly regulation in reservoirs), and uncoordinated actions of the countries. For example, in 2000, the total damage in the Amu-Darya downstream caused by water shortage was estimated to be US$250 million. When distributing water shortages proportionally along the river, if water availability in the downstream could be kept at 80%, the resulting productivity losses would be no more than 15% and the total damage from undersupply would be only about US$50 million.

One of the shortcomings in current planning of the water distribution is the absence of calculations for stream-flow regulation by reservoirs on a long-term basis. Such calculations could provide rational restrictions on allowable values of filling of the reservoirs by the end of the year and define more exactly the available resources. Often, the operation of reservoirs themselves creates artificial shortage during water distribution. Stream-flow regulation should be considered first of all as a means for increasing the secured water volume. To increase guaranteed water delivery of the cascade of river and intra-system reservoirs, it is important to consider balanced distribution of the regulatory functions.

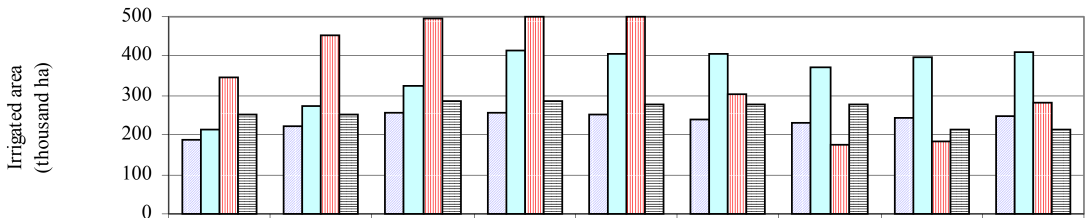
1.5. IRRIGATED LANDS AND THEIR PRODUCTIVITY

1.5.1 Use of irrigated lands

Development of virgin lands and irrigation in the lowlands was very intense between 1980 and 1985 (Fig.1.5.1). During this time, approximately 205,000 ha, of which 203,000 ha along the Amu-Darya, were brought into agricultural production. The newly cultivated lands were put mainly into rice crop rotation in Karakalpakstan (111,000 ha). By 1990 the irrigated area accounted for 1, 364, 000 ha, of which the lowlands of the Amu-Darya were 1, 078, 000 ha and on the Syr-Darya 286,000. From 1990 to 1995 about 88,000 of virgin land was put into agricultural production in mainly Dashoguz province of Turkmenistan.

In the low water years (2000 and 2001), due to a sharp reduction in water supply, a catastrophic reduction of irrigated areas took place, to only 327 thousand ha in Karakalpakstan. In 2000 the reduction came down to 198,000 ha and in 2001 to 129,000 ha, as shown in Fig.1.5.2. During the following two years irrigation was restored on 109 thousand ha, but on the remaining 218,000 ha was not. The reduction of irrigated areas in Khorezm province was in a lesser degree (down to 24,000 ha), and as well as in Dashoguz province (to 36,000 ha). During the following two years irrigation was restored on 20,000 ha in the Khorezm province, but on 9,000 ha crops were put in rotation during 1990 to 2003. In 2003, in the Dashoguz province the amount of irrigated areas was practically restored (412,000 ha) to the 1995 level (413,000 ha).

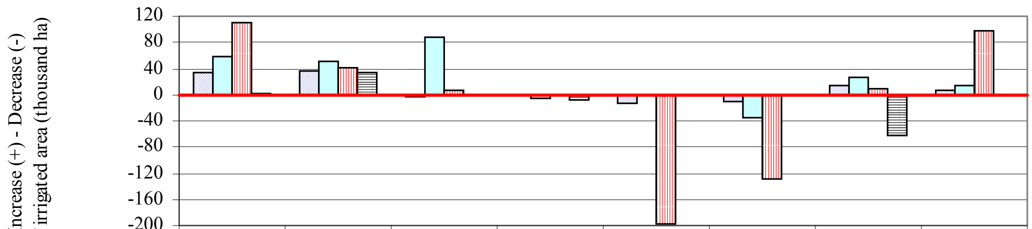
In the Syr-Darya lowlands - Kyzylorda province - the influence of socio-economic situation and low water supply in 2 000 and 2001 led to worsening of the ameliorative conditions of the lands, and, as a result, put about 71,000 ha out of production (between 1990 and 2003).



	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	189	222	258	255	254	241	230	244	250
Dashoguz province	215	273	325	413	407	407	371	398	412
Karakalpakstan	344	455	495	501	501	303	174	183	282
Kyzylorda province	250	253	286	286	278	278	278	215	215

Years

Fig. 1.5.1 Availability of irrigated lands



	1980-1985	1985-1990	1990-1995	1995-1999	1999-2000	2000-2001	2001-2002	2002-2003
Khorezm province	33	36	-3	-2	-13	-11	14	6
Dashoguz province	58	52	88	-6	0	-36	27	14
Karakalpakstan	111	40	6	0	-198	-129	10	99
Kyzylorda province	3	33	0	-8	0	0	-63	0

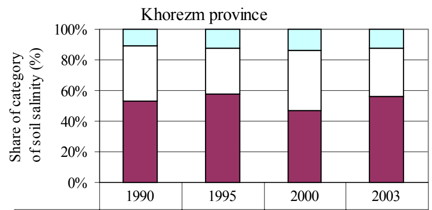
Periods (Years)

Fig. 1.5.2 Increase (+) / decrease (-) of irrigated area relatively to 1980

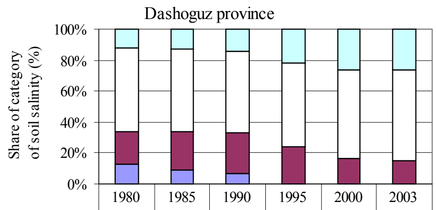
Economic consequences from putting the lands out of production could be traced on the example of Karakalpakstan. With US$550/ha[1] as an average productivity for irrigated lands in Karakalpakstan, the losses for land falling out of production during low water years (2000 and 2001) were about US$180 million.

1.5.2 Salinity of irrigated lands

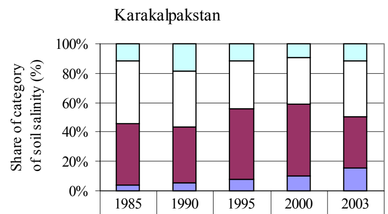
Salinity of irrigated lands in the Amu-Darya and Syr-Darya lowlands results from wastewater flow, originating in natural salinity of soils on a significant territory, as well as the arid climate. In Khorezm, Dashoguz and Kyzylorda provinces all lands are practically saline in some degree (Fig.1.5.3).



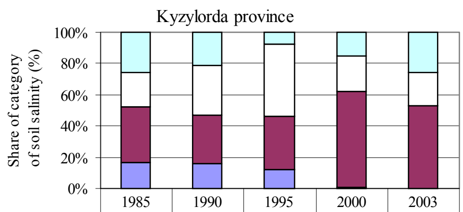
	1990	1995	2000	2003
severe	11	12	14	12
moderate	35	30	39	31
slight	53	58	47	56
nonsaline	0	0	0	0



	1980	1985	1990	1995	2000	2003
severe	12	13	14	22	26	27
moderate	54	54	53	54	57	58
slight	21	25	26	24	16	15
nonsaline	13	9	7	0	0	0



	1985	1990	1995	2000	2003
severe	11	18	12	10	12
moderate	43	38	32	32	38
slight	42	38	48	49	35
nonsaline	4	5	8	10	16



	1985	1990	1995	2000	2003
severe	25	21	7	15	26
moderate	22	32	47	23	21
slight	35	32	34	61	53
nonsaline	17	16	12	1	0

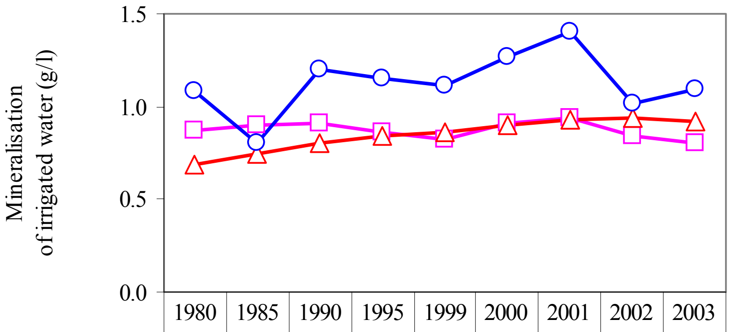
Fig.1.5.3 Salinity of irrigated lands

Development of irrigation in the lowlands had intensified the processes of salt exchange; the lack of drainage and increase of mineralization of the irrigated water (due to the rise of the number of

[1] «Drainage in the Aral Sea Basin towards steady development strategy», 2004, edited by V.Dukhovny, SIC ICWC, Tashkent.

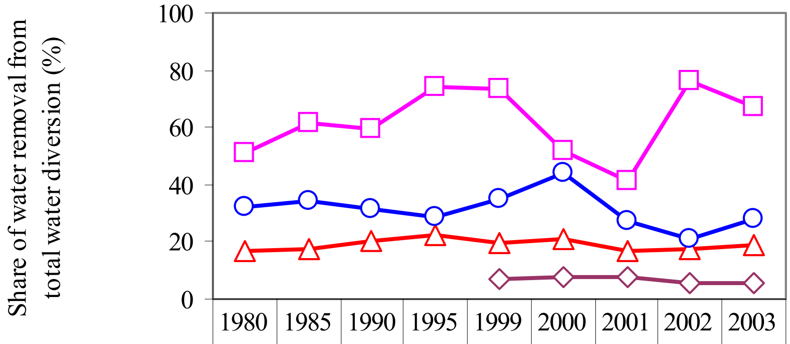
intakes from the rivers upstream, and discharges of wastewater and returned water into the rivers), the secondary salinity has sharply risen increased. These processes became more intense in the last few years, due to inconsistent management of water resources and irrigation/drainage systems, at both national and interstate levels.

In the Khorezm province there is an inclination to reduce the percentage of the moderately saline irrigated lands (to 7% - relative to 2000) towards lightly saline. In the Dashoguz province the area of severely and moderately saline soils has been on the increase, especially between 1980 and 2003. In the Kyzylorda province the area of severely saline lands has increased (to 11% - relative to 2000) at the expense of lightly and moderately saline soils. In Karakalpakstan the data on the salt monitoring provide a mixed picture. While the area of highly and moderately saline lands is increasing, by 2% and 6% (relative to the year 2000), the non-saline land areas have increased by 6%. These tendencies can be verified by preliminary testing of water/salt balances (Annex 1) of the irrigation water (Fig.1.5.4) and their transport in the drainage flow (Fig.1.5.5 and 1.5.6).



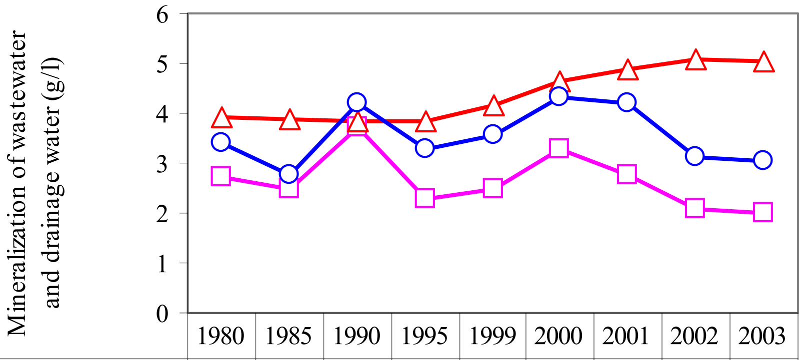
	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.8	0.8
Dashoguz province	0.7	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Karakalpakstan	1.1	0.8	1.2	1.2	1.1	1.3	1.4	1.0	1.1

Fig.1.5.4 Mineralization of irrigation water



	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	51	62	59	74	73	51	41	76	67
Dashoguz province	16	17	20	23	20	21	17	17	19
Karakalpakstan	32	34	31	29	35	44	27	21	28
Kyzylorda province					7	7	8	5	6

Fig.1.5.5 Share of water taken from the total volume of diversion

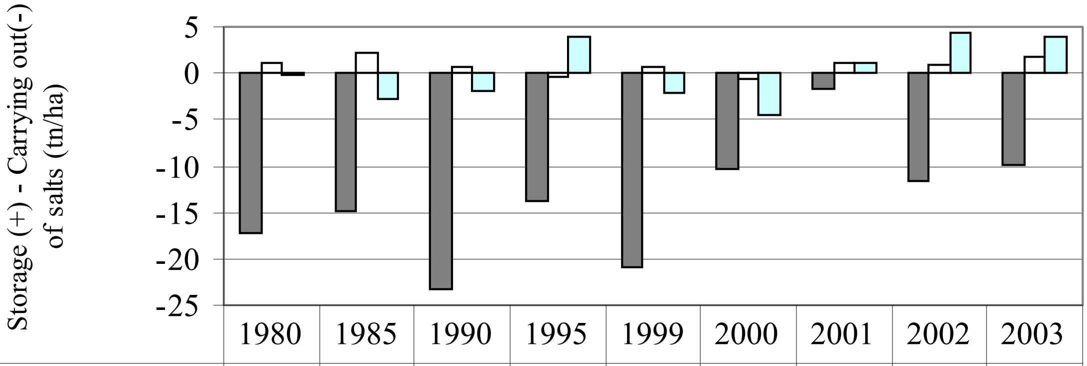


	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	2.7	2.5	3.7	2.3	2.5	3.3	2.8	2.1	2.0
Dashoguz province	3.9	3.9	3.8	3.9	4.2	4.7	4.9	5.1	5.1
Karakalpakstan	3.4	2.8	4.2	3.3	3.6	4.3	4.2	3.1	3.0

Fig.1.5.6 Mineralization of wastewater and drainage water

Undoubtedly, a more complete picture could be obtained on the basis of salt balances of the aerated soil layer, to account for salts contained in groundwater while rising.

In the Khorezm province the process of drainage water carrying salts (10t/ha in 2003) prevails (Fig.1.5.7. At the same time, the share of water diverted here was about 70% of the total water supplied at the intake (Fig.1.5.5), exceeding the need more than two times. That is caused only by irrational water use and direct overflow of water into drainage network. In the Dashoguz province the process of accumulation of salts contained in the irrigation water has been studied for the last three years (Fig. 1.5.7).



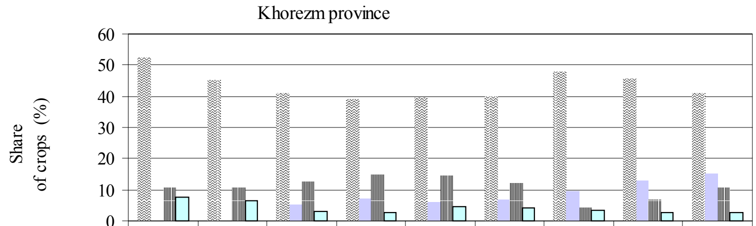
	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	-17.3	-14.8	-23.2	-13.7	-21.0	-10.4	-1.8	-11.5	-10.0
Dashoguz province	1.2	2.1	0.6	-0.5	0.6	-0.7	1.2	0.8	1.7
Karakalpakstan	-0.2	-2.8	-1.9	3.9	-2.1	-4.5	1.1	4.3	3.9

Years

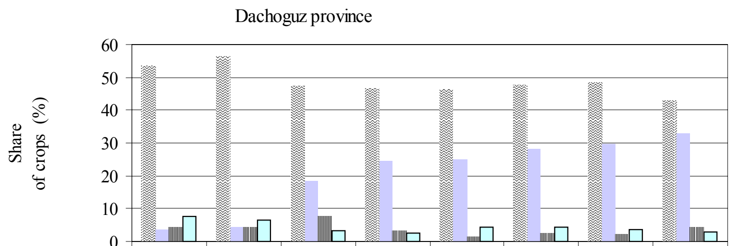
Fig.1.5.7 Accumulation (+) and export (-) of salts by drainage from irrigated acreage

1.5.3 Planting on irrigated lands

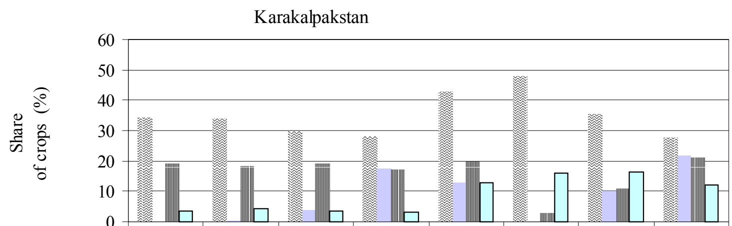
Between 1981 and 1990 the main crop in the Khorezm and Dashoguz provinces was cotton (45-56% of the total sown area), in Karakalpakstan cotton prevailed cotton (34%)and rice (18-19%), as shown in Figure 1.5.8. In the Kyzylorda province the main irrigated crops were rice (38%), perennial and annual grass (32%).



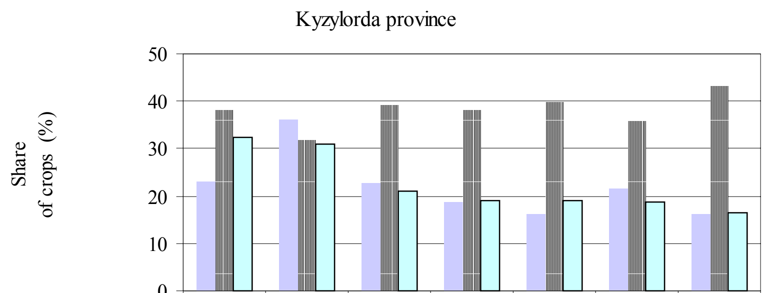
	1981-1985	1986-1990	1991-1995	1996-2000	1999	2000	2001	2002	2003
Cotton	52	45	41	39	40	40	48	45	41
Spike grain crops	0	0	5	7	6	7	9	13	15
Rice	11	11	13	15	14	12	4	7	11
Perennial and annual grass	8	7	3	3	4	4	3	3	3



	1981-1985	1986-1990	1991-1995	1996-2000	2000	2001	2002	2003
Cotton	54	56	47	47	46	48	49	43
Spike grain crops	4	4	19	25	25	28	30	33
Rice	4	4	8	3	1	3	2	4
Perennial and annual grass	8	7	3	3	4	4	3	3



	1981-1985	1986-1990	1991-1995	1996-2000	2000	2001	2002	2003
Cotton	34	34	30	28	43	48	36	28
Spike grain crops	0	0	4	17	13	0	10	22
Rice	19	18	19	17	20	3	11	21
Perennial and annual grass	3	4	4	3	13	16	16	12



	1986-1990	1991-1995	1996-2000	2000	2001	2002	2003
Spike grain crops	23	36	23	19	16	22	16
Rice	38	32	39	38	40	36	43
Perennial and annual grass	32	31	21	19	19	19	17

Period (years)

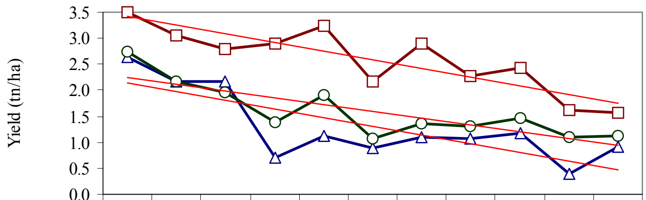
Fig.1.5.8 Plantings on irrigated areas in the lowlands

In the following years, the effort to secure “grain” independency, there will be wheat (mainly winter wheat (15-33%), as an eessential irrigated crop added to the cropping pattern in Khorezm and Dashoguz provinces and Karakalpakstan. The cotton share will be reduced (28 to 43%). The share of cotton and winter wheat, which were under strict state order during the past, was 50% for Karakalpakstan and 76% for Dashoguz province. In the Kyzylorda province rice remains the main irrigated crop (43%), but area under perennial and annual grass was decreased, almost more than two times (to 17%).

1.5.4 Productivity of main irrigated crops

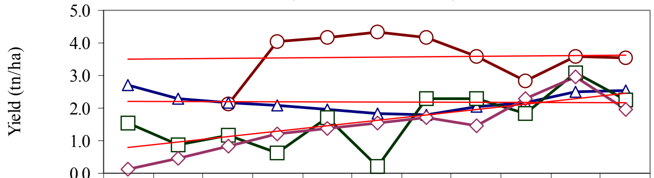
Comparison of yields of cotton in the year 2003 with the one obtained in the period of 1981 to 1985 showed a reduction - more than 2.2 times in the Khorezm province, 3 times in the Dashoguz province, and 2.5 times in Karakalpakstan, as shown in Fig. 1.5.9 below.

COTTON



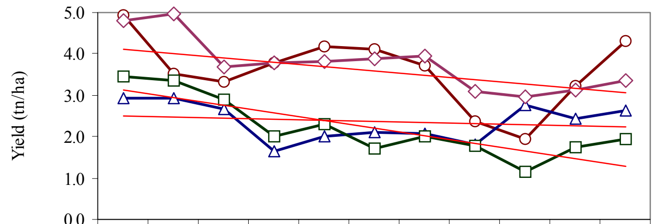
	1981-1985	1986-1990	1991-1995	1996	1997	1998	1999	2000	2001	2002	2003
Khorezm province	3.5	3.1	2.8	2.9	3.3	2.2	2.9	2.3	2.4	1.6	1.6
Dashoguz province	2.7	2.2	2.2	0.7	1.1	0.9	1.1	1.1	1.2	0.4	0.9
Karakalpakstan	2.7	2.2	2.0	1.4	1.9	1.1	1.4	1.3	1.5	1.1	1.1

CEREALS (WINTER WHEAT)



	1981-1985	1986-1990	1991-1995	1996	1997	1998	1999	2000	2001	2002	2003
Khorezm province			2.1	4.1	4.2	4.3	4.2	3.6	2.8	3.6	3.5
Dashoguz province	2.7	2.3	2.2	2.1	2.0	1.8	1.8	2.1	2.2	2.5	2.6
Karakalpakstan	1.6	0.9	1.2	0.6	1.7	0.2	2.3	2.3	1.8	3.1	2.3
Kyzylorda province	0.1	0.5	0.8	1.2	1.4	1.5	1.7	1.4	2.3	3.0	1.9

RICE



	1981-1985	1986-1990	1991-1995	1996	1997	1998	1999	2000	2001	2002	2003
Khorezm province	4.9	3.5	3.3	3.8	4.2	4.1	3.7	2.4	1.9	3.2	4.3
Dashoguz province	2.9	2.9	2.7	1.7	2.0	2.1	2.1	1.8	2.8	2.4	2.6
Karakalpakstan	3.5	3.4	2.9	2.0	2.3	1.7	2.0	1.8	1.1	1.8	1.9
Kyzylorda province	4.8	5.0	3.7	3.8	3.8	3.9	3.9	3.1	3.0	3.1	3.4

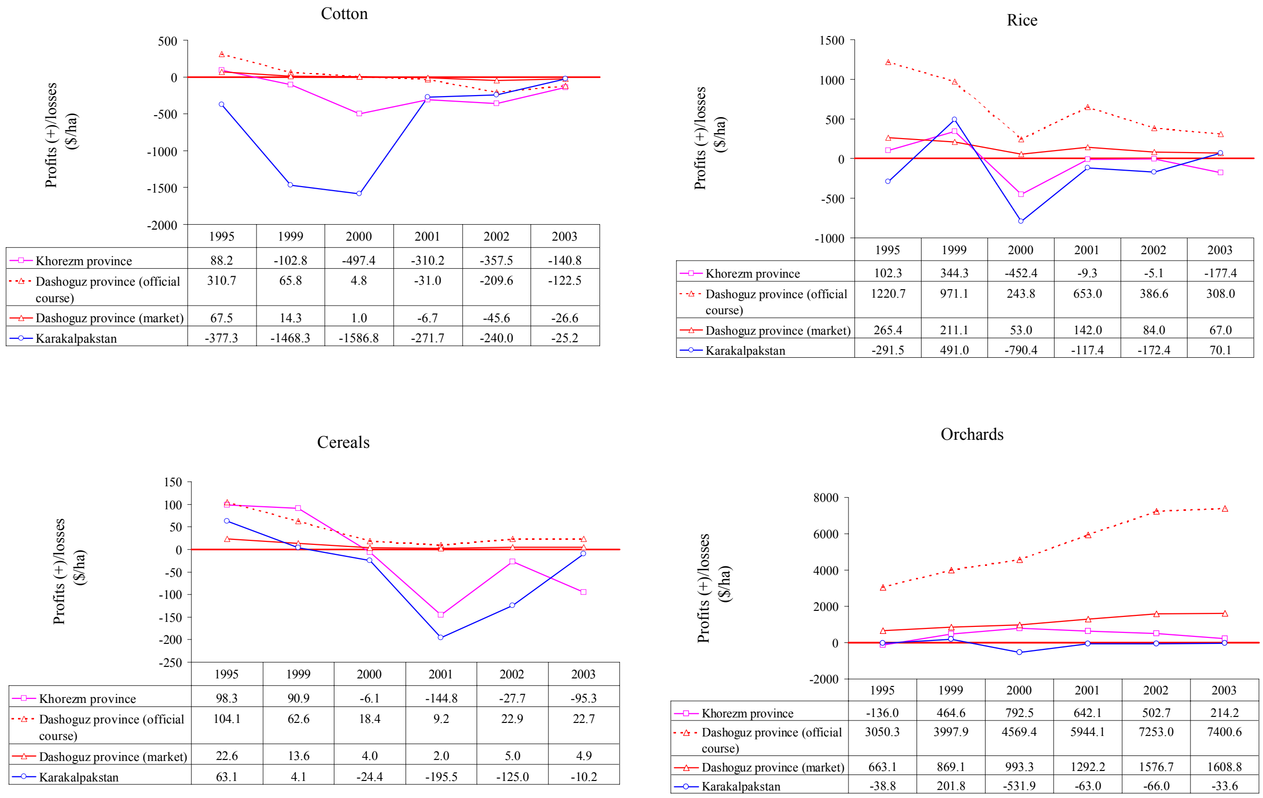
Fig.1.5.9 Yields for main irrigated crops in the lowlands

At the same time, during the low water years 2000 and 2001 in the Khorezm province the yields were about 1.5 times higher than in the next, relatively high water years, 2002 and 2003. Thus, yield reduction here depended not only on the reduced water supply, but also on other factors – lack of fertilizers, pesticides, mechanized labor, etc. - and also on the aggravated conditions of the land reclamation infrastructure.

A mixed picture presents the data for rice production, although during the years 1981-2003 there was a reduction in the rice yields, specifically more so in the period of 1981 to 1985, and particularly in Karakalpakstan, where the yield dropped more than 1.85 times. In the Kyzylorda province the rice yield decreased 1.4 times during that time. There is more positive picture on the process of cereals, mainly winter wheat, although their yields are about 1.5 times below than it can be achieved in these lowlands.

1.5.5 Profitability of irrigated crop production

Profitability of irrigated crop production significantly fluctuates in Khorezm, Dashoguz provinces and Karakalpakstan (Fig.1.5.10). The crop producers suffered maximum losses in cotton, cereals and rice during the low water years 2000 and 2001. For the year 2003 the cotton production, due to the state dictating a sale price, was not profitable for growers in all project-considered provinces. In most cases, the losses in cotton production were not fully covered by state, but partially laid on the farmer's shoulders.



Cotton

	1995	1999	2000	2001	2002	2003
Khorezm province	88.2	-102.8	-497.4	-310.2	-357.5	-140.8
Dashoguz province (official course)	310.7	65.8	4.8	-31.0	-209.6	-122.5
Dashoguz province (market)	67.5	14.3	1.0	-6.7	-45.6	-26.6
Karakalpakstan	-377.3	-1468.3	-1586.8	-271.7	-240.0	-25.2

Rice

	1995	1999	2000	2001	2002	2003
Khorezm province	102.3	344.3	-452.4	-9.3	-5.1	-177.4
Dashoguz province (official course)	1220.7	971.1	243.8	653.0	386.6	308.0
Dashoguz province (market)	265.4	211.1	53.0	142.0	84.0	67.0
Karakalpakstan	-291.5	491.0	-790.4	-117.4	-172.4	70.1

Cereals

	1995	1999	2000	2001	2002	2003
Khorezm province	98.3	90.9	-6.1	-144.8	-27.7	-95.3
Dashoguz province (official course)	104.1	62.6	18.4	9.2	22.9	22.7
Dashoguz province (market)	22.6	13.6	4.0	2.0	5.0	4.9
Karakalpakstan	63.1	4.1	-24.4	-195.5	-125.0	-10.2

Orchards

	1995	1999	2000	2001	2002	2003
Khorezm province	-136.0	464.6	792.5	642.1	502.7	214.2
Dashoguz province (official course)	3050.3	3997.9	4569.4	5944.1	7253.0	7400.6
Dashoguz province (market)	663.1	869.1	993.3	1292.2	1576.7	1608.8
Karakalpakstan	-38.8	201.8	-531.9	-63.0	-66.0	-33.6

Fig.1.5.10 Profitability of crop production

Farmers obtain the highest income from producing foodstuffs, which can be directly marketed at free prices and some profits obtained. The data for 2003 in the Khorezm province shows, that production of foodstuffs - fruits, vegetables, and melons (cucurbitaceous) - was profitable. In Karakalpakstan only vegetables and rice production were profitable. In the Dashoguz province all production was profitable except of cotton. As seen in Fig.1.5.10, even in considering the exchange rate - the net profits presented seem too high. This can be explained by minimum outlay for crop production in Turkmenistan, as the expenses for electric power, fuel, lubricants, water delivery are heavily subsidized by the state.

1.6 IRRIGATION AND DRAINAGE INFRASTRUCTURE

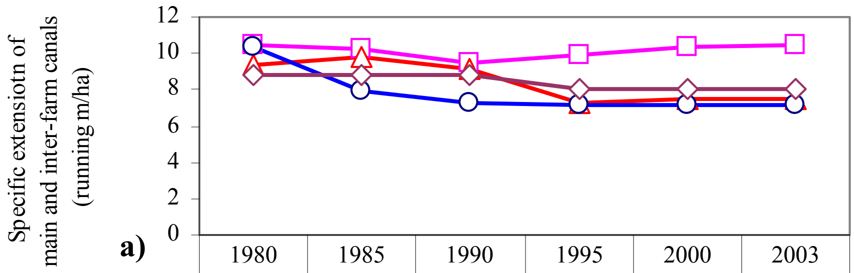
1.6.1 Irrigation network

The irrigation system in the Amu-Darya lowlands contains 1,843 km of main canals, 7,586 km of inter-farm canals and 41,382 km of on-farm irrigation network (Table 1.6.1). The Syr-Darya lowlands include the Kyzylorda province, which has 2,286 km of inter-farm canals and 13,097 km of on-farm irrigation network.

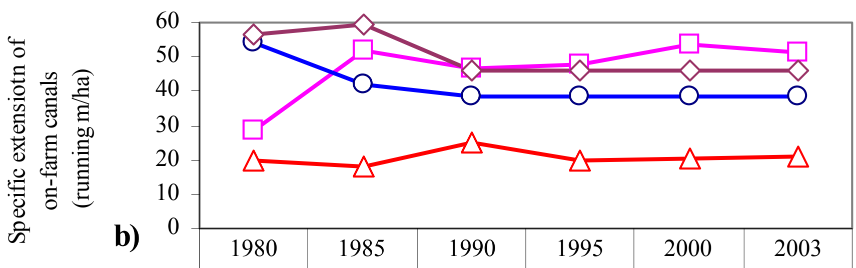
Table 1.6.1 Irrigation network

Province	Main canals (km)	Inter-farm canals (km)	On-farm irrigation network (km)
Khorezm province	330	2 416	13 493
Dashoguz province	617	2 479	8 727
Karakalpakstan	896	2 691	19 162
Kyzylorda province		2 286	13 097
	1 843	**9 872**	**54 479**

Virtually the whole irrigation network in the lowlands of the Aral Sea is comprised of unlined canals. A part of canals, such as Shavat, Palvan-Gazavat in the Amu-Darya river basin represents systems of the ancient irrigation with along history; the major part of the network was constructed during the Soviet period and its history is estimated at decades. The largest density of the irrigation network is 62 m/ha in the Khorezm province (Fig.1.6.1). The inter-farm and on-farm systems in the Khorezm province constitute a complex and unnecessarily dense irrigation network.



	1980	1985	1990	1995	2000	2003
Khorezm province	10.4	10.2	9.5	9.9	10.4	10.5
Dashoguz province	9.3	9.8	9.1	7.3	7.5	7.5
Karakalpakstan	10.4	7.9	7.2	7.2	7.2	7.2
Kyzylorda province	8.8	8.9	8.8	8.0	8.0	8.0

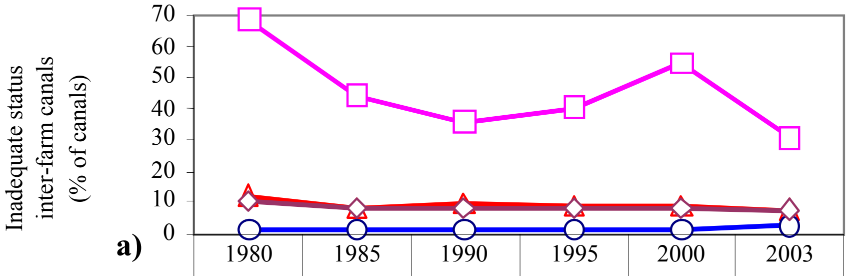


	1980	1985	1990	1995	2000	2003
Khorezm province	28.3	52.0	46.6	48.0	53.4	51.5
Dashoguz province	19.9	18.2	24.8	19.8	20.7	21.2
Karakalpakstan	54.3	41.7	38.6	38.2	38.2	38.2
Kyzylorda province	56.4	59.6	46.0	45.8	45.8	45.8

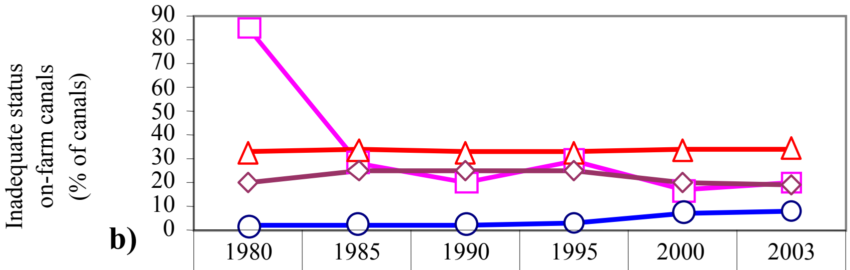
Year

Fig.1.6.1 Density of main and inter-farm canals (a) and of on-farm irrigation network (b)

The state of inter- and on-farm canals is unsatisfactory (for 2003 it is 11% for inter and on-farm canals in Karakalpakstan), and 51.1% for Khorezm province), as derived from Fig.1.6.2. Funds allocated for O&M and reconstruction of irrigation systems are not adequate to cover the need.



	1980	1985	1990	1995	2000	2003
Khorezm province	68.7	44.5	35.7	40.2	54.5	30.7
Dashoguz province	12.5	8.2	9.8	9.1	8.7	7.5
Karakalpakstan	1.0	1.1	1.1	1.1	1.5	2.6
Kyzylorda province	10.0	8.4	8.4	8.5	8.1	7.8

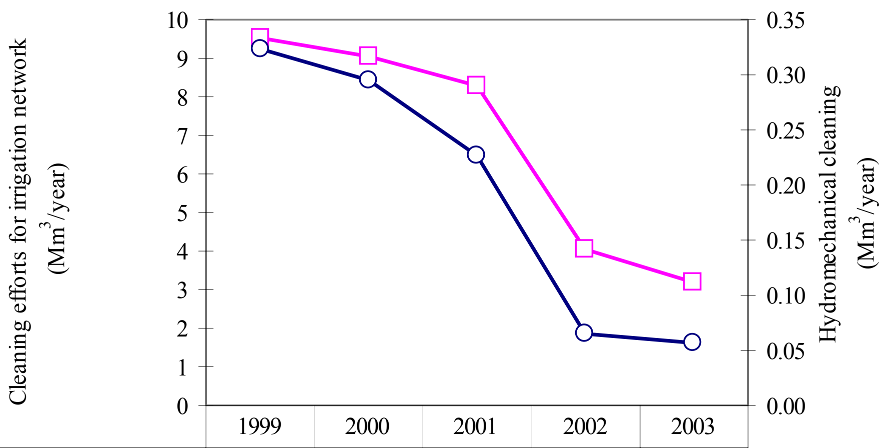


	1980	1985	1990	1995	2000	2003
Khorezm province	85.3	28.6	19.9	29.8	16.5	20.4
Dashoguz province	33.0	33.8	32.5	32.9	33.7	34.1
Karakalpakstan	1.5	2.1	2.2	3.4	7.7	8.5
Kyzylorda province	20.0	25.0	25.0	25.0	20.0	19.2

Year

Fig. 1.6.2 The status of inter- and on-farm irrigation networks

Thus, the Khorezm province shows (below in Figure 1.6.3) a sharp reduction of cleaning efforts of inter-farm canals and, particularly, of those which are cleaned by suction-tube / dredge.



	1999	2000	2001	2002	2003
Total	9.50	9.04	8.28	4.04	3.21
by suction-tube dredge	0.32	0.29	0.23	0.07	0.06

Fig.1.6.3 Volumes related to cleaning the main and inter-farm irrigation network in Khorezm province

The causes of the maintenance problem are connected with lack of material and technical resources, lack and deterioration of machinery, particularly of the suction-tube dredges. Meanwhile, the transfer of once trans-boundary main canals, such as Tashsaka, Shavat, Palvan-Gazavat, and Gazavat to a level of 'in-province' canals worsened their technical status due to the compelled operation in a regime other than they were designed for. As a result, the control/command water levels in these canals have sharply dropped. This led to problematic intakes for the inter-farm network, causing the canals run in supporting-varying regime, provoking an excessive silting. Such problems became worse in dry years.

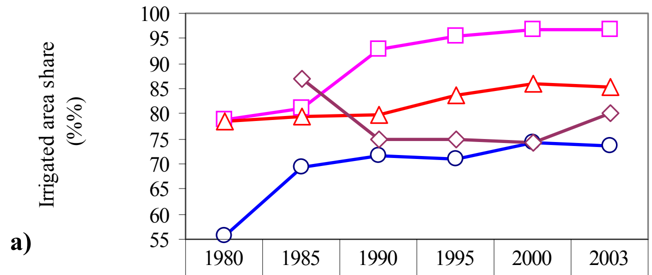
1.6.2 Drainage situation

With no natural ability to drain, for the irrigated areas of lowlands the collector-drainage systems play an important role in land reclamation. The extent of drainage system is shown in Table 1.6.2.

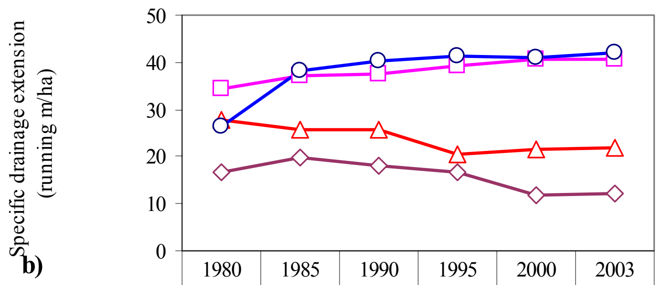
Table 1.6.2 Extent of drainage system on the lowlands

Province	Main collectors (km)	Inter-farm collectors (km)	On-farm horizontal drainage (km)	Vertical drainage (well)
Khorezm province	444	3 274	6 922	250
Dashoguz province	668	2 671	5 670	
Karakalpakstan	1 196	3 444	16 421	
Kyzylorda province		903	1 702	162
	2 308	10 292	30 715	412

The largest extent of artificial drainage is in Khorezm province (97 %), while the lowest is in Karakalpakstan (74 %), as pictured in Fig.1.6.4.



	1980	1985	1990	1995	2000	2003
Khorezm prov.	79	81	93	95	97	97
Dashoguz prov.	79	79	80	84	86	85
Karakalpakstan	56	69	72	71	74	74
Kyzylorda prov.		87	75	75	74	80



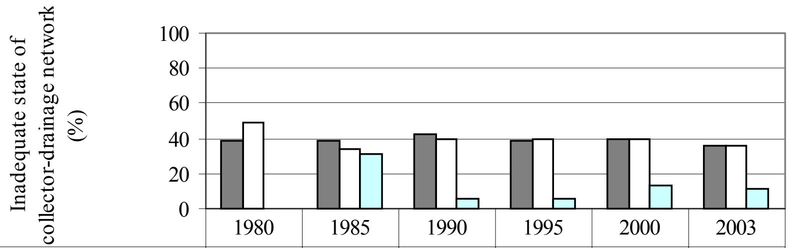
	1980	1985	1990	1995	2000	2003
Khorezm prov.	34	37	37	39	41	41
Dashoguz prov.	28	26	26	21	22	22
Karakalpakstan	26	38	40	41	41	42
Kyzylorda prov.	17	20	18	17	12	12

Year

Fig.1.6.4 Degree of drainage provision (a) and drainage density (b)

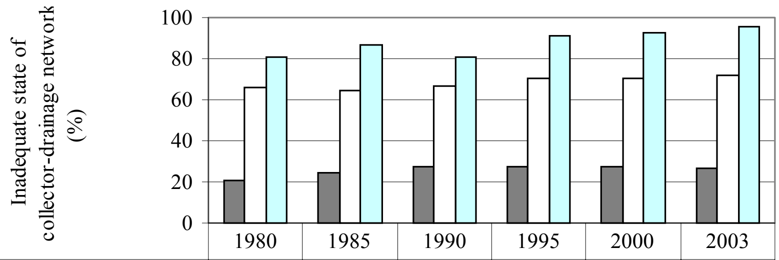
The total density of surface drainage is the highest in Khorezm province and Karakalpakstan (41 to 42 m/ha), while almost half of that in the Dashoguz province (22 m/ha) and twice lower in Kyzylorda province (12 m/ha). The status of main and inter-farm collectors is unsatisfactory in Karakalpakstan (21%) and Kyzylorda province (48%), as show in Fig. 1.6.5. This hampers the normal outflow of saline waters from drained area and induces further salinization.

Khorezm province



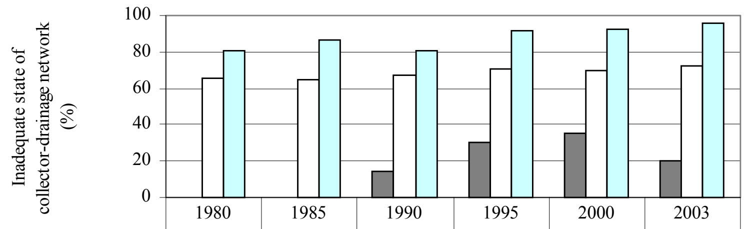
	1980	1985	1990	1995	2000	2003
main and inter-farm	39	39	42	38	40	36
field surface	49	34	40	40	39	36
field subsurface		31	6	6	13	11

Dashoguz province



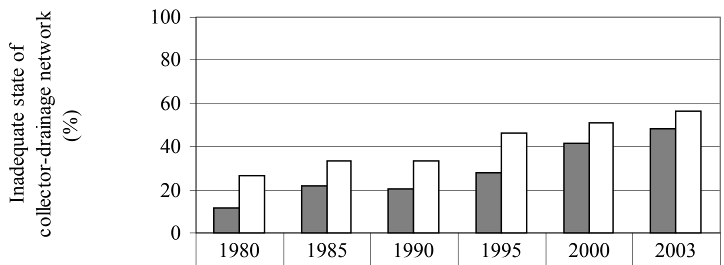
	1980	1985	1990	1995	2000	2003
main and inter-farm	21	24	27	27	27	27
field surface	66	64	67	70	70	72
field subsurface	80	87	81	91	93	96

Karakalpakstan



	1980	1985	1990	1995	2000	2003
main and inter-farm	0	0	14	31	35	21
field surface	66	64	67	70	70	72
field subsurface	80	87	81	91	93	96

Kyzylorda province



	1980	1985	1990	1995	2000	2003
main and inter-farm	12	22	20	28	41	48
field surface	26	33	33	46	51	57

Year

Fig.1.6.5 State of drainage

Out of 250 vertical drainage wells in the Khorezm province, no well is operated due to hight cost for energy and equipment repair and reconditioning. Similar situation is observed in Kyzylorda province, where 241 vertical drainage wells were constructed on 37 thousand ha until 1990. Since 1992, the wells have practically not been operated due to the high energy and O&M costs. A portion (79 wells) had been out of function. This complicated situation with drainage systems is mainly due to medium to high salinization.

1.6.3 Efficiency of water use in irrigation systems

When analyzing structure and location of irrigated crops vs. the saline land coverage, *Water Use Coefficient* can be evaluated as an indicator for irrigation systems. This can be done by using evaluating crop water use, irrigation norms "net-field" (as given in National work teams' reports), which were increased by weighted average and differentiated, subject to degree of salinity and leaching norms (water diversion to province – inflow to irrigated fields):

$$WUC = \frac{r * F}{W} \times 100 \tag{1.6.1}$$

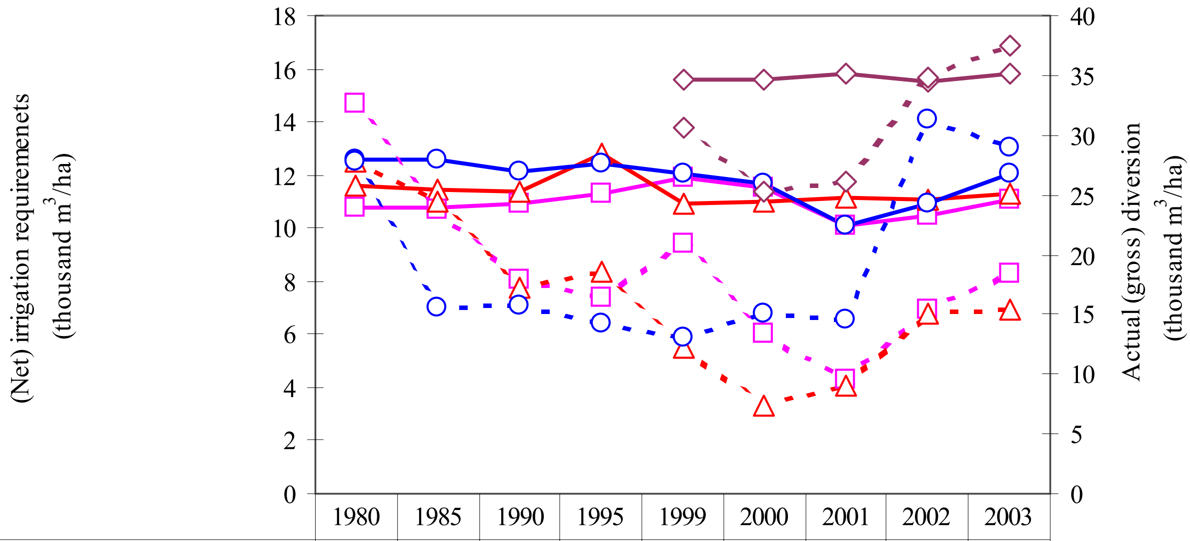
Where:

WUC - Water Use Coefficient for irrigation systems (%)

r - crop water requirements, taking into account additional water for leaching, "net" irrigation norm, (m^3/ha) in Fig. 1.6.6

F - actual irrigated area in ha

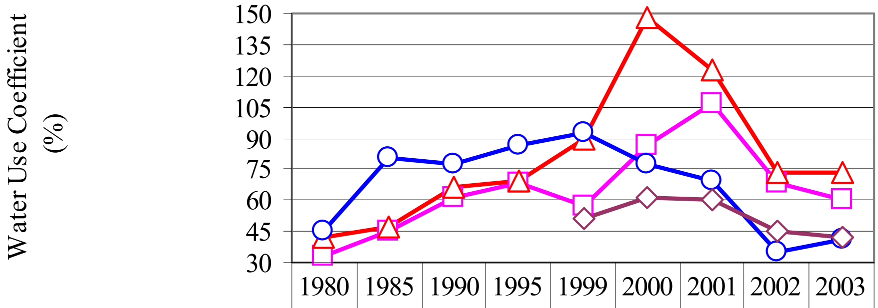
W - diversion to provincial irrigation systems (m^3) in Fig. 1.6.6



	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province (solid)	10.8	10.8	10.9	11.3	11.9	11.5	10.1	10.5	11.1
Dashoguz province (solid)	11.6	11.5	11.4	12.8	10.9	11.0	11.1	11.1	11.3
Karakalpakstan (solid)	12.6	12.6	12.2	12.4	12.0	11.7	10.1	10.9	12.0
Kyzylorda province (solid)					15.6	15.6	15.8	15.5	15.8
Khorezm province (dashed)	32.7	23.8	17.9	16.5	20.9	13.4	9.5	15.4	18.4
Dashoguz province (dashed)	27.8	24.5	17.3	18.5	12.2	7.4	9.1	15.0	15.4
Karakalpakstan (dashed)	27.8	15.6	15.8	14.3	13.1	15.1	14.6	31.2	28.9
Kyzylorda province (dashed)					30.7	25.3	26.1	34.7	37.5

Fig. 1.6.6 (Net) Irrigation requirements (———) and actual diversion (▪▪▪▪▪▪▪) to irrigation systems in downstream area

For irrigation systems that are completely comprised of unlined canals the typical Water Use Coefficient (WUC) is 55-65% (under the efficiency of the system of main, inter- and on-farm canals of 65-75% and the efficiency of water use at field level of 75 to 85%). Under such conditions, if WUC is less than 55%, it indicates underutilization of water and potential for water conservation. When WUC is more than 75 %, there is a lack of irrigation water and under-irrigation of crops. In the eighties, water use efficiency was low in almost all systems, and WUC much lower than 55% (Fig. 1.6.7), with the exception of Karakalpakstan, where the water supply was inadequate already in 1985. Since the water for irrigation is allocated on basis of volume limits, water shortages have become more frequent in all provinces.



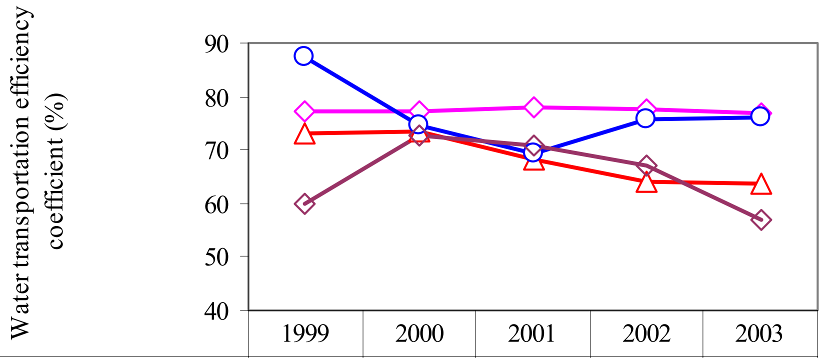
	1980	1985	1990	1995	1999	2000	2001	2002	2003
Khorezm province	33	45	61	69	57	86	106	68	60
Dashoguz province	42	47	66	69	90	148	123	74	74
Karakalpakstan	45	80	77	87	92	77	69	35	42
Kyzylorda province					51	62	61	45	42

Fig. 1.6.7 Water Use Coefficient in irrigation systems of lowlands

Taking into account that the share of saline lands in all four given lowlands provinces is close to 100% (Fig.1.5.3), practically everywhere it is necessary to include the leaching fraction in the general irrigation requirement. Because of low efficiency of unlined irrigation canals, the diversion volume has to be increased. Water deficit and inadequate drainage have brought on more rapid increase of salinization.

The lowest water supply was recorded in low water years 2000 and 2001, when extremely stressful situation was in Karakalpakstan, where 327,000 ha of irrigated lands have been lost (Fig.1.5.2). In the same period, irrigated areas in Khorezm and Dashoguz provinces have decreased by 24,000 ha and 36,000 ha, respectively. Following these two low water years, 62,800 ha of irrigated lands were lost in the Kyzylorda province.

A destabilizing effect of the low water years was also reflected in a sharp reduction of Water Use Coefficient in the remaining irrigated areas in Karakalpakstan and Kyzylorda province. Water use discipline and irrigation system management/controllability has sharply declined as well. This can be verified by decreased Coefficient for Canal Efficiency (conveyance efficiency), which can be calculated as a ratio of volumes delivered to the boundary of farm to the volume at the boundary of province (Fig.1.6.8). In the Kyzylorda province this Coefficient decreased by 16% in high water year 2003 against the low water year 2001. In essence, all 16% are management losses resulting from poor controllability of irrigation systems.



	1999	2000	2001	2002	2003
Khorezm province	77	77	78	78	77
Dashoguz province	73	73	68	64	64
Karakalpakstan	87	75	69	76	76
Kyzylorda province	60	73	71	67	57

Fig.1.6.8 Canal Efficiency Coefficient (reflecting on water delivery to farm boundaries)

2. ANALYSIS OF POLITICAL, LEGAL, AND INSTITUTIONAL SUPPORT FOR INTEGRATED WATER RESOURCES MANAGEMENT (IWRM)

2.1 KEY ASPECTS AND SUPPORT FOR THE IWRM

Currently, IWRM is being considered as a viable alternative to the conventional (administrative and technocratic) approach to water resources management. The institutional aspects of IWRM call for the following important considerations:

- Transition from water management based on the administrative boundaries to one that is based on hydrographic boundaries
- Transition from the sectoral approach to a more systematic and integrated WRM
- Water demand management rather than the conventional supply-side management
- Implementation of a cooperative style water management rather than the administrative command method
- Replacement of non-transparent institutional structures by more transparent ones
- Participation of stakeholders in water management decisions and bottom up approach

To implement the above-mentioned principles, appropriate decisions at various hierarchical levels need to be made and adequate political, legal, institutional, and financial mechanisms need to be developed. The necessary financial resources should be sought after to aid in creating favorable conditions for the IWRM.

The key elements necessary to promote and implement the IWRM have been identified by the Global Water Partnership (GWP) and are chiefly categorized as:

- ***Political support and decisions*** – in terms of water policies
- ***Legal framework*** - water policies converted in a form of law
- ***Financial and motivational aspects and structures*** - financial resources

Pertinent *political decisions* represent the most complex aspect in the area of interstate water relations in the Central Asia Region (CAR). Hence the water and environmental problems concerning the interstate relationships have been most often discussed in the meetings amongst the Heads of the Central Asian States. This is evidenced by the adoption of numerous documents, as the Kyzylorda, Nukus, Alma-Ata, and Dushanbe Declarations, the Ashgabat Statement, and the Aral Sea Basin Programs (ASBP-1 and ASBP-2). Additionally, many bilateral and multilateral meetings at the highest level have been dedicated to those issues. Therefore, it can be said that the political basis for joint management of the international trans-boundary water resources, including the areas along the downstream of the Amu-Darya and the Syr-Darya (involving Kazakhstan, Turkmenistan, and Uzbekistan), exists.

At the same time, a degree of *political support and legal and institutional framework* for the IWRM differ considerably among the three downstream States of the Aral Sea Basin. The need for radical reforms within the water sector is well understood at the top political level in Kazakhstan and Uzbekistan, and at the level of water and environmental managers in Turkmenistan.

To date, important political decisions have been made (new national water policies developed) and solid support for water reforms obtained in Kazakhstan and Uzbekistan. Although the supporting legal and institutional framework for the IWRM has not advanced equally (most advanced being in Kazakhstan), the efforts are on the way to accelerate it. In Uzbekistan, the framework is expressed in a form of future priorities for development of water sector and the associated legislative and regulatory acts, serving as a basis for the transition to basin (hydro-boundary) management. Called prerequisites, these acts need to contain elements at the national level that are important for:

- *horizontal (sectoral) coordination*
  - consideration of all economic sectors using water
  - coordination with all interested parties, including the public
- *vertical (hierarchical) coordination*
  - coordination of institutional structures covering all levels of water resources management within a river or an irrigation system

2.2 LEGAL PRECONDITIONS FOR IMPLEMENTING THE IWRM AT THE NATIONAL LEVEL

The key points of the IWRM cover all aspects of prudent and holistic water management, with the main principle for a shift toward basin management. The river flow is formed and dispersed, depending on various natural and anthropogenic factors. As water does not recognize political and administrative boundaries within the countries, unified management of all factors affecting the volume and quality of water resources is best feasible and practical within a catchment area or an irrigation system; i.e., on the basis of hydro-boundary principle. In fact, a river basin may belong to a different jurisdiction (e.g. state or federal unit). However, it is advisable to concentrate water management aspects of the river basin into the hands of one authority. The basin principle embodies the holistic principle of water resources management.

Kazakhstan. A new Water Code of the Republic of Kazakhstan was adopted on July 9, 2003. It establishes the basin-based water management, provides a legal basis for the IWRM at the national level, and sets out a range of other provisions (main priorities, environmental water demand, public participation in water management, etc.), which overall promote the IWRM. The Kazakh legislation that regulates water, land, environment, and other relations is the most advanced in the CAR.

Main problems in Kazakhstan relate to the difficulties with enforcing the law and broadly adopting the IWRM.

Uzbekistan. The existing water law of the Republic of Uzbekistan on 'Water and Water Use' was adopted on May 6, 1993. Subsequently, this law was amended and supplemented by a number of other regulatory and legal acts. Since the law does not contain the basin principle of water management, it was set out by a separate Decree of the President of Uzbekistan and enacted by the Cabinet of Ministers in 2003. The Decree also provided for reforming the water managing organizations.

Basically, water, land and other national laws allow for an implementation of the IWRM principles. Nevertheless, amendments and/or supplements, as well as new regulatory acts are needed for successful implementation of the IWRM. This, in particular, relates to a development of economic instruments to promote rapid reforms in all water sub-sectors and improved organization of public involvement in water management decision.

Problems in Uzbekistan are similar to Kazakhstan - they also relate to the enforcement of the legal and regulatory acts as well as an understanding of IWRM principles and adoption of a high level decision to move toward the IWRM.

Turkmenistan. The Water Code of the Turkmen Soviet Republic, dated June 1, 1973, had remained in force until October 31, 2004. A New Code of Turkmenistan on Water was adopted on November 1, 2004. The new Code does not make reference to the IWRM concept.

The relevant water / land legislation of Turkmenistan needs to be improved to provide a more solid basis for the necessary elements of the institutional framework, so that the IWRM could be implemented. Initially, it would be important to do a lot of promotional work, starting with seeking an approval of the IWRM by the public and obtaining support from policy makers to make changes in the management of water resources. Successful implementation of the IWRM in the selected pilot system of Dashouz province would greatly facilitate broader understanding and eventually an adoption of IWRM principles across other provinces.

2.3 ANALYSIS OF THE LEGAL AND REGULATORY FRAMEWORK FOR MAKING A SHIFT TOWARD IWRM

2.3.1 Historical development.

Before independence, water relations within and amongst the Central Asian Republics were regulated by the 'Fundamental principles of water legislation of the Soviet Union and the union republics'[1] (hereinafter 'Fundamental principles WL SSR') and the respective republican water acts. As a result, the water legislation of all Central Asian Republics was very similar since the Fundamental principles WL SSR placed limits for the republican lawmaking regarding water.

Establishment of the new independent states has called for a revision of the legal framework for water resources management, at the state and the interstate level. Most Central Asian States adopted some new water legislation during 1993 and 1994, such as: Water Code of Kazakhstan (March 31, 1993); Water Code of Tajikistan (December 27, 1993); Law of Kyrgyzstan on Water (January 14, 1994); and Law of Uzbekistan on Water and Water Use (May 6, 1993). More recently, new versions of Water Codes were adopted by Tajikistan (November 29, 2000), Kazakhstan (July 9, 2003), and Turkmenistan (November 1, 2004).

It is noted that the new Water Code of Kazakhstan (2003) is fundamentally different from the former one. As for Turkmenistan, the expectations that the new Water Code passed in 2004 would be advanced and provide a solid legal framework for the IWRM have not been met.

In regard to the International Legal Framework (ILF) for regional interstate water relations, it should be noted that this pilot project, having an interstate character, stipulates the need for an analysis of the international/interstate water relations. Although the degree of execution of the international regulations seems much smaller than that of the national ones[2], it is important that a sound and comprehensive ILF is developed to adequately cover the downstream zones. This is partially due to environmental reasons, but primarily to the regional security involving water supply. Particularly sensitive is the downstream area of the Amu-Darya, as the pilot zone there has an international trans-boundary nature, as opposed to the downstream lands of the Syr-Darya, where the pilot sites are located within one state - Kazakhstan. In this context, comparative analysis of water laws in the CAR is topical since it attracts the attention of water managers to the key aspect - regional water security. At the same time, it offers potential for making the Kazakh, Turkmen, and Uzbek water laws converge, by considering important points to achieve positive results and by

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[1] **Fundamental principles of water legislation of the Soviet Union and the union republics**.//Fundamental principles of legislation of the Soviet Union and the union republics. – M.:Yuridicheskaya literature, 1983-p.45-62 (approved on 10.12.1970 and enacted on 01.09.1971).

[2] It is perceived, that in a public internal law the established legal regulations are observed due to presence of a general 'traffic policeman' – which is to be the government. Such an authoritative 'policeman' is generally absent at the interstate level. (Kulagin V.M. International relations on the verge of XXI century. "Mezhdunarodnaya zhizn", 1999, №7 – p.21).

excluding undesirable points, both at the national and international levels. Separate water law analysis of the three Central Asian States is available[3].

The need for uniting the water laws in a common interest is significant. It is underscored by the fact that the first "sovereign" water laws of Kazakhstan, Tajikistan, Kyrgyzstan, and Uzbekistan were developed by using old models. Introduction of new aspects had turned into re-arranging, splitting, and combining paragraphs, chapters, articles, parts, and items of those old Water Laws (See Table 2.1 for the three States under project consideration).

Table 2.1 Structure of Water Laws in Kazakhstan, Turkmenistan, and Uzbekistan

#	Parameter	Kazakhstan	Turkmenistan	Uzbekistan
1	Year of adoption	2003 (1993)	2004 (1973)	1993
2	Number of paragraphs	11 (6*)	6 (5)	-
3	Number of chapters	32 (26)	27 (30)	29
4	Number of articles	123 (146)	113 (134)	119
5	Conceptual structure	Yes (yes)	Yes (no)	No
6	General provisions	Paragraph 1	Paragraph 1 (1)	-
7	Main provisions	Chapter 1	Chapter 1 (1)	Chapter 1
8	Water use	Paragraph 4 (2)	Paragraph 2 (2)	Chapter 6-23
9	Water protection	Paragraph 7 (3)	Paragraph 3 (3)	Chapter 24
10	Adverse water effect	Paragraph 7 (3)	Paragraph 3 (3)	Chapter 25
11	Government accounting and planning	Paragraph (11) 4	Paragraph 4 (4)	Chapter 26
12	Water disputes	Paragraph 10 (5)	Paragraph 5 (Chapter 23)	Chapter 23
13	Responsibility for violation of water law	Chapter 30 (Paragraph5)	Paragraph 5 (5)	Chapter 27
14	International water relations	Paragraph 11 (6)	Paragraph.6 (Art.108[4])	Chapter 29
15	Economic instruments for water use	Paragraph 9 (-)	-	-
16	Water pricing (free water use)	Art. 133 (Chapter 5)	Art. 29 (34*)	Art. 30
17	Paragraph 1: № of articles	1-21 (1-23)	1-15 (1-20)	-
18	Paragraph 2: № of articles	22-32 (24-96)	16-91 (21-108)	-
19	Paragraph 3: № of articles	33-63 (97-109)	92-98 (109-124)	-
20	Paragraph 4: № of articles	64-76 (110-115)	99-104 (125-130)	-
21	Paragraph 5: № of articles	77-89 (116-122)	105-112 (131-134)	-
22	Paragraph 6: № of articles	(90-111) 123	113 (-)	--
23	Paragraph 7: № of articles	112-126 (-)	-	-
24	Paragraph 8: № of articles	127-131 (-)	-	-
25	Paragraph 9: № of articles	132-136 (-)	-	-
26	Paragraph 10: № of articles	137-144 (-)	-	-
27	Paragraph 11: № of articles	141-146	-	-

Note: In line #2 the '(6*)' for Kazakhstan means 'from the old Kazakh Water Code of 1993'.
In line #16 the '(Art 34*)' for Turkmenistan states that 'Water Code of Turkmenistan of 1973 was called as "Free water use".

[3] Taking into account this report limitation in size, a comparative analysis of the key points in Water Codes of Kazakhstan (of 2003) and of Turkmenistan (of 1973), Code of Turkmenistan on Water (of 2004) and Water and Water Use Law of Uzbekistan (of 1993) is covered as a separate article by Yusup Risbekov, 2004).

[4] Art.108 of Turkmenistan's Water Code of 1973 was referred to as: "Water use on trans-boundary water courses of USSR". There was also the art.99. Resolution of water disputes between water users of Turkmen Soviet Republic and other union republic. International water relations were regulated by legislation of USSR.

2.3.2 Existing water regulatory and legal framework

The existing water regulatory and legal framework of the Central Asian states is generally composed of the following:

- Respective provisions in national Constitutions
- Water Laws (as mentioned above)
- Respective provisions in Laws regulating 'allied' relationships, such as land, forest, mountain, sensitive environment, etc.
- Decrees of Supreme State Authority
- Declarations by the Heads of States (having the power of law in some cases)[5] and/or the Government, Ministries, State Committees, and Departments
- Decisions of local public authorities
- Respective water-related provisions of civil, administrative, criminal and another legislations, and international agreements between the States

Hence, there is a wide range of water regulations and legal acts enacted by the respective government of each State. In regard to this project, to achieve implementation of the IWRM in the lands within deltas and around downstream of the Amu-Darya and the Syr-Darya, it would be advisable to take into account the ***key directions*** for which important results toward IWRM must be produced. Considering sectors, it would be management of agriculture and water, but also management of natural resources, so that they remain sustainable. Therefore, it would be important to analyze fewer documents, thus only those pertaining to the transition toward market economy, such as: *water, land, and environment* relationships.

An example of the ***multitude of legal and regulatory framework*** (policies, regulations, rules, and procedures) for the Republic of Kazakhstan is given below. In ***Kazakhstan***, the Ministries with a vested interest in water resources participated in the development of this framework. Primarily, it was the Ministry of Agriculture, which contains in its structure the chief water managing body - Committee for Water Resources - and then, depending on the need for specific rules, the Ministries of Environment, Health, Transport and Communications, as well as the local governments (provincial akimats).

1. Procedure for using water for fire-protection (August 19, 1994); **2.** Procedure for using waterways for navigation (August 19, 1994); **3.** Procedure for developing and approving master plans for water use and protection (August 19, 1994); **4.** Procedure for approving and permitting special water uses (December 29, 1994); **5.** Regulation for granting separate water use of reservoirs (December 29, 1994); **6.** Procedure for using reservoirs for air-service needs (December 30, 1994); **7.** Procedure for state water cadastre (January 24, 1995); **8.** Provision for state accounting of water resources and their use (February 15, 1995); **9.** List of water reservoirs of national importance or of a particular scientific value, which use is limited or completely prohibited (of 03.03.1995); **10.** Provision for state control over the use and protection of water resources (April 29, 1995); **11.** Procedure for disposal of harmful substances and waste discharge underground (October 18, 1996); **12.** Provision for state monitoring over the deep underground (January 27, 1997); **13.** Unified rules for protection of the underground resources while mining mineral wealth, oil, gas, and groundwater in the Republic of Kazakhstan (July 21, 1999); **14.** Provision for procedures for estimating, collecting and paying surface water charges by the economic sector of the Republic of Kazakhstan (August 7, 1997); **15.** Rules for organization and maintenance of unified monitoring system for the environment and natural resources (June 27, 2001); and many others.

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[5]Thus, according to the Law of the Republic of Uzbekistan "on Regulatory Legal Acts" (Dec 14, 2000):
the legislative enactments are: 1) Constitution of the Republic of Uzbekistan; 2) Laws of the Republic of Uzbekistan; 3) Decrees of Oliy Mazhlis of the Republic of Uzbekistan;
are: 1) Decrees of the President of Uzbekistan; 2) Resolutions of the Cabinet of Ministers; 3) Regulatory Legal Acts of ministries, state committees and departments; 4) Decisions of local public authorities.
At the same time, several Decrees of the President of Kazakhstan and the President of Turkmenistan have the power of national laws.

According to the Decree of Prime Minister of the Republic (October 8, 2003) "About measures for implementation of the Water Code in the Republic of Kazakhstan", a List of National Acts was approved and these acts need to be adopted to implement the Water Code. This document provided for development and introduction of the following regulatory legal acts:

1. List of water-management structures of particular strategic importance; **2.** List of water objects of national importance and legal regulation regime of economic activities; **3.** List of water structures under national ownership; **4.** Rules for temporary management of water facilities, which are of a particular strategic importance for national and regional economies; **5.** Rules for state monitoring over water objects and for accounting of water and its use; **6.** Procedure for maintaining the state water cadastre; **7.** List of especially important cluster of water supply systems that are un-replaceable sources of water; **8.** Rules for subsidizing costs of services for drinking water supply from the especially important cluster of water supply systems under national ownership; **9.** Rules for subsidizing costs of services for agricultural water users; **10.** Rules for identification of water-protection zones and buffer strips; **11.** Rules for developing and approving master-plans for water use and protection and water-economic balances for major rivers basins and the republic as a whole; **12.** Rules for renting and granting management of water facilities; **13.** Rules for approval, placement and putting into operation of factories and other structures that impact water situation, as well as of construction and other activities in water objects, water-protection zones and strips; **14.** Rules for regulation of water relations among the provinces in the republic; **15.** Rules for organization and state control for use and protection of the water fund; **16.** Rules for permitting the use of groundwater for household-drinking and industrial needs, with extraction limits ranging from fifty to two thousand cubic meters per day; **17.** Rules for licensing special water uses; **18.** Rules for development, approval and adoption of standard-technical and meteorological requirement for water control and accounting; **19.** Rules for development and approval of standards for maximum permissible harmful impact on water objects; **20.** List of objects related to improvement of health with national value; **21.** List of water objects used for navigation and taking off of aircraft; **22.** Rules for navigation of waterways; **23.** List of navigable waterways and rules of their operation; **24.** Rules for joint use of water objects given to local executive authorities; **25.** Rules for establishing shorelines in the Republic of Kazakhstan; **26.** Rules for use of water bodies as drinking water supply sources.

2.3.3 Analysis of Framework for Water and Natural Resources Management

Kazakhstan. Development of regulation and legal framework in the area of natural resources use is closely related to the establishment of new economic relations for the Republic of Kazakhstan. Accordingly with the Decree of the President of Kazakhstan "About measures to implement strategy for formation and development of Kazakhstan as a sovereign state" (July 15, 1992), water sector can be seen as playing a critical role in the development of the national agriculture. Kazakhstan developed a "National Program for Rational Nature Use and Conception of State Ecological Policy", including rational water use, in 1993.

Experts were of the opinion that the main disadvantage of those documents was an adherence to the outdated approaches for the use of natural resources; namely, the regulatory and legal framework did not express the need for improvements in water relations, including the economic and ecological processes. These opinions were taken into account, and a number of Presidential Decrees were issued in 1997 and 1998, to recognize the need for improving the environmental legislation as a priority. This was also reflected in National Development Strategy "Kazakhstan 2030". The laws passed later were more comprehensive and included methods for an effective use of natural resources (including water use).

Presently, the necessary regulation and legal framework oriented toward effective management and use of natural resources exists. The ***main legal documents regulating water, land, and environment*** in the Republic of Kazakhstan are:

- Constitution of the Republic of Kazakhstan (September 30, 1995)
- Water Code (July 9, 2003)
- Land Code (June 20, 2003)
- Ecological Expertise Law (March 18, 1997)
- Law on Protection of the Environment (July 15, 2001)
- Law on Agricultural Consumers' Cooperative for Water Users (April 4, 2003)

A number of other national laws, such as 'Underground resources and their use' (January 27, 1996) - as a Presidential Decree, 'On sanitary-epidemiological conditions of the population (February 4, 2004)', 'On special protection of natural areas' (July 15, 1997), 'On national security (June 26, 1994)', etc., also include provisions to regulate the use of natural resources. The legal norms for regulating the charges for use of water from surface sources are included in Tax Code (2001). Further, the National Security Law (1994) makes public agencies, organizations (independent of ownership), officials, and citizens responsible for an environmental protection and rational use and protection of natural resources. The Civil Code, Code on Administrative Violations, and the Criminal Code set out the civil and administrative liabilities and/or criminal acts for violating the use of water, land, and other natural resources.

Kazakhstan joined the Helsinki Convention (dated March 17, 1992) on Conservation and Use of Trans-boundary Watercourses and International Lakes on October 23, 2001.

It is evident that Kazakhstan has created a solid legal framework for implementing the IWRM at the national level, including the aspects of market economy. Further activities should be aimed at improvement of legislation in regard to some aspects of the IWRM implementation.

Turkmenistan. Turkmenistan has declared a policy of positive neutrality, as a basis for regulatory and legal framework. Long-term plans for agricultural development are set in the following National ***Programs of the President*** of Turkmenistan:

- "10 years of stability", "Grain", "New Village", "1000 days", "Clean water"
- "Strategy for socio-economic reform in Turkmenistan until 2010"

The main ***legal instruments to regulate water, land, and environmental relations*** in Turkmenistan are:

- Constitution of Turkmenistan (1992)
- Presidential Decree "On Right of Ownership and Use of Land in Turkmenistan" (1993)
- Code of Turkmenistan "On Water" (2004), effective on November 1, 2004
- Code of Turkmenistan "On Land" (2004), effective on November 1, 2004
- Law on Environmental Protection
- Dehkan Farm Law (1994)
- Law "On Dehkan Associations" (1995)

Since in Turkmenistan the Water Code from the Soviet period (1973) was valid until November 1, 2001, the water, land and environment legislation had been adapted to the new political and economic conditions via an enactment of relevant regulatory legal acts as amendments and supplements to the old Water Code. The legal aspects of use and protection of water and other natural resources are regulated by the respective Decrees of the President of Turkmenistan and the Cabinet of Ministers.

The ***bilateral water relations*** are regulated by an "Agreement between Turkmenistan and the Republic of Uzbekistan on cooperation in water-related issues" (Turkmenabat, January 15, 1996). Some principles and provisions of the Agreement are listed below:

- Joint use of trans-boundary water resources
- Refusal to adopt methods putting pressure when solving water-related issues
- Mutual responsibility and consideration of mutual interests

- Settlement of water-related problems via agreed-on means
- Lands placed by Turkmenistan under Uzbekistan's water works are the exclusive property of Turkmenistan
- Water bodies and organizations of the Karshi main canal (KMC), Amu-Bukhara pumping canal (ABPC), Tuyamuyun waterworks (TW) located in Turkmenistan are the property of Uzbekistan
- Lands for KMC, ABPC, TW and other interstate water bodies are placed at Uzbekistan's disposal as compensation
- Assurance of good operation of water bodies /objects located on their territories
- Allocation of water from the Amudarya River (Kerki station) in equal shares (50 to 50);
- Adoption of measures against water-logging of lands adjacent to Daryalyk and Ozerniy collectors crossing Turkmenistan
- From 1999 cessation of discharge of drainage water from both banks of the Amudarya

Current legislation, in particular, does not contain provisions that would set out water use procedures without considering radical changes of land law. It also poorly reflects the aspects of public involvement in water management and the economic aspects of use and protection of water and other natural resources.

In conclusion, it can be stated that the IWRM can be implemented in the pilot zone only with the support of the Ministry for Water Resources of Turkmenistan, as well as the support of public agencies of Dashoguz province and their corresponding decisions.

Uzbekistan. According to the Decree #3226 of the President of Uzbekistan dated March 03, 2003, titled "On Major Directions for Intensification of Agricultural Reforms" and the Enactment of the Cabinet of Ministers #320 of July 21, 2003, "On Improvement of Water Management", the administrative-territorial management of irrigation systems was shifted to basin-based management. New institutional structures - Basin Authorities for Irrigation Systems - were established at the Ministry of Agriculture and Water Resources.

The ***main legal acts regulating water, land, and environmental relations*** in the Republic of Uzbekistan are:

- Constitution of the Republic of Uzbekistan (1992), including Constitution of the Republic of Karakalpakstan
- Law on Water and Water Use (1993)
- Land Code (1998)
- Law on State Land Cadastre (1998)
- Law on Agricultural Cooperative (Shirkat) (1998)
- Law on Private Farms (1998)
- Law on Dehkan Farms (1998)
- Law on Nature Conservation (1992)
- Law on Ecological Expertise (2000)
- Decrees of the President of Uzbekistan:
  - On Major Directions for Intensification of Agricultural Reforms (2003)
  - Concepts of Dehkan Farm Development for 2004-2006 (2003)
- Enactments of the Cabinet of Ministers:
  - #174 - On approval of the declaration regarding water-protection zones of reservoirs and other water bodies, rivers, main canals and collectors, as well as sources of drinking and household water supply and sources of health and recreational importance in the Republic of Uzbekistan (April 7, 1992)

- #385 - On limited water use in the Republic of Uzbekistan (August 3, 1993)
- #320 - On management improvement in water sector (July 21, 1993)

Regarding the interstate water relations, Uzbekistan recognizes all documents that were adopted and agreed on earlier by the CAR States. Those documents were developed on the basis of the existing conditions in the region and underwent a thorough examination. One such document is a Protocol of Scientific and Engineering Council at the USSR Ministry of Land Reclamation and Water Resources (September 10, 1987). This Protocol, prepared with participation of all five republics of the former union, sets out the water withdrawal volumes for each republic (now being independent states). In particular, fundamental points of the earlier mentioned Agreement between Turkmenistan and Uzbekistan are based on the provisions of this Protocol.

The Governments of all CAR states confirmed in an Agreement of February 18, 1992, that the agreements regarding regional trans-boundary water management concluded at the time of the former union would remain in the force. One of those treaties affecting Uzbekistan is the 1998 Agreement accepted by Kazakhstan, Kyrgyzstan, and Uzbekistan, relating to the use of water-energy resources in the Syr-Darya River Basin. Tajikistan joined into the Agreement in 1999.

Given the current legislation of the Republic of Uzbekistan in the area of water, land, and environmental relations, the IWRM at the national level can be implemented. Nevertheless, improvements pertaining to the economic aspects of the use and protection of water resources can be made. The improvements would most likely affect the legal framework for WUAs activities, but mainly would relate to the removal of disparity between market and state prices for agricultural output produced by the Government order[6]. In addition, involvement of the public in water management at various hierarchical levels would also need to be secured.

2.4 ORGANIZATION OF WATER MANAGEMENT IN THE LOWLANDS OF SYR-DARYA AND AMU-DARYA

Current management structures in water sector are shown in Figures 2.4.1 for Kazakhstan, 2.4.2 for Turkmenistan (Turkmenistan water management is organized under administrative districts) and 2.4.3 for Uzbekistan. The organizations responsible for management of water resources in these countries are:

- Kazakhstan: Committee for Water Resources within the Ministry of Agriculture (CWRMA)
- Turkmenistan: Ministry of Water Resources (MWR)
- Uzbekistan: Central Administration of Water Resources at the Ministry of Agriculture and Water Resources (CAWR MAWR)

Kazakhstan. The CWRMA performs water management on the basis of basin principle. Eight basin water-management authorities (BWAs) were established prior to the independence. The main tasks of BWAs are to: (i) manage the use of water resources; (ii) set out water withdrawal limits and confirm water supply plans; (iii) issue permissions for special water use; (iv) organize the water accounting; and (v) control the status of hydro-structures and reservoirs.
In 1999, on the basis of provincial water committees, a total of 14 (fourteen) Republican State Enterprises (RSEs) -Vodkhozes - were established. Their governance conforms to the administrative/territorial principle. The RSEs operate large water bodies of national importance

[6] By the Government order the Government regulates volumes and types of outputs to be produced and determines their prices. In agriculture, basic crops under this order are cotton and wheat. Thus, purchase of raw cotton at fixed government prices is the government monopoly. These prices are much lower than those on the market. The Government takes on a responsibility to provide producers with credits for purchasing seeds, fertilizers, etc., but this is connected with certain problems.

(e.g., RSE for operating the Bartoga reservoir and Big Alma-Ata canal, RSE for operation of Irtysh-Karaganda canal). Additionally, they are responsible for operation of waterworks, head intake structures, reservoirs, pumping stations, and clustered water supply lines.

The District and inter-district Water Management System Administrations (WMSA) report to the provincial RSEs, which are financially self-supporting. Relationships between the district and inter-district WSAs and the private and cooperative water users are based on contracts. Water management hierarchy in the Republic, with the pilot zone *(in parentheses and italics: BWA, province RSE, WMSA)*, has the following structure:

1) National level:
   - Committee for Water Resources at the Ministry of Agriculture
2) Basin level:
   - BWA (*Aralo-Syrdarya BWA*)
3) Provincial level:
   - RSEs (*Province Utility Enterprise "Kyzylordavodkhoz"*)
4) Inter-district and district levels:
   - WMSA (*District Utility Enterprise "Kazalyvodkhoz"*);
5) Inter-farm level: Agricultural Consumer Cooperatives of Water Users (ACCWU); (*Kazalinsk waterworks: Right-bank main canal*)
6) On-farm level (secondary water users)

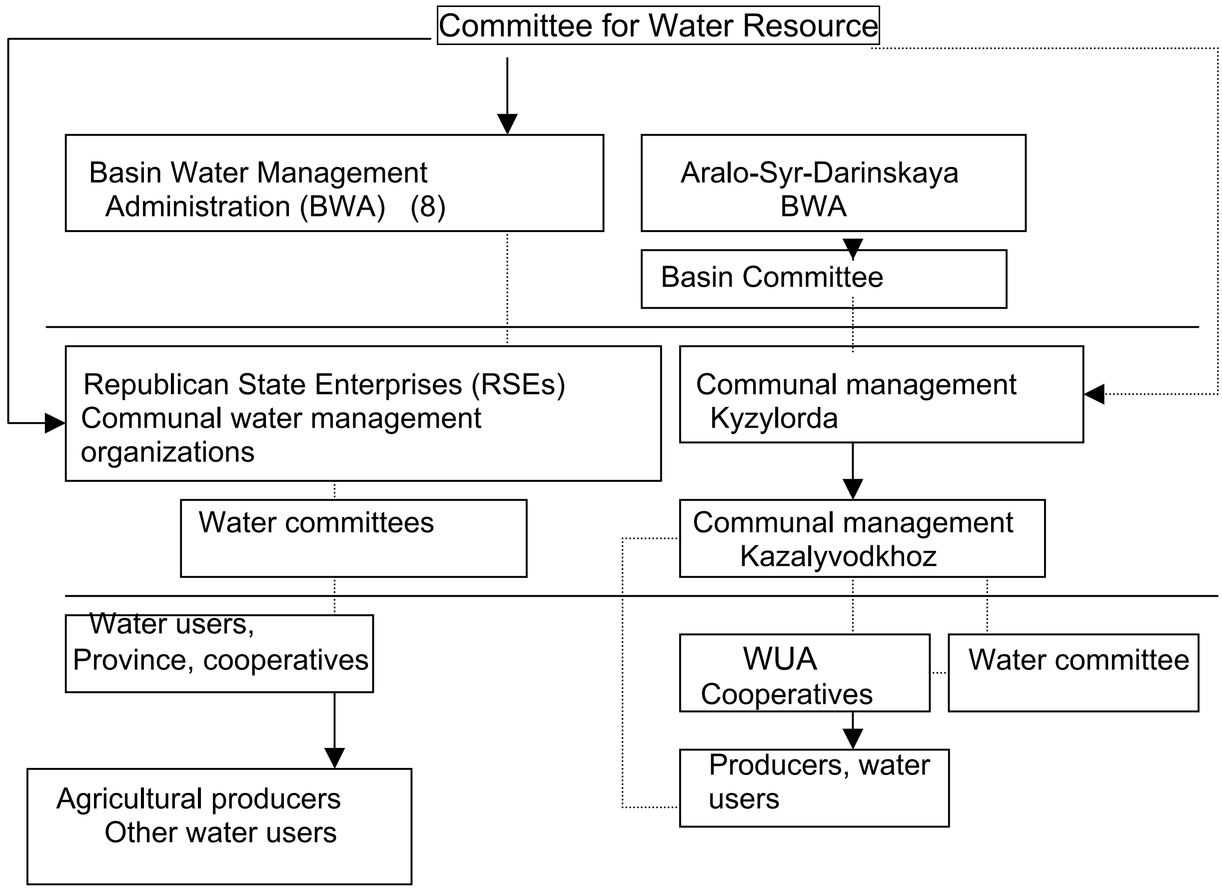

Fig. 2.4.1 Organization of water management in Kazakhstan, Kyzylorda province, Kazalinsk district

Turkmenistan. As a whole, the system of water resources management is based on the administrative/territorial principle. As mentioned above, the Republican Water Code does not reflect the IWRM principles. Also, there are no other regulatory legal documents that would contain provisions stating the need for basin-based water management. At the same time, some experience with water management on the basin principle exists, as follows:

- Until recently, the Tedjen Irrigation Systems Authority (TISA) had served three administrative districts.
- Currently, the main waterways of Turkmenistan, Karakumderya (Karakum canal) and Turkmendaerya (Dashoguz canal) are operated on the basis of basin principle.
- Association "Karakumderyasuvkhuzhalyk" manages water from Karakumderya, which serves 26 etraps (districts) in four velayats (provinces), such as Akhalsk, Balkan, Lebap, and Mary. Nine operational offices of the association "Karakumderyasuvkhuzhalyk" function along the Karakumderya, without having to subordinate to the local administration.

The central Water Agency is the Ministry of Water Resources, which controls the association "Karakumderyasuvkhuzhalyk" and provincial water management associations (WMAs) of the water entity "Suvkhozhalyk". The provincial WMAs include units for operation, repair and construction, and other services. Administratively, the provincial association controls the districts' (etraps') and inter-districts' (inter-entraps') water management offices (WMOs), whose authority extends to the districts' administrative boundaries. The provincial associations have within their structure divisions for operations, repair and building and emergency.

In such a way, WMA "Dashoguzsuvkhozhalyk" includes 8 district offices ("Suvkhozhalyk"), 2 inter-district offices (Turkmenderyasuvkhozhalyk and "Shakhsenemsuvkhozhalyk") that operate the inter-district water bodies "Turkmenderyasy" and canal Shakhsenem, as well as 3 service units. The WMOs distribute water at inter-farm level (between daykhan associations and farmer-water users). The district WMOs staff, Daykhan Associations (DA), and farmers themselves perform water management at the on-farm level. Water management entities such as WUAs or their unions do not exist.

The water management hierarchy in the Republic, including the pilot zone has the following structure *(the pilot areas are in parentheses and italics*: *provincial WMA, canal*, *inter-district and district WMO, daykhan association):*

1) National level: Ministry of Water Resources
2) Inter-provincial and provincial levels:
   - association "Karakumderyasuvkhuzhalyk";
   - provincial WMA: (*WMA "Dashoguzsuvkhozhalyk"*; *main canal Shavat*)
3) Inter-district and district levels:
   - Inter-district and district WMOs: (*Inter-etrap WMO Shakhsenemsuvkhozhalyk" and Yilanlyk etrap WMO*)
4) Inter-farm and on-farm levels*:
   - Daykhan Associations (*Cherkezov DA in Shikh-Sovma canal command zone, DA Ashgabat in Shavat-Yab canal zone, and Ersariyev DA in Ata-Yab canal zone*); daykhans (tenants), farmers

Note: * Water management institutions do not exist at these levels, therefore the DAs, farmers, and tenants conclude water supply contracts directly with the district WMO.

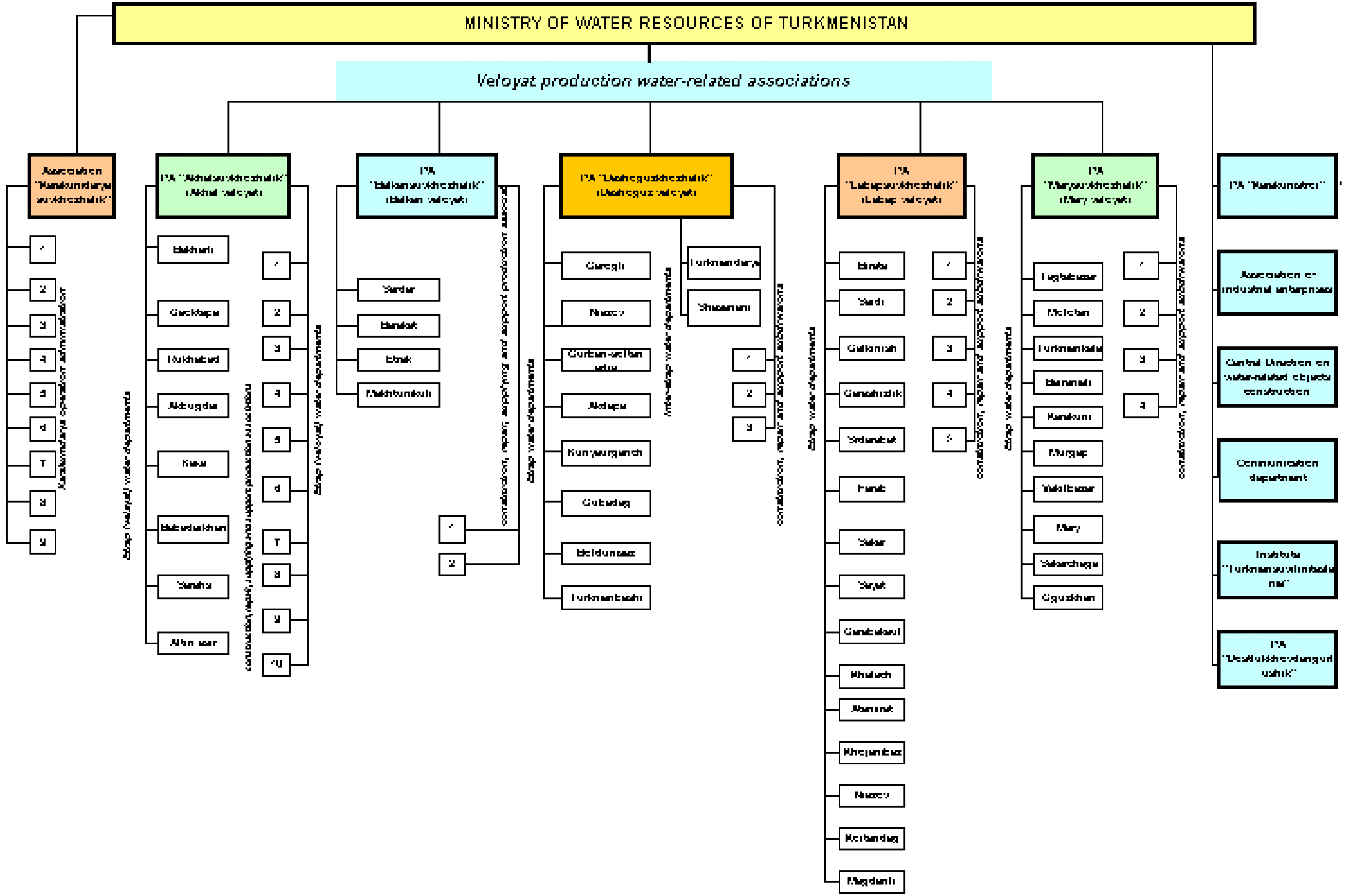

Fig. 2.4.2 Organization of water management in Turkmenistan

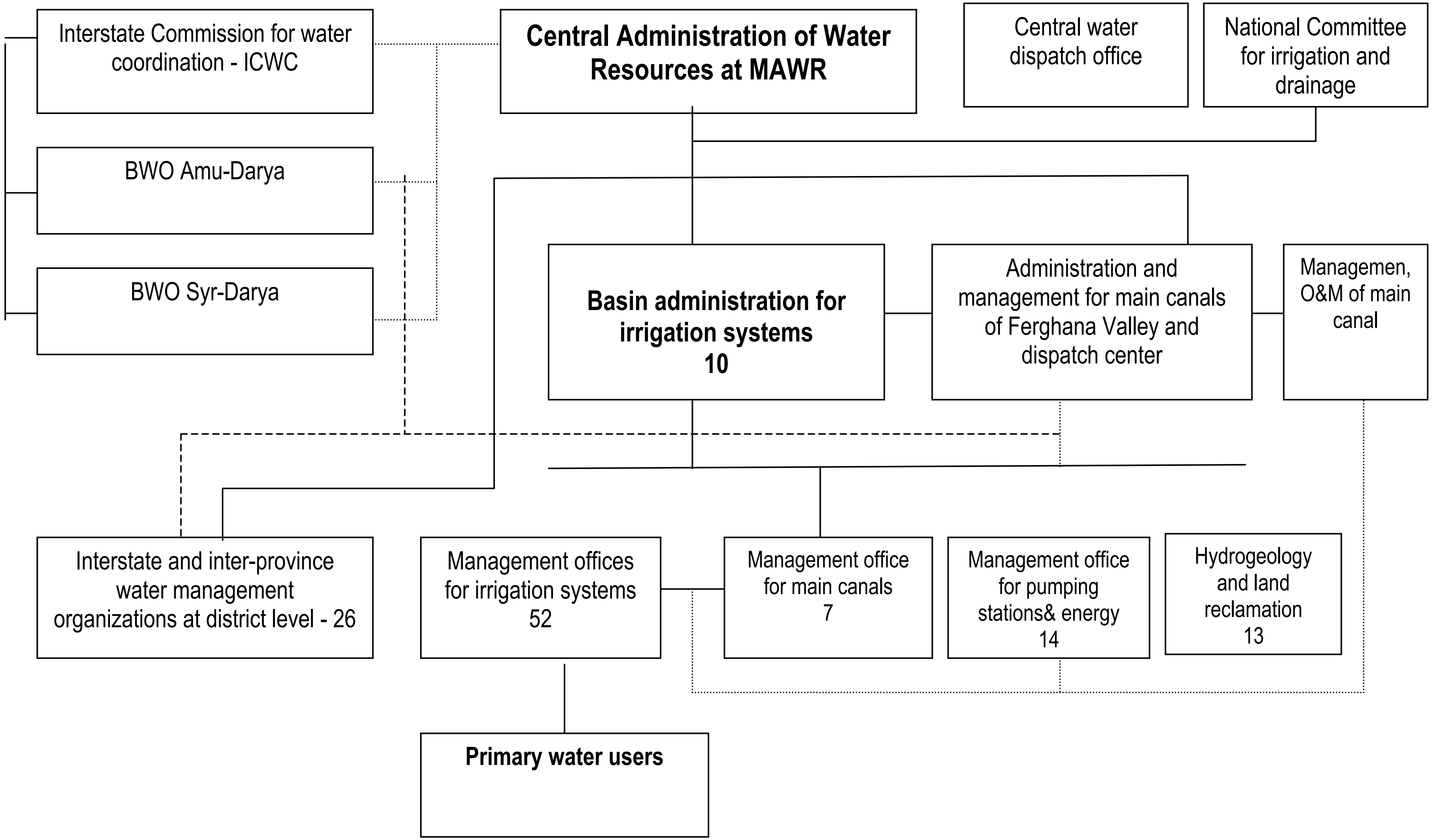

Fig. 2.4.3 Organization of water management in Uzbekistan

Uzbekistan. In 2003 the water resources management was transformed into the basin management. As a result, 10 Basin Administrations for Irrigation Systems (BAISs) and an Administration for the Main Canal Systems (AMCSs) in the Ferghana Valley were created and appropriately apportioned to the Syr-Darya and the Amu-Darya river basins, as follows:

Syr-Darya River Basin: 5 BAISs (Naryn-Karadarya, Naryn-Namangan, Syrdarya-Sokh, Lower-Syrdarya, Chirchik-Akhangaran) and the AMCS with a single control center for Fergana Valley counting 6 basin units

Amu-Darya River Basin: 5 BAISs (Amu-Surkhan, Amu-Kashkadarya, Amu-Bukhara, Lower-Amudarya, and Zarafshan)

The structure of the BAISs and AMCSs in the Ferghana Valley includes 3 management offices for main systems, 7 management offices for main canals and 52 management offices for irrigation systems. Within the structure of the BAISs are also 14 territorial administrations for pumping stations, power and communication and 13 hydrogeological and land reclamation companies. As a result of the reorganization, the governing branches were considerably reduced from the former 230 to a mere 73 organizations and service providers.

The **former** institutional structure for water management has included:

- **Karakalpakstan:** Ministry of agriculture and water resources of the Republic of Karakalpakstan, 15 district authorities for agriculture and water resources, 5 canal administrations (Pakhta-Arna, Suenli, Kyzketken, Bozatou, Tallyk) and Priaralie delta authority
- **Khorezm**: Khorezm provincial authority for agriculture and water resources, 11 district authorities for agriculture and water resources, Kyzyldjar Administration, Tuprakkala Agricultural Company, Administration for inter-district canals

After the change to hydro-boundary water management, a single management organization for Karakalpakstan and Khorezm called ***Lower-Amu-Darya BAIS*** was created. This BAIS consists of 10 offices for management of the irrigation systems (Pakhtaarna-Nayman, Kuvanyshzharma, Kyzketken-Kegaili, Kattagar-Nozatou, Tashsaka, Palvan-Gazavat; Karamazy-Klychbay, Shavat-Kulavat, Mangyt-Nazarkhan, Suenli) and Priaralie delta authority.

Water management hierarchy in the Republic, including the pilot zone, has the following structure *(the pilot objects are in parentheses and italics- BAIS, OIS, WUA, PF*):

1) National level:
    - Central Administration of Water Resources at MAWR
2) Basin level:
    - Basin Administrations for Irrigation Systems: (*Lower-Amudarya BAIS*)
    - Administration for Main Canal Systems in Fergana Valley
3) Provincial* level:
    - (*Ministry of AWR of the Republic of Karakalpakstan*)
    - (*Khorezm provincial authority for agriculture and water resources*)
    - Offices for Irrigation Systems (OIS): (the Republic of Karakalpakstan: *OIS Kuvanyshzharma*; Khorezm province: *OIS Palvan-Gazavat*)
    - Offices for Main Canals
    - Administrations for Pumping Stations, Power and Communication
    - Hydrogeological and Land Reclamation companies

4) District* level:
    - (*Karakalpakstan: 15 district Authorities for agriculture and water resources*)
    - (*Khorezm province: 11 district Authorities for agriculture and water resources*)
5) Inter-farm level:
    - Water User Associations (WUA), shirkats, private farm unions (Karakalpakstan: *WUA Beldar*; Khorezm province: *WUA Mirab*)
6) On-farm level:
    - Tenants, private farms (PF): (Karakalpakstan: *PF Elista; PF Tabyn Reyim; PF Artykbay Yesbosynov*; Khorezm province: *PF Matyakubov; PF Oybek; PF Masharip ata*)

Note: * Under the current organizational structure of management, the provincial and district organizations do not have a practical role, and water users must conclude contracts for water supply directly with management OIS.

2.4.1 Inter-state water resources management – existing organizations

In the context of transitioning to IWRM in the region as a whole, the water management system consists of five organizational levels:

- **Inter-state:** the Interstate Commission for Water Coordination (ICWC) of Central Asia
- **Regional basin:** 2 Basin Water Organizations (BWOs):
  BWO Amu-Darya, BWO Syr-Darya
- **National:** Central Water Agencies in CAR states:
    - CWRMA (the Republic of *Kazakhstan*)
    - Department for Water Resources at the Ministry of Agriculture, Water Resources and Processing (the *Kyrgyz Republic*)
    - Ministry of Land Reclamation and Water Resource (the Republic of *Tajikistan*)
    - Ministry of Water Resources (*Turkmenistan*)
    - CAWR MAWR (*the Republic of Uzbekistan*)
- **National basins:** Basin water management authorities (BWAs)
  Basin Administrations for Irrigation Systems (BAISs)
- **Local:** at present, conditionally:
  Provincial and district water management organizations; associations, unions, and cooperatives of water users; and water users themselves

The above-mentioned institutions (ICWC, BWOs, etc.) are appropriately empowered to manage water resources within their jurisdiction (region, river basin, irrigation system, territorial-administrative unit).

Many other entities or agencies are involved in the water management in the CAR states at different levels, as follows:

- Inter-state (regional) - Central Asian Cooperative (CAC) organization, the Interstate Fund for the Aral Sea (IFAS)
- Intra-state - national Parliaments, Governments, local public authorities, agencies of local government
- Ministries and agencies (National Agencies for natural resources or nature conservation, emergency, geology, hydrogeology, economic sectors) directly or indirectly concerned with water resources.

At the national level, vertical hierarchy of water management involves legislative, executive and other public entities at different (national, provincial, etc.) levels.

At the higher level of the regional water management structure are the CAC (members are the CAR States except Turkmenistan) and the IFAS (all five CAR States are members). Both organizations include trans-boundary water management of CAR as one of the aspects of the regional political governance on the basis of general internationally accepted norms and mutually beneficial cooperation.

2.4.2 Interstate water resource management: pilot zone proposals for future work

2.4.2.1 Amu-Darya lowlands and delta

Dashoguz province, Turkmenistan. The province takes water from the Amu-Darya through six canals - Shavat, Gazavat, Klychbai, Kipchak-Bozsuv, Dzhumabai-Saka, and Khan-Yab, with their head-intake structures located in the Republic of Uzbekistan. All canals except Khan-Yab canal are inter-state. Water to Dashoguz province is supplied via Khorezm and Karakalpakstan. The ***canal Shavat (pilot canal),*** being one of the oldest irrigation systems in the Khorezm oasis, starts at the 34^{th} km of the Tash-Saka canal. The length of the Shavat, including the tail inter-farm section is 165 km, of which 87 km is contained within the Dashoguz province.

Collectors Ozerniy (with Doudan branch) and Daryalyk (with Shavat-Andreyev, Chagat-Atabent, and Mangit branches) are also trans-boundary, serving to drain the irrigated lands in Khorezm and Dashoguz provinces and the left-bank area of the Republic of Karakalpakstan. The total length of the inter-state collectors is 668 km (Ozerniy – 219 km, Doudan– 51 km, Daryalyk - 292 km, Shavat-Andreyev – 31 km, Chagat-Atabent – 52 km, and Mangit – 23 km). These collectors are the main drainage routes for the lower left bank of the Amu-Darya. Annually, they were transporting to the Sarykamysh Lake an average of 4.042 km^3 of drainage flow, 75 % (3.042 km^3) of which originated in Uzbekistan and 25% (1000 km^3) in Dashoguz province of Turkmenistan. The Sarykamysh Lake, located about 300 km from Dashoguz city, is accumulating water since 1953; its surface area is about 2500 km^2 and average depth 12 m.

The main problems in managing collectors of trans-boundary character are connected with the transit of excessive flows (above norms) during leaching and pre-planting irrigation (winter-spring). This leads to intensive erosion and distortion of the collectors' bed, destruction of water infrastructure, water-logging of drainage systems, and deterioration of irrigated lands and pastures in Dashoguz province.

Despite the available inter-state, inter-governmental, and inter-agencies agreements and inter-ministerial arrangements, problems related to the reconstruction of the inter-state collectors, accordingly with the shares - 65% the Republic of Uzbekistan and 35% Turkmenistan - have not been resolved. Further deterioration of the collectors, causing considerable damages to water structures and facilities in both countries, has greatly aggravated the status of the irrigated lands and pastures in Dashoguz province. It would seem prudent that the operation of the inter-state collectors, as part of trans-boundary irrigation and drainage system (inclusive of the receiving water bodies such as the Sarykamysh lake), fall under the responsibility of BWO Amudarya.

At present, there are no acute problems in the water allocation between Turkmenistan and Uzbekistan. Nevertheless, a portion of water intakes from the inter-state canals (such as Dashoguz and Gazavat canals) in Dashoguz province finds itself out of the control by the BWO Amudarya. Consolidation of management of the trans-boundary watercourses and water disposal tracts within Turkmen and Uzbek Priaralie by the BWO Amu-Darya would become one of the prerequisites for implementing the IWRM at the regional level in this zone. This would partially answer to the critics of the BWO Amu-Darya arguing that as a regional water management agency, it is unable to control the situation in its subordinated area.

The IWRM can also be perceived as a system-based water management. In Turkmenistan, there was a positive experience in water management on the basis of system-management accumulated before 1960, when the water sector was reorganized on the basis of the administrative-territorial principle. In this context, the transition to IWRM as 'system water management' in Turkmenistan may be justified, and an appropriate support of decision-makers may be attained.

It is proposed to examine the establishment of Basin Administrations for Water Management System (BAWMS) within the framework of canal systems in the Dashoguz province:

- Gazavat BAWMS (Gorogly etrap)
- Shavat BAWMS (Niyazov, Yilanly, and Akdepa etraps)
- Klychbai-Dzhumabai-Sakinsoy BAWMS (Gubadak and Boldumsaz etraps)
- Khanyab BAWMS (Koneurgench and Saparmurad Turkmenbashi etraps)
- Turkmendarya BAWMS (outlying lands of etraps in Shakhsenem scheme)
- Administration for Inter-state Collectors (AIC) at BWO Amu-Darya

It would seem logical, that at the initial stage, BAWMSs would be responsible for: (i) modernization and maintenance of water infrastructure; (ii) water intake and transportation to the boundaries of daykhan associations (future WUAs); and (iii) technical support for daykhan associations in field of irrigation and drainage system management.
Keeping in mind the former experience with 'the system water management' and optimistic thinking, the shift to the IWRM in Turkmenistan could be feasible, since it would present an opportunity to resolve water related problems. Nevertheless, to implement the IWRM would require a lot of focused preliminary work. Given the absence of special government programs or any other existing regulatory measures or documents for the IWRM, it would be advisable to take the ***following steps:***

1) Develop a draft of respective resolutions for top policy makers and get political support for reform of the water sector
2) Ensure that decision-makers and the public understand the meaning of IWRM
3) Reach a basic agreement with the official high-level to undertake a set of measures toward implementing the IWRM via water professionals
4) Successively promote the advantages of IWRM with public authorities, local governments, leaders of daykhan associations, daykhans and tenants
5) Develop proposals for amendments and supplements to current legislation regulating land, water and other related matters
6) Develop national water policies leading to the improvement of institutional structures of water management and the transition to IWRM
7) Develop programs for capacity building and training
8) Improve financing of reforms in water sector
9) Take other necessary steps that create conditions for implementing the IWRM

The selected pilot zone, including main canal Shavat, Cherkezov DA at the head, DA Ashgabat midstream, and Ersariyev DA at the tail of the irrigation system, has a relatively satisfactory irrigation infrastructure as compared to other zones in the province. At the same time, it would be difficult to implement the IWRM without considerable capital investments from the Ministry of Water Resources of Turkmenistan. As mentioned earlier, Turkmenistan and the Dashoguz province in particular have good experience in irrigation management, both in the system management and basin-style management (Karakumdarya, Turkmenderya). This experience could be used when implementing the IWRM in the Dashoguz province.

For a successful implementation of the IWRM in the pilot areas, ***a series of workshops*** should be held to: (i) disseminate positive experience in system water management; (ii) raise awareness and knowledge of those people who would be involved in implementing the IWRM in the pilot objects (training, information exchange, data base); and (iii) raise stakeholder awareness of the ultimate aims of the project. Taking into account the lack of information regarding the IWRM principles and the mind-set of the audience, initially, the emphasis would need to be placed on the national experience in basin and system water management, and supplemented by an experience of shifting to the basin approach in Uzbekistan, Kazakhstan, and IWRM-Fergana Project. Training should be started from the core of professionals in water management. This would include water managers and water professionals from institutions at the province and district levels, inter-district administrations for large canals, and operational sections of interstate collectors.

The next training workshop should be held in the command zone of main canal Shavat (pilot canal) with the participation of the top echelon and water professionals from the district water management institutions (Niyazon, Yilanly and Akdepa etraps) and the mirabs of Daykhan Associations in the etraps. A conclusive workshop after the series of workshops will be conducted directly in the pilot DAs with participation of water professionals from the district water management entity, mirabs of daykhan associations, daykhans, tenants and other stakeholders. *The Regional Working Group experts should play an active role in those workshops.*

The IWRM is oriented towards low-cost technologies, thus organization of the workshops should follow this principle as well. The workshops at all three levels of water management should be organized in series, thus one after another. The focus should be placed on the lowest organizational level, such as WUAs and water users. The themes of the workshops must contribute to project objectives. They should contain aspects to clarify the understanding of basic IWRM principles, aims and objectives of the IWRM, and examine the possible implementation of the IWRM in the pilot zone, pointing out the IWRM advantages against the current state of affairs, and further extension of IWRM to a scale of province, republic.

Province of Khorezm and the Republic of Karakalpakstan, Uzbekistan. Water management institutions that follow the basin approach seem to function at different hierarchical levels. Therefore, the focus should be made on improvement of their activities, concerning primarily the development of WUAs. Taking into account the characteristics of the pilot zone and current water management conditions, ***a series of training workshops*** should be planned and focused on the following:

1) Exchange of practical experience in implementing the IWRM in pilot objects
2) Discussion of key shortcomings of implementation
3) Identification of obstacles to implementation
4) Aspects of water conservation and better crop yields for irrigated hectare
5) Approaches to solution of regional ecological problems
6) Public involvement in water management
7) Economic aspects of irrigation system operation
8) Experience in conflict resolution between water users and water managers
9) Legal framework for activities and steps needed to take in case officials violate the rights of those who participate in the given process
10) Other issues relevant to pilot implementation of IWRM

Since there are common factors for the three zones (Dashoguz, Karakalpakstan, Khorezm), it would be convenient to hold at least two joint workshops annually, with participation of stakeholders from Turkmenistan and Uzbekistan. The similarities are in: (i) relatively similar natural (climatic, soil) and other conditions; (ii) direct relation of pilot objects to Priaralie; (iii) critical environmental, socio-economic and other conditions; and (iv) trans-boundary problems of water management in the Amu-Darya.

2.4.2.2 The Syr-Darya lowlands and delta

Kyzylorda province (Kazakhstan). The ***key differences between the pilot zones*** *in Kazakhstan* (Kyzyl-Orda province, Kazalinsk district) *and Turkmenistan* (Dashoguz province) and *Uzbekistan* (the Republic of Karakalpakstan and Khorezm oblast) are stated below. In Kazakhstan:

- *no interstate water management problems*

At the same time, the Kyzyl-Orda province as a whole and the Kazalinsk district in particular, largely depend on water management in the upstream and midstream countries (Kyrgyzstan, Tajikistan, Uzbekistan). Under mutual coordination of the operation of Toktogul reservoir in Kyrgyzstan and Kairakkum reservoir in Tajikistan and relevant water facilities in Uzbekistan (e.g., Arnasai, Charvak) most social, economic and environmental damages caused by the annual autumn/winter floods would be eliminated or diminished. As such, the costs of flood protection measures in the Syr-Darya downstream would be minimized.

- *stricter requirements for minimum environmental releases to the Syr-Darya Delta and the Northern Aral Sea (NAS) downstream the Kazaklinsk waterworks*

Due to the existing political support of the Kazakh Committee for Water Resources (CWR) and clear national water policy, the minimal volume below the Kazalinsk waterworks to provide for ecological needs of the Syr-Darya delta and NAS has been determined. The possibility of keeping the delta and NAS viable is embodied in this paradigm. Another situation is observed in the Amu-Darya lowlands. The Amu-Darya delta (Turkmen and Uzbek Priaralie) and Large Aral Sea (LAS) generally receive their water limits during high water levels in the Amu-Darya; however, this may also happen as a consequence of inadequate volumes accumulated upstream.

- *available strong political support and comparatively solid legal framework for shift to IWRM (water, land and other laws)*

In particular, Kazakhstan implements a project “National IWRM Plan for Kazakhstan” under the support of the Government of Norway and the Global Water Partnership

- *developed market relations (as oppose to Turkmenistan and Uzbekistan)*

This is enhanced by the fact that there is no disparity between market and state prices for agricultural production of basic crops in Kazakhstan, as opposed to Turkmenistan and Uzbekistan. A developed agricultural service market, to a large degree, enables implementation of the IWRM in Kazakhstan; however, it will need greater efforts by the initiators of the implementation of the IWRM, than in the pilot zones in Turkmenistan and Uzbekistan. In this context, the need for IWRM needs to be justified and convincingly stated so that both the public authorities and the agricultural producers in the pilot zone will embrace it.

- *no cotton grown*

Cotton is one of the profitable agricultural crops. Crop production in the pilot zone is focused mainly on noncompetitive rice varieties.

- *greater depreciation of water infrastructure and unfavorable state of irrigated lands, as well as low factor of agricultural land use (a lot of abandoned lands)*

The IWRM can be implemented in the pilot zone with appropriate support and financing by CWR and Akimat (local government) of Kyzylorda province. It would be advisable to hold workshops in the pilot zone accordingly with the schematic for Turkmenistan and Uzbekistan. Themes of the workshops would depend on particular characteristics of the pilot zone.

Joint workshop for all countries (Kazakhstan, Turkmenistan, Uzbekistan) is to be held to summarize *annual progress*, with participation of project executors in Tashkent.

2.4.3 Basin Water Institutions: BWO Amu-Darya and BWO SyrDarya

2.4.3.1 History of development

The trans-boundary character of the major Central Asian rivers defined the need for regulation of water relations in the region. In 1927, an Administration of the Amu-Darya Delta Irrigation Systems (AADIS) was created and located in Novo-Urgench (Khorezm). The AADIS dealt with construction and reconstruction of irrigation/drainage systems and allocation of trans-boundary water resources among the republics. In 1940, the AADIS constructed one of the largest water intake structures in the Amu-Darya downstream – Tash-Saka, with a flow capacity of 202 m^3/s. Independent water intakes “Shavat”, “Palvan”, “Gazavat”, “Yarmysh”, and other canals were connected with it and formed Tash-Saka system.

After the provincial water management organizations of Khorezm and Tashauz had separated from the AADIS structure, it was renamed as Administration of the Amu-Darya Irrigation Canals (AADIC). Within its system of 350 km of inter-state canals, 60 hydraulic engineering structures and 110 gauging stations were operated. As a regional water management body, the AADIC was historically a predecessor of the future Basin Administration (BWO Amu-Darya).

The Amu-Darya water shortages downstream were already recognized by the Soviet Government. In 1987, a letter from the Minister of reclamation and water resources of USSR underscored the status of water resources of the Amu-Darya as practically exhausted. Even in the normal years the water management situation within the basin was critical. It was also noted that the situation with water supply in Central Asia Republics was exacerbated by a lack of unified water management body. To remedy this, in 1987 the Ministry of Reclamation and Water Resources intended to create a Basin Administration for the inter-republican distribution of Amu-Darya water resources and make it responsible for the main water intake structures.

Following a set of resolutions, Basin Administrations (BWOs) for the Syr-Darya and the Amu-Darya were established in Tashkent and Urgench, respectively, and were charged with the water allocation between the republics and operation of the associated hydraulic structures. Those resolutions were: (i) October (1985) Plenum of CC CPSU; (ii) CC CPSU and CM USSR of 23.10.1984, #182 “About long-term program of reclamation, improving reclaimed land use efficiency to reach sustainable growth of food fund of the country” and of 17.03.1986 #340 “About measures on accelerating ecological and social development of Karakalpak ASSR”; and

(iii) Protocol instruction of CC CPSU Secretary Nikonov V.P. of 17.03.1987, within MRWR USSR framework.

Both BWOs included territorial departments/divisions for regulating the use of water resources, operating water diversion structures and waterworks. The Syr-Darya BWO included Gulistan, Uchkurgan, Chardara, Chirchik and the Amu-Darya BWO Charjou, Kurgan-tyube, Urgench, and Nukus, respectively. As such, the BWOs established in 1987 were predecessors of the BWOs as they exist today.

2.4.3.2 Current flow distribution

Current surface flow distribution amongst the Aral Sea Basin States, related specifically to the water sharing from the Amu-Darya between Turkmenistan and Uzbekistan, was adopted by a protocol decision of MWR USSR (approved by a minister of MRWR USSR N.F.Vasilyev on December 3,1987). This pertained to the historical and existing water use, actively irrigated lands and planned specific water consumption, while taking into account the total use of water in the Amu-Darya (average long-term data). The total water use by the States within the Amu-Darya basin[7] represents annually 61 km^3, not counting Afghanistan, and is divided as follows:

Kyrgyzstan: 0.4 km^3/year (0.6%)
Tajikistan: 9.5 km^3/year (15.4%)
Turkmenistan: 22.0 km^3/year (35.8%)
Uzbekistan: 29.6 km^3/year (48.2%)

Below the Kerky gauging station the annual water use is 44 km^3, of which 50% (or 22.0 km$^{3)}$ is shared equally between Turkmenistan and Uzbekistan. When the water availability is lower, water withdrawals are reduced proportionally. If in the Amu-Darya water availability is higher than estimated, water excess is accumulated in reservoirs, and only under very high water a share of water may be released downstream to improve the sanitary-epidemiological situation in Turkmen and Uzbek Priaralie.

Similarly, the total of 21.4 km^3 water resources available annually in the Syr-Darya basin are divided accordingly with the ICWC withdrawal limits[8] amongst the countries as:

Kyrgyzstan: 0.2 km^3/year (0.9%)
Tajikistan: 2.0 km^3/year (9.3%)
Kazakhstan: 8.2 km^3/year (38.3%)
Uzbekistan: 11.0 km^3/year (51.5%)

2.4.3.3 Status of BWO Amu-Darya and BWO Syr-Darya

The Interstate Agreement[9] describes the BWO "Amu-Darya" and BWO "Syr-Darya" as executive and inter-jurisdictional control bodies of the ICWC. According to Article 9 of this Agreement, the BWOs are funded from budgets (via deductions) of national water organizations on a principle of parity shares. By-laws of the BWO Amu-Darya and Syr-Darya were approved by the ICWC on

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[7] Altiyev T.A. "Basic functions of regional water organizations. Linkage of national interests with basin constraints. Role of international organizations and country-donors in developing regional cooperation" - SIC ICWC Training Center, 2001 -p.3.

[8] Dukhovny V.A. Transboundary water resources and approaches from view of legal water right. – SIC ICWC Training Center, 2001 –p.21.

[9] Agreement between Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan "Cooperation in joint management and protection of water resources from trans-boundary sources" (art.9), Alma-Ata, 18. Febr. 1992

April 6, 1992 in Ashgabat. Accordingly, they should supply water in the amounts/limits established by the ICWC (pp 1.3) and operate and regulate water resources (pp 3.1) with the goal of providing water for the respective States. The organizational structure of the BWOs was established in 1992 according to the by-laws (pp 4.1), as follows:

BWO Amu-Darya:

Administration of Inter-republican Amu-Darya Irrigation Canals (AADIS) in Urgench
Kurgantyube Waterworks Administration in Kurgan-Tyube
Charjou Waterworks Administration in Charjou (presently Turkmenabat)
Nukus Waterworks Administration in Takhiatash and
other independent enterprises working fully on a self-financed basis

BWO Syr-Darya:

Golodnostep Administration of Waterworks and Canal named by Kirov in Gulistan
Uchkurgan Waterworks Administration in Andizhan
Verkhnechirchik Waterworks Administration in Chirchik
Charvak Reservoir Administration in Charvak
Toktogul Reservoir Administration in Tashkumyr and self-financing enterprises:

- Gulistan Mobile Mechanical Division, Gulistan self-supporting transport enterprises, auxiliary facilities (all in Gulistan)
- Self-supporting repair-construction section (Uchkurgan)

2.5 PROBLEMS AND SHORTCOMINGS OF WATER MANAGEMENT IN CENTRAL ASIA

2.5.1 Interstate level

During the last thirteen years the Heads of CA States were paying attention to water and environmental problems in the Aral Sea Basin. They were meeting often to discuss various issues (Almaty -1992, Kyzylorda -1993, Nukus -1995, Bishkek -1996, Ashgabad – 1999, etc.).
In addition, many high-level bilateral and multilateral meetings took place addressing the joint water management issues, especially within the context of the CAC organization (Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan).

Relevant to the above mentioned Agreement about cooperation in the area of joint management, use and protection of water resources amongst the Central Asian States, the establishment of the ICWC and the BWO Syr-Darya (Ashgabat, April 6, 1992), and BWO Amudarya (Ashgabat, April 6, 1992), as well as the SIC ICWC (Bishkek, December 5, 1993) was an important step towards keeping the status quo in the regional water management. The ICWC and its executive bodies exerted great efforts to improve relationships regarding the trans-boundary water management in the Amu-Darya and the Syr-Darya basins. Eventually, a practical approach of the ICWC yielded relatively safe and stable arrangements for managing the trans-boundary situation on the Amu-Darya and the Syr-Darya, despite some predictions of possible wars in CA.

According to the above-mentioned Agreement, water allocation between the states is based on Master Plans for Water Use and Protection of Water Resources (MP WUPWR) developed during the 1980's for the Amu-Darya and Syr-Darya basins. The ICWC became responsible for the general governance of the regional water-management system. At the same time, a number of factors prevented the ICWC and its executive bodies from fulfilling their mission and the mandate to solve problems related to trans-boundary water management. The analysis shows that the main ***destabilizing factors*** regarding water related development in the CAR are:

- *water allocation principles reflected in the MP WUPWRs*

The Master Plans were approved, including the established water withdrawal limits and the earlier adopted documents on regional water management, as confirmed by the CAR states in the Alma-Ata Agreement of 1992. Disagreements amongst the states regarding water allocation may become the key problem in the region. In this regard, the upstream states (Tajikistan and Kyrgyzstan) consider the established water allocation limits as unfair.

- *neglect of the needs of ecosystem in the MP WUPWRs*

This, in particular, is one of the main causes of the ecological disaster in Priaralie and the Aral Sea. Additional water volumes are needed for restoring and preserving the ecosystems in lowlands/downstream areas of the Amu-Darya and the Syr-Darya. The volumes, for different water years, should be determined and agreed upon by the States. In fact, the downstream ecosystems receive their water shares only in high water years using the residual principle or in case of force majeure (high floods, insufficient capacities of reservoir upstream).

- *absence of agreed-on quotas and quality standards for water releases to deltas of the Amu-Darya and the Syr-darya and to the Aral Sea*

This is very topical since the entire amount of available water resources in the region is allocated.

- *operating schedule of large reservoirs within the Amu-Darya and Syr-Darya basins*

In the Syr-Darya basin the Toktogul waterworks were designed as a multi-purpose reservoir to meet both irrigation and power needs. In the last few years, the Toktogul has been primarily operated in the power-generation mode, causing environmental and other problems for the downstream countries. Data show that the damage from water-logging and the associated costs with flood protection in Kazakhstan was about US$ 40 million in 2004.

In the Syr-Darya basin, the Kairakkum reservoir, as a seasonal flow regulator, can regulate more than 80% (about 5 km^3) of water needed in summer for Uzbekistan and Kazakhstan. However, the expenses for the operation of the Kairakkum are upheld mainly by Tajikistan. Importantly, during the autumn-winter period the operational regime of the Kairakkum and Toktogul need to be coordinated for the safety of the lowlands.

Similarly, Nurek waterworks represent a seasonal flow regulator. Before independence, the electricity generated at Nurek HEPS in summer was supplied to users in other Central Asian states, while in winter Tadjikistan received the necessary fuel and energy from those states. At present, electricity generated by Nurek in summer does not have a market.

- *construction of water infrastructure having a trans-boundary impact without agreement of riparian countries*

Construction of the Arnasai complex of water management structures in Uzbekistan was not agreed upon by Kazakhstan and as such, it reduced the opportunity for trouble-shooting releases from the Chardara reservoir. This complicates the water management of the Syr-Darya in winter. If appropriate consultation had been held, it would have been possible to find a mutually acceptable solution.

- *plans and intentions for a long-term hydropower development in the upstream states (the Republic of Tajikistan and the Kyrgyz Republic)*

Definitely, it should not be self-sufficiency of the economies in the CA States that would allow them, on account of the calculated economic growth, to construct new hydropower facilities or complete work already started, like: Rogun and Sangtuda HEPS in Tajikistan and cascade of Naryn HEPS in Kyrgyzstan. This indicates a lack of regional inter-sectoral relations.

- *uncertainties related to global warming*

In the past decades, processes, taking place in the flow-formulating zone (Tajikistan, Kyrgyzstan), have caused a decrease in the areas of glaciers and snow. This may lead to a reduction of their regulating capacities and could have a considerable impact on the annual distribution and amount of river flow. These issues are still beyond consideration of the regional water management institutions.

- *lack of conflict resolution mechanism*

Resolution mechanism concerning water use and water allocation and compensation for certain damages caused by breach of the Allocation Agreements and inadequate economic mechanism for the inter-state water allocation does not exist. This is one of the weaknesses of water management, causing unreliable water supply in terms of quantity and quality at the inter-state level.

- *weak organization in the exchange of information*

The exchange of information between the CA States, primarily the hydro-meteorological information, is weak in regard to reliability, especially in water availability forecasting. This indicates poor cooperation among the agencies and services on which the management of trans-boundary water resources depends.

Besides the above, the following impacts negatively water management in the CAR:

- *absence of joint approaches, directions and programs* for regional economic integration, weak regional cooperation (division of labor)
- *indecisiveness in questions of assessing consequences and minimizing damages,* caused by transformation of natural hydrological regime in the large rivers
- *poor organization of disseminating latest experiences* in Central Asian countries on trans-boundary water management
- *low public awareness and involvement of civil institutions* at all water-management hierarchical levels, including decision-making processes
- *relatively low capacities of regional water agencies,* concerning monitoring and control of water quantity and quality within their jurisdiction
- *in a number of cases – attempts to solve national problems to the detriment of other countries (such called "hydro-egoism", etc.)* affect negatively the effectiveness of interstate trans-boundary relations

The main objective of the regional water management institutions (ICWC, BWO Syrdarya, BWO Amudarya) is to ensure sustainable economic development, rational water use and protection, and mutually beneficial cooperation among the CAR States on the basis of international law and agreements in water and environmental area. Current inter-state and national institutions for water and allied sectors as well as major water users must closely cooperate in order to successfully implement the IWRM. Relevant activities should be aimed at a wide range of specific (as listed above) and general aspects, including:

- ensuring rights to execute mandate of the ICWC executive bodies (BWO Amu-Darya, BWO Syr-Darya, etc.) in regional water management
- establishing new institutions to improve controllability of water resources (for example, International Water-Power Consortium of Central Asian states could be one of such institutions for ensuring irrigation and power interests)
- special problems with assuring support of the IWRM process at the regional level
- complex (water and allied sectors) problems in case of competition between economic sectors, as well as ecosystems
- wider involvement of the public, key stakeholders and decision-makers in long-term water management planning
- organization of the water education system
- development of common regional technical approaches to implement the IWRM
- critical understanding and improvement of regional water management methods
- development and introduction of economic and other incentives for water conservation
- provision of information for successful IWRM implementation
- information dissemination to the public about IWRM advantages via mass media and other means to help formulate a public opinion, conducive toward implementation of IWRM at the regional level, etc.

When implementing the IWRM, it may be difficult to avoid conflicts of interest. For a successful transition to the IWRM it is important to identify aspects of the conflict that would: (i) clarify specific and general IWRM objectives; (ii) identify key obstacles on the way to fulfill these objectives; (iii) determine and coordinate questionable aspects and try to reach a solution (possibly involve experts); and (iv) make adjustments of planned activities to the benefit of all involved parties.

It appears that the main goal of the ICWC and its executive management bodies should be reaching a mutual understanding between the CA States and implementing concrete measures for mutually beneficial trans-boundary water use to secure national and regional interests. In general, a mutual understanding can be reached if the parties wish to voluntarily use mechanisms to settle disagreements without resorting to legal solutions. At the same time, the legal basis for settling disputes must be developed. The existing Agreements between the States regarding different aspects of the trans-boundary water management allow the States to undertake national measures within legal grounds. If any controversies occur, the parties, as a rule, focus on the provisions of those Agreements that were broken rather than appeal to a third party for mediation. Therefore, a solid international legal basis for trans-boundary water management in the region would be an important element to bring emotional dealings under control and eliminate pointless disputes.

In this context, it needs to be admitted that activities for development of draft Interstate Agreements (IA) on trans-boundary water management and their approval by the relevant authorities are not carried out adequately and vigorously. The activities are incorporated in the Program of Concrete Actions for Environmental and Socio-Economic Improvement in the Aral Sea Basin for 2003-2010 (ASBP-2). It needs to be underscored that ASBP-2 was developed accordingly with the instructions of the Heads of Central Asian States (Dushanbe, October 6, 2002) and approved by the International Fund for Saving the Aral Sea (Dushanbe, August 28, 2003). The ASBP-2 program specifically calls for developing a draft of IAs as a key priority, to strengthen the legal background for international management of the water resources of CAR.

According to priority 1 of the ASBP-2, there are ten drafts of IAs to be prepared:

- *The period for preparation of the following drafts of IAs expired in 2004:*

1. Improvement of the institutional structure of ICWC branches; **2.** Establishment of regional, national, and basin information systems and exchange of information; **3.** Management of water quality toward creating ecologically sustainable trans-boundary water bodies; **4.** Arbitration in the field of joint management, use and protection of water resources in the Aral Sea basin;

- *The following drafts of IAs are to be completed in 2005*:

5. Key points of joint management, use and protection of water resources in the Syrdarya basin; **6.** Ecological flow requirements for the Syr-Darya River, with accounting for the Northern part of Priaralie and the Aral Sea; **7.** Key points of joint management, use and protection of water resources in the Amu-Darya basin; **8.** Ecological flow requirements for the Amu-Darya River, accounting for the Northern part of Priaralie and the Aral Sea; and

9. Water management regulations for the Syr-Darya basin; **10.** Water management regulations for the Amu-darya basin.

As a whole, the ASBP-2 includes 14 positions that stipulate development of international legal acts for regional water management by the ICWC and IFAS together with the respective ministries of Central Asian States. Although recent efforts have been made to develop legal rules and regulations of regional nature, only the following could be considered satisfactory:

1. Strengthening of institutional structure for management, protection and development of trans-boundary water resources in the Aral Sea basin; **2.** Establishment and operation of national, basin and regional data bases for integrated use and protection of water resources in the Aral Sea basin; **3.** Protection of trans-boundary waters, rules for water quality control and regulations for providing regional environmental sustainability; **4.** Key principles of join and rational trans-boundary water use in the Syr-Darya basin.

At this time, no drafts of Agreements were yet signed. The main reason is that the parties were not ready for technical cooperation. When discussing the drafts, practically every party insists that its own comments are included in the drafts and usually no one is ready to compromise. Activities (of the IAs toward the ASBP-2) regarding the establishment of the International Water-Power Consortium (IWPC) are advancing quite slowly. To this date, the riparian countries in the Syr-Darya basin have developed and signed only the IWPC concept for its establishment. The analysis shows that it is practically impossible to develop IAs in a full volume and accordingly with the schedule stipulated in the ASBP-2. Therefore, work should be initiated in this direction, since the IWRM could be implemented at the regional scale without strong international legal basis.

2.5.2 National level

Many specific national problems are expressed below:

- *Part of the infrastructure of the water management system falls, due to privatization, into the hands of people who have no relationship to irrigated agriculture* (Kazakhstan)

  The new owners become monopolists who make water users indebted.

- *While declaring a basin approach to water management, provincial branches of the chief water agencies are shifted under the jurisdiction of local public authorities and government* (Kyzylordavodkhoz in Kazakhstan), *or, interactions of basin water management administrations with the district and provincial agricultural and water management branches remain unclear* (Uzbekistan)

- *Weak economic basis for regulating relationships between the water managing and water using entities*

This is particularly reflected in the imbalance between the cost for water delivery services and the ability of agricultural producers to pay for the service.

- *No mutual interest in water conservation by water users on one side, and water managing entities on the other*

  This is one of the main causes of low productivity of water and productivity of land - from one irrigated hectare. In a number of cases, delivery water losses constitute about 30% of withdrawal, while drainage discharge from the fields account for about 25%.

- *Excessive depreciation of capital assets and poor material and technical basis of water management organizations*

  Further deterioration of water infrastructure results from inadequate and unstable funding.

- *Premature transfer of water management organizations to become self-supporting* (Kazakhstan)

  This leads to weakening of material and technical basis of those organizations and deterioration of the irrigation and drainage system within their jurisdiction, as well as to a loss of water specialists.

- *Discontinued training of water sector specialists* (Kazakhstan), *shortcomings in education, re-training and placement of water personnel, as well as absence of professional staff in a number of water management institutions*

  Such a situation does not provide economic incentives for young professionals to enter the water sector management system.

- *Lack of monitoring of water use, mainly of common public systems*

  Monitoring is especially important during the transition period, when changes in agricultural use, ownership, and water management structure take place.

- *Lack of office equipment, up-to-date water meters, communication facilities, transport means and equipment of water management organizations*

- *Less attention paid to measures toward protection of environment*

  As a result, water shortage and increased pollution in the countries.

- *Increase of costs for irrigation within the composite cost structure*

  This sharply reduced the competitiveness of agriculture.

- *Simultaneous concentration of functions of economic activity and state control in the hands of water management institutions*

- *Aggravated situation with providing safe drinking water to the population*

- *Decreased yield of irrigated crops* (1.5 to 2 times) over the last 10-15 years

- *The on-farm irrigation and collector/drainage systems do not have an owner in many cases* (Kazakhstan)

- *Absence of strong legislative basis for WUAs*

  As a result, activities of the progressive water management organizations are ineffective and most water users work separately (Kazakhstan, Uzbekistan).

- *Poor public involvement in water management*

- ***Overall imperfect regulatory legal basis for water sector and inadequate state and public control of the adherence to water, land, and environmental laws***

These and many other problems in water management system are related, to a certain degree, to the problems of the water sector in the region and dependent on the expenditures/cost of water management at the national level. For instance, if a water shortage is caused by a distribution of water not according to the limits, conflicts between water users located in different parts of the hydrographic system may arise. Frequently, water users located upstream receive a volume of water above the set limits, and users downstream an insufficient amount. Such an unequal distribution may take place at all levels of the system (from local to regional) and generally, it does not depend on water availability.

The poor exchange of information (hydro-meteorological, hydrological, etc.), which is needed for operational water management at the national level is an acute problem, and more so at the regional level. Reduced fees for water services, financing of water management institutions from the state budget, and absence of appropriate sanctions for excessive water use often contribute to a low interest of water users in saving water.

One of the delicate problems in water management is a weak coordination between economic sectors that are the major water users. For example, in Turkmenistan, surface water management (including control of collector/drainage) is under responsibility of water management institutions, but groundwater is under the responsibility of the Ministry of Geology; water supply & sanitation for communities is controlled by the local executive government. Ministries of relevant sectors control water supply and waste disposal to and from industrial and construction enterprises. Nature conservation department controls water quality and microbiological water control is under the jurisdiction of public health agencies. A similar picture is in Kazakhstan and Uzbekistan.

Many factors that are considerably influencing water management at the national level are of trans-boundary nature, but are actually defined by the outlay of costs for water management at the regional level. For example, sustainable water management in the Amu-Darya downstream lands in Uzbekistan and Turkmenistan depends on both the national water policy in Tajikistan and the coordinated actions of Turkmenistan and Uzbekistan in water management, as well as on observance of “water discipline” by the upstream regions. In concrete terms, water availability in the Amu-Darya downstream depends largely on water withdrawals to Surkhandarya, Kashkadarya, and Bukhara provinces of Uzbekistan and a number of provinces in Turkmenistan along Karakumderie (Karakum canal). Therefore, the downstream regions, particularly Dashoguz and Khorezm provinces and the Republic of Karakalpakstan, do not receive the established water limits. In this context, reliable accounting of water intake along the whole length of the Amu-Darya becomes especially critical.

A similar situation is observed in the Syr-Darya basin. Unlike the Amu-Darya river basin, there are some peculiarities related to full regulation of the river by reservoirs and their operation.

Under current conditions, the regional water management organizations, particularly BWOs Amu-Darya and Syr-Darya, do not have workable instruments to apply sanctions against the upstream water users who break the established order. Presently they are unable to control the water management situation in the full length of the rivers. It appears that this problem of equitable water distribution between the regions inside a country and water users throughout the irrigation system at the national level can be relatively easily solved. The solution consists in revealing the misuse of water as well as the interventions of local government, making them accountable for their actions.

One of the mechanisms to restrict illegal intervention of local government officials in water management (usually providing water above the established limits or giving certain benefits to selected water users) could be an increase of penalties for the 'above the limit' water intake and raised responsibility and accountability of officials for fair water use and management process.

2.6 PUBLIC INVOLVEMENT IN WATER RESOURCES MANAGEMENT

If the water resources management framework is set up properly, the public is involved, and provides a valuable assistance to the government bodies to accomplish the sectoral reforms. From this position, the governmental support of the civil society and institutions for its development is very important. To involve major stakeholders in the regional water resources management it is necessary to establish entities, which would present and protect the stakeholders' interest. In the CAR it would seem prudent to create the following entities through which the public would be able to participate in water resources management at different levels:

1) Interstate: Water-Power (or another) Council;
2) Regional basin: Basin Council;
3) National: Coordination Water Council at the Government;
4) Sub-national basin: Water Commissions AIS, Water Canal Committees;
5) Local: WUAs/cooperatives, or similar entities of public right for water management.

The above entities, functioning as consulting bodies, would contribute to coordinating the actions of water users, state bodies, and public organizations to increase water management efficiency. The forms of public participation can vary in nature and extent of the involvement, such as public associations, production enterprises, NGOs, mass media, etc.

Public involvement in water management can be implemented by creating subdivisions of water management bodies, such as ICWC and its executive bodies at the regional level and Central National Water Agencies and its departments at the national level. Also, creation of working groups (WG) within the organizational structure of the water management bodies can be very effective. Such WGs could be formed for: (i) addressing specific problems related to the promotion of the IWRM (involving water experts and public); (ii) solving specific problems emerging under a competition for water by economic sectors (involving experts in water and water related sectors as well as public); (iii) developing long-term water management plans (staff of agencies, stakeholders and decision-makers).

Additionally, the public may be involved in decisions to:

- Establish extension services (for training and sharing practical experience)
- Arrange training courses and "round-tables" (e.g., staff training)
- Involve experts to evaluate problematic situations
- Create groups of NGO representatives
- Use of mass media, and other acceptable forms to adopt IWRM successfully

- Utilize a willingness to help and sharing of experience and capabilities of international organizations in public involvement of water resources management

In the Soviet period and during the first years of independence, the attention of the public to water management problems was minimal and had a more advertising nature. State bodies were not interested in involving the public in the water management process and generally ignored the issue of development of the civil society. There were only a few organizations that could really deal with water problems at the public level, involving stakeholders.

To a certain extent, the reason for undeveloped public participation process was a passive attitude of most of the population, which, in general, was caused by difficulties in transition to the market economy. But it was also due to a need to solve basic survival problems. Only recently, significant changes took place in this regard – many NGOs emerged, in particular, dealing with water and environmental problems. More importantly, political understanding of the orientation toward public opinion and participation means an imperative for our era and foundation of civil society.

Kazakhstan. Political support and legal reinforcement of the public participation in water management exist. The attitude of authorities toward this is positive, which can be confirmed by an organized campaign on public awareness of problems in the water sector. The water legislation stipulates formation of public bodies with involvement of all concerned parties, organizations and water users, at different water management levels. The latest Water Code emphasizes the openness and public involvement in decision-making processes regarding water use and conservation as key legal principles, as well as the accessibility of data related to the national water fund.

The Water Code provides for establishment of Basin Councils at Basin Water Management Administrations (BWMAs) as consultative/advisory bodies on water resources management issues. The Heads of BWMAs lead the Basin Councils, which also include representatives of public organizations along with the representatives of local, executive, and territorial entities. For each Basin, Agreements for restoration and conservation of water bodies are to be developed. The Agreements would be based on water balances, master plans for long-term water use and conservation, forecasts for socio-economic development (state and sectoral) and research. Basin Agreements are to be concluded between the Basin Administrations, local authorities and other entities located within the basin to coordinate their activities. In order to reach goals of Basin Agreements, juridical and physical persons have right to establish funds, as a means to finance restoration and protection of water bodies. The Water Code also stipulates public control (through public initiatives) of use of water resources and their conservation.

Kazakhstan has started to form WUAs as entities of public right for water management at the lower level of the water management system. Such WUAs are established accordingly with the law titled "About rural consumer co-operative of water users". The water users' cooperative represents a voluntary association of citizens and/or juridical persons formed for a joint operation and management of water use systems for needs of the agrarian sector. Thus, the legal framework for participation of all interested parties in management of water resources was created at all levels of the hierarchy.

Uzbekistan. The Government of Uzbekistan has taken a positive stand toward activities of public administration agencies, contributing to various spheres of social-political life. More than a hundred environmental non-governmental nonprofit organizations (NGOs) are functioning in the republic, having a main goal to focus an attention of state regulatory bodies and decision-makers on topical national environmental problems, in particular, effective water use and conservation problems.

Within the framework of a project “River for all, all for river” implemented by a group of environmental NGOs in 2004, an analysis of the existing environmental and water-related regulatory legal acts was carried out and proposals on improvement of water legislation were prepared. In September 2004, environmental NGOs were integrated into the ECOFORUM of Uzbekistan.

According to the Government Decision, public water management institutions were established at different levels – national, basin, and local. For basin it was a main canal (system) and irrigation system, and for local the inter-farm and on-farm network.

The Council for rational use of land and water resources, irrigation development, and soil fertility improvement was established under the aegis of Central Administration of MAWR. It is comprised of famous scientists and experts of water economy. Also, National Committee on Irrigation and Drainage (NCID) was formed, comprising of leaders of the concerned ministries and departments, leading scientists and experts from water using sectors of the economy.

To ensure collective leadership and transparency of the decision-making process, Water-Management Councils (WMCs) were created at the level of the Basin Administrations of Irrigation Systems (BAISs), and Water Commissions (WCs) at the level of Irrigation System Administration (ISAs). WMCs consist of the managers of BAISs, relevant provincial, agricultural, and water administrations, territorial bodies of the State Committee for Natural Resources, and managers of ISAs, main canals (systems), relevant district agricultural and water divisions, highly qualified water experts, representatives of water users (shirkats, WUAs), and other stakeholders. By 2004 about 270 functional WUAs were created in the republic; however, they do not considerably impact the IWRM implementation process.

Pilot zone:

In the *Republic of Karakalpakstan*, 72 WUAs were created by 2004, covering an irrigated area of 217 000 ha, including 4,130 private farms.

In Khorezm oblast, as of January 1, 2004, 15 WUAs were functioning, and by July 1, 2004, 29 WUAs were established, covering an irrigated area of 61,300 ha, including 3170 private farms, of which 7 WUAs were formed on the basis of hydrographic principle – along canals. According to a 2003 decree by oblast khokim, shirkat farms must be liquidated as follows: 15 in 2004, 30 in 2005, and 57 liquidated in 2006. Private farms will be created on areas of these shirkats, the rest of the lands will be offered for lease. WUAs will be formed to manage the lands of shirkats and tenants.

Currently, the WUAs mainly have to deal with water allocation among water users. As usual, farmers are not able to cover the costs of repair and maintenance of the on-farm network. The basic reason is a lack of equipment, fuel and lubricant materials. Overall, the WUAs are in a poor financial situation, as they operate on funds raised by the water users’ fees. Low prices for agricultural production and consequently a weak financial position, do not allow for farmers to pay for WUA services. Therefore, WUAs badly need the government support. Although the water management was transformed to a basin principle, most WUAs operate within the boundaries of former soviet collective or state farms and later shirkat farms.

Turkmenistan. Several environmental NGOs are functioning, but in reality, they do not have an influence on formation of a public opinion. It could be said that the IWRM is an abstract term in Turkmenistan. Therefore, a successful adoption of the IWRM principles in the pilot zone could play a critical role in embracing this new concept nation-wide.

To provide political and public support for the IWRM principles, it is necessary to undertake substantial work at all administration levels. A way of obtaining political support can be by dissemination of the IWRM concepts, provision of reliable information about IWRM advantages for top-level policy-makers (Presidential Service, the Cabinet of Ministers) and governmental bodies (Ministry of Economy and Finances, Ministry of Agriculture, Ministry of Environment Conservation, etc.). One of the effective approaches to inform high-level leadership can be a presentation of progress in implementing the IWRM in various countries, achievement of results in the socio-economic improvement through IWRM implementation and associated activities of international organizations (GWP, ESCAP, and SIC ICWC). At the same time, action should be undertaken to raise public awareness about the IWRM advantages, indicating the need for public involvement in water resources management as one of the essential IWRM elements.

3. NATIONAL AND INTERNATIONAL PROJECTS ON WATER RESOURCES MANAGEMENT IN THE AMU-DARYA AND SYR-DARYA DOWNSTREAM

The whole set of issues related to the Integrated Water Resources Management (IWRM) in the Amu-Darya and Syr-Darya downstream has never been examined before. However, specific IWRM elements have been more or less studied within the framework of national and international projects implemented during the past two decades in downstream zones.

3.1 PROJECTS AND PROGRAMS IN THE AMU-DARYA LOWLANDS

3.1.1 Khorezm province (Uzbekistan)

- ***Project "Reconstruction of the interstate main canal in Khorezm and Dashoguz provinces"*** (Uzbek State Design Institute of Waterworks "Uzgiprovodkhoz", 1980).

One of the project objectives was to switch water intake from canals "Palvan-Gazavat", "Gazavat", "Shavat", "Tashsaka" to the Tuyamuyun Feeder at Tuyamuyun Waterworks. Besides that, the following matters were to be solved:

- Straightening of irrigation and collector-drainage network
- Reducing the number of water diversion points to farms as well as the length of canals
- Providing an appropriate water infrastructure and water works along the canals
- Consolidating small irrigation plots into larger ones
- Constructing a transmission line and providing communication means and control devices to improve management efficiency

The project was planned for implementation in two phases. The first phase (up to 1990) included reconstruction of the Tashsaka system including major canals "Shavat", "Palvan-Gazavat", "Gazavatthe", and switching canals "Urgench-arna" and "Daryalyk-arna" over to feeding from the Tuyamuyun water works. The second phase (up to 2000) included reconstruction of the Tuyamuyun water works, widening and deepening of main canals "Shavat", "Palvan-Gazavat", "Gazavat"[1] as well as transfer of the Klychbay system to feeding from the Tuyamuyun waterworks. High cost of works and lack of time allowed implementation of only the first phase. After the establishment of independent states in CAR, the work of the second phase stopped.

- ***Subproject "Study of Agricultural Water Use and Management"*** (WUFMAS subproject, project WARMAP-1 and WARMAP-2 under European Community Program "Tacis", 1996-1998).

Different aspects of agricultural production and the achieved crop yields were measured and estimated on 360 fields, including 20 fields of Khorezm province in Khankin district (farm "Navoiy") and Urgench district (farm "Pakhtakor") in the Aral Sea Basin. Selected farms and fields for different natural-economic conditions served as indicators of the actual situation for agricultural production in the Aral Sea Basin states.
The WUFMAS database, created from the project data, was used for analysis of basic trends in the irrigated agriculture of the CAR region and for development of recommendations for improved use of the available resources and for securing profitable agricultural production.

- ***Project "Economic and Environmental Restructuring of Land and Water Use in Khorezm Province "*** (Government of Uzbekistan, UNESCO, Bonn University, 2002). The

[1] At present the water level in the above named canals is low, and thus the water delivery to the farm network has become very difficult.

Ministry of Agriculture and Water Resources and Ministry of High Education of Uzbekistan are involved).

The Project objectives are to:

- ○ Develop a concept for restructuring landscapes in Khorezm province to achieve effective and environmentally sustainable use of land and water
- ○ Develop proposals for implementing reorganization of land and water use

The project also aims at improving scientific cooperation between Germany and Uzbekistan in the field of research development and training of young specialists. The project implementation phases are:

2002 – 2003: creating a register and database for natural resources of the province
2004 – 2006: carrying out the appropriate scientific and applied research
2006 – 2009: dissemination of research results from pilot farms
2009 – 2011: implementation of research results at the scale of the province

- ***Project "Improvement of Water, Natural, and Land Resources Management in Khorezm Province"*** (USAID, 2002). One of the project partners is Water Users Association "A.Timur", Urgench district.

Main project goals are:

- ○ Assistance to farmers in implementation of modern water supply methods
- ○ Improvement in management of water resources by the WUA
- ○ Preparation of regulatory/legal acts for WUA activity

During the elapsed time, more than 20 training courses and seminars were held, gauging stations, pumping station, and other structures were constructed and other works were fulfilled in WUA "A.Timur" under the support of USAID. USAID also assisted in supplying the WUA with a computer and other equipment (instruments, excavators, and transport means).

- ***Program "Clean Drinking Water and Population Health"***

Within the framework of relevant national projects, 32 km of water pipes were reconstructed jointly with a South Korean Company "SHIN-DON", in Urgench. The works were completed at the end of 2002. In September 2004, the South Korean Company started design works on reconstruction of the Main Urgench Water Diversion to increase its capacity by 100 000 m^3 and improve drinking water supply to the population in the city of Urgench. To this end, the World Bank has allocated 10.8 million US$. Currently, projects for improving water supply and quality of drinking water in Khiva, Kushkupyr, and Yangiaryk districts are under preparation.

3.1.2. Turkmenistan (Dashoguz province)

- ***National Program of Turkmenistan on desertification control***

One of the priorities of the program is rational use of land and reclamation. Under this program it is planned to implement a project under the support of the German Technical Cooperation Agency (GTZ). Using the Gorgoly etrap/district in the Dashoguz velayat/province as an example, the project calls for solutions to improve the status of the degraded irrigated lands. Implementation of the project would decrease the ecological tension within the district, characterized by poor water quality and sharp land degradation. In general, the project would serve as a model for fulfilling similar works in other zones, taking into account their specific conditions.

- ***Project "UNDP/UNSO under National Program "Development of Public Utilities in Turkmenistan cities"***

This project is the most capital-intensive and largest during the whole history of UNDP activities in Turkmenistan. The project partners are 9 cities of the country, including Dashoguz and Koneurgench. There are many aspects to the project, but one of its main goals is improving the system for urban water supply.

- ***Project of Turkmen Golden Age Lake – settling of drainage water***

The project envisages the completion of the construction of the Main Collector (720 km long) into the Turkmen Lake, allowing the collection of drainage water from all provinces via 9 inlets. The annual average drainage discharge would be approximately 10 km^3 of drainage water[2]. The Turkmen Lake would allow for desalination of a part of the groundwater, and, after proper treatment, these waters could be used for irrigation.

- ***Projects to clean the irrigation/drainage network and repair hydraulic structures*** (Scientific-Operational Institute "Turkmensuvylymtaslama" and its Dashoguz branch).

These projects constitute annual cleaning and repair of about 50% of irrigation and 30% of the collector-drainage network in Dashoguz velayat, to ensure water supply and discharge according to standards.

3.1.3. Karakalpakstan (The Republic of Uzbekistan)

International and national projects that were or being implemented in Karakalpakstan are basically aimed for preparation of proposals to mitigate negative effects of the shrinking of the Aral Sea and associated deficit of water.

- ***Concept and plan for "Mitigation of the shrinkage of the Aral Sea by creating artificially regulated reservoirs in the Amu-Darya delta"*** (Central Asian Research Irrigation Institute (SANIIRI), 1988-1989).

The conception and the plan were developed under the direction of V.A.Dukhovny with involvement of SANIIRI's and its Karakalpak branch staff. Basic objectives and provisions of the project are:

- Restoration of the Amu-Darya delta environmental regime by creating conditions for normal life activities of the population
- Establishment of a unified complex of reservoirs and forest protection zones to mitigate negative effects of seabed exposure
- Preservation of the remaining biological capacity of the sea

On the basis of a low probability of preserving the large sea, SANIIIRI elaborated a plan for developing a system of shallow reservoirs in the delta and on the dried-up seabed.

[2] Upon an agreement with Uzbekistan the annual water withdrawal from the Amu-Darya going to site Kerky is 22 km^3 on the average long-term.

- ***"Techno-economical assessment (TEA) of constructing structures for regulating water regime in the shallow coastal areas of the Aral Sea within the delta of the Amu-Darya"***(Institute"Sredazgiprovodkhlopok", now Uzgipromeliovodkhoz"), 1989).

Basic parameters for reservoirs in former bays (Rybachiy, Muynak, Ajibay, and Djyltyrbas), as well as a schematic for filling them with collector/drainage waters and water from the Amu-Darya were worked out. To maintain continuous flow and target water levels in the reservoirs as well as in the lake system of Dumalak and Makhpalkul, basic parameters of Mezhdurechenskoye reservoir were determined.

- ***"Techno-economic basis/feasibility study for creating artificial reservoir at city of Muynak"*** (Institute "Sredazgiprovodkhlopok", presently "Uzgipromeliovodkhoz"), 1990.

The study determined parameters for filling-up and operation regimes of Muynak and Rybachiy reservoirs, as well as the possibility of their economic use. Based on this, a range of projects was implemented, hydraulic structures and dams were built in Muynak, Rybachiy bays, and Mezhdurechenskoye reservoir. However, the projects were lacking in the integrated approach to solve the delta problems and also neglected predictions of the river inflows.

- ***Draft proposal "Creation of continuous freshwater lagoon along the coastline of the dried-up Aral Sea bed "*** (Association "Vodproject").

The draft proposed to create a freshwater lagoon of 180 km in length, from Ustyurt chink to Akpetkin archipelago, with a water level of 53 m (former sea level). The dike of the lagoon should have locked channels in the river delta and create backwater for their mouths, and intercept flow coming to the delta periphery zone and distribute it between channels and lakes.
Flow through the lagoon would have been secured by use of Mezhdurechenskoye reservoir and water dividing works in the Porlytau site. Basic drawbacks of the project were: (i) that the availability of water resources necessary for filling these reservoirs was not taken into account; and (ii) deficiency in the feasibility study regarding large construction efforts.

- ***Project "Restoration of the Aral Sea wetlands in the Republic of Karakalpakstan"*** (Consortium of company "Euroconsult", The Netherlands, 1996).

The project planned creation of 4 areas as floodplains: floodplains south of Muynak bay, around Tuz Lake north of Karajar, floodplains of the Sudochie and Karateren systems.

The MAWR of Uzbekistan raised objections due to the omission of:

- Strategies for creating wetland ecosystem in the Amu-Darya delta
- Justification and solutions for water delivery to the river delta
- Regulation of water delivery and water distribution
- Solutions for release of floods and their use to water the delta
- Justification and calculations for an appropriate set of structures, etc.

- ***Subproject "Study of Water Use and Management in Agriculture" (WUFMAS)*** (project WARMAP-1 and WARMAP-2 under the program of European Community "Tacis", 1996-1999).

The actual use of factors important for agricultural production and the associated crop yields were measured and assessed on 20 fields of Karakalpakstan in Kegeyli district (farm "Khalkabad") and Nukus district (farm "Shortanbay"). The WUFMAS database, created from the collected data, was used for analysis of basic trends in irrigated agriculture in the CAR and for developing a set of recommendations for improving the use of the available resources and securing profitable production.

Concrete benefits related to an increase of water productivity were obtained on the WUFMAS fields in Karakalpakstan (demonstration and control fields with rice crop were selected in the farm “Shortanbay”) in 1999. This was because the factors relevant to agricultural production were improved and crop yields were increased together with a reduction of unproductive water losses. In the fall of 1999, workshops were held for the district staff working on the WUFMAS demonstration plots. About 30 to 40 local farmers, mid-level experts from water and agricultural management and district leaders took part in each workshop. The project demonstrated a real opportunity for creating specific consultations and expanding practical applications of the recommendations developed by the project to other areas.

- ***Project “Creation of small local reservoirs along the coastline as a buffer zone to control and secure fishery production of the population of the Priaralie”*** (Institute “Uzgipromeliovodkhoz”, 1999-2000).

This project considered rehabilitation of Muynak and Rybachiy bays and Mezhdurechenskoye Reservoir, with special attention paid to the construction of headworks at the main canal Glavmyaso and the reconstruction of dams and the Bortovoy spillway. The project also provided for construction of outlets in Muynak and Rybachiy bays. Mezhdurechenskoye reservoir regulation was poorly developed under this project, and the following was not justified:

- Structures and threshold of the Bortovoy spillway
- Threshold of Headwork at Canal Glavmyaso

- ***Project “Integrated water resources management in the Aral Sea Basin to recharge wetlands in the Priaralie”*** (NATO, Resource Analysis Consortium (The Netherlands) and SIC ICWC).

The basic project goal was to develop a set of environmental, ecological, and reclamation measures for the Amu-Darya delta. This project considers the degradation of the Aral Sea and Priaralie, and elaborates on approaches for selecting optimal scenarios for the problems within the delta for water years with different water availability. Actual data was included in the modeling for optimal parameters of hydraulic structures and for social-economic assessment of the recommended measures.

- ***Project “Sudochie Lake restoration”*** (World Bank, GEF, 1999-2002).

Under this project the principles of water-salt processes and their regulation within the Amu-Darya delta were elaborated.

- ***Project “Assessment of socio-economic impact of ecological disaster – Aral Sea shrinkage”,*** (INTAS/RFBR; NATO SFP 974357, 2001).

The project identified and analyzed factors inducing degradation of the natural system in the Priaralie, such as:

- Reduction of water inflow into the delta and the sea, with the resulting reduction of flooded areas
- Drop in the ground water table

- ○ Formation of a self-regulating ground water regime
- ○ Increase in ground water salinity
- ○ Desertification - development of aeolian process/transport of salt and silt

Further, the project analyzed changes in:

- ○ Soil-natural complex (soil maps of the Priaralie regions)
- ○ Vegetation cover of the Priaralie area (tugay forests)
- ○ Decrease of productivity of the artificial and natural landscapes
- ○ Bird populations
- ○ Fish productivity

Categories of social, economic, and environmental damage were identified, as well as direct and indirect damage. The resulted losses were assessed.

- ***Project "Best Practices"*** (IWMI-SIC ICWC, 2001-2002)

The project objectives were: (i) study of water users' initiatives undertaken for water conservation and effective use of irrigation water; (ii) selection of the best approaches initiated to use water effectively and disseminate them widely as irrigation practices. The project activities included:

- ○ Assessments, analyses, and popularization of water conservation approaches used in the best farms
- ○ Establishment of database to estimate water use and consumption efficiency on the fields selected as indicators
- ○ Identification of factors promoting water conservation, as well as reasons for hampering its wide dissemination

The project target areas in Karakalpakstan were farms of Khojeyli ("Nayman", "Khamza", "Dosluk") and Kegeyli ("Khalkabad","Jumaniyazov", "Kegeyli") districts.

- ***Reconstruction of South Collector to increase its flow capacity in Karakalpakistan*** was started (using the World Bank credit with cost-sharing by the Government of Uzbekistan).

3.2. PROJECTS AND PROGRAMS WITHIN THE SYR-DARYA DOWNSTREAM

3.2.1. The Republic of Kazakhstan (Kzyl-Orda province)

- ***Project "Regulation of the Syr-Darya channel and conservation of the Northern Aral Sea".***

This is the largest project implemented by the Government of Kazakhstan in the Kazakhstan part of the Priaralie. The project stipulates:

○ *Construction of the North Aral Sea Dam (NAS).* Basic functions of the dam are maintaining the sea level at 42 m, bringing the sea surface area to 3,300 km^2, with water volume of 27.1 km^3. Sea salinity is expected to be from 4 to 17 g/l. After the project completion, 65 to 70% of NAS would be able to support freshwater fish. This will also provide water for 21% of the dried seabed and improve the socio-economic situation in the Priaralie, as the employment would increase. Annual fish catch is expected to be within 1.9 to 6.5 thousand tons.

○ *Reconstruction of the Kyzylorda Waterworks* to improve the Syr-Darya regulation in the city of Kyzylorda, assuring water supply to 98,000 ha of irrigated lands, and transporting adequate amounts of water to the Syr-Darya delta and the Aral Sea.

○ *Construction of the Aytek Waterworks.* Main tasks: (i) increase of the Syr-Darya flow capacity in the Aytek district during flood period (spring - up to 1500 m^3, winter – up to 800 m^3); and (ii) provision of sustainable water supply for irrigation of islands (16,800 ha); (iii) securing riverbed flushing of the Syr-Darya; and (iv) reducing the rise of groundwater within the city of Kyzylorda.

○ *Reconstruction of Kazalinsk Waterworks* will improve water supply for 32,700 ha of irrigated lands, water supply to the Aksay-Kuvandarya left-bank lake system, and water transportation to the Priaralie, especially in the winter period.

○ *Construction of hydraulic structures in the Syr-Darya delta (construction of waterworks Raim and Aklak with water distribution canals for lake systems; structures for recharging the Aksay-Kuvandarya lake system).* Basic objectives: (i) improvement of water supply for 657 km^2 (presently used 309 km^2) of piscicultural lakes, including 39,400 ha of Kamyslybash and Akshaut, 6,260 ha of coastal lake systems, and 20,000 ha of Aksay-Kuvandarya lake system; (ii) watering of hayfields on 187 km^2; (iii) improved water supply for 393 km^2 of natural systems; (iv) reduction of losses and improvement of flow in the river bed to NAS; (v) protection of settlements and infrastructure from flooding.

○ *Construction of Terenozek Bridge (instead of existing pontoon bridge)* to improve auto-transport across the Syr-Darya (Terenozek and Chagan zone).

○ *Construction of protection dams along the Syr-Darya.* This includes rehabilitation of existing dams and construction of new dams, straightening the river channel within settlements (Aksu and Belsendy) for flood protection; in particular, of the city of Kyzylorda. At completion of construction, the annual water volume for water delivery would increase in NAS by 0.8 km^3, flood destruction risk along the river would be reduced. Unproductive releases to Arnasay depression in Uzbekistan would be reduced.

○ *Chardara Dam rehabilitation project.* The first phase of the project includes reconstruction of the Kyzylkum water intake structure and rehabilitation of the drainage system (on the irrigated area), fulfillment of other works to provide dam safety, as well as reduction of losses of the irrigation water and increased water supply for agriculture and other sectors of the economy. The general water situation in the Kyzylorda province and the security within the Syr-Darya downstream depends on successful implementation of the Chardara project.

- ***Project "Regulation and Development of the Syr-Darya delta"(***International Reconstruction and Development Bank; Italian companies "Italconsult" and "Elektroconsult" under the Aral Sea program, 1996).

This project aimed to improve the environmental and socio-economic situation of the Priaralie by rehabilitating and maintaining NAS and the Syr-Darya delta ecosystems. A water management model was developed by means of three alternative schemes.

- ***Subproject "Study of Water Use and Management in Agriculture" (WUFMAS)*** (project WARMAP-1 and WARMAP-2 under the program of European Community "Tacis", 1996-1998).

The actual use of various factors of agricultural production and the achieved crop yields were measured and estimated on 360 fields, including 20 fields of Kyzylorda province in Jalagash district (farm "Akzharma") and Terenozek district (farm "Akumsky")) in the Aral Sea Basin. Selected farms and fields in different natural-economic conditions served as indicators of agricultural production in the Aral Sea Basin States. WUFMAS database, created from the collected data, was used for the analysis of basic trends in the irrigated agriculture in CAR and for development of a set of recommendations to improve the use of available resources and profitability of production.

- ***Subcomponent A-2 "Participation in water conservation"*** (GEF Project "Water and Environment Management", DHV Consultants BV (the Netherlands), Landell Mills Ltd (UK), ICWS (the Netherlands), 1999-2000).

Subcomponent A-2 objectives were to:

- ○ Bring out the best methods for water conservation and efficient water use, as well as pre-requisites that are instrumental for application of given methods, specific for individual areas, which can be accounted for in the regional water policy development
- ○ Identify concepts and initiatives of water organizations and water users toward water conservation
- ○ Study and assess possibilities for dissemination of positive experiences from pilot objects of water conservation and rational use of water under conditions typical for the irrigated areas of the region
- ○ Prepare the appropriate proposals and recommendations for the Project Management Agency to be used in components A-1 and B

"Water Conservation Competition" was organized with the material encouragement of participants who were successful in water conservation under high irrigation water efficiency as well as high crop yield. All together, 6 district water organizations, 8 major farms with different types of property, and 12 private farms were involved in the project in Kyzylorda province.

- ***Project "Best Practices"*** (IWMI-SIC ICWC, 2001-2002)

The project objectives were to:

- ○ Study water users' initiatives undertaken for water conservation and effective irrigation water use
- ○ Select the best newly initiated approaches to effective water use in order to disseminate them in irrigated agriculture practices

The project activities included:

- ○ Assessments, analyses, and popularization of water conservation approaches used in the best farms;
- ○ Establishment of a database to estimate water use and consumption efficiency at field-indicator levels
- ○ Identification of factors promoting water conservation and reasons hampering its wide dissemination in irrigated farming

The studied objects in Kyzylorda province were farms of Shiyeli ("Zhana Tokeriz", "Akmaya-2") and Janakurgan ("Togusken","Zhana Zhol") districts.

- ***Project "Water supply to Kazalinsk/Novokazalinsk".***

The goal is to improve the situation in the drinking water supply for the population of Kazalinsk and Novokazalinsk cities.

- ***Projects within the framework of the national sectoral program "Drinking water".***

These projects were directed toward the improvement of water supply to rural settlements, in particular, in Kyzylorda province: construction of Zhideli and Aralo-Sarybulak pipelines.

- ***Project "Economic assessment of local and joint measures on reducing socio-economic damage in the Priaralie"*** (INTAS-1059, 2004).

This project collected sufficient analytical, field and hydrological (GIS, RS) data. This facilitated a transition from the assessment of damages (associated with natural degradation of the arid zone) to the assessment of measures to be taken (in addition to the existing projects) to stabilize the socio-economic and environmental situation, and, at the same time, to restore the economic and environmental productivity of the Syr-Darya delta.

The project consists of the following components:

- Identification of basic trends, components and scales of damages as a result of Aral Sea desiccation and delta degradation (damages represented spatially)
- Comparative analysis of damages throughout the North and South Priaralie
- Description of the available projects within the Kazakh Priaralie and their expected impact on situation improvement and analysis of their conditions
- Results of field examinations and survey questionnaires by local stakeholders and concerned organizations regarding identification of additional measures
- Plans of actions and proposals

Implementation of this project is an important step made by the European Union towards the assessment of socio-economic and environmental damage caused by the drop in the Aral Sea level. This will justify further government measures for the protection of the Priaralie and also create an economic basis for undertaking of serious measures to create an ecologically sustainable system on the territory of three districts in Kyzylorda province.

Implementation of the IWRM in Kazakhstan has become an important issue during the last few years. To solve the water sector problems, international financial organizations, such as the World Bank, Asian Development Bank and Islamic DB, UNDP, USAID, and others have become involved.

The UNDP, together with the Investment Policy Department of the Ministry of Economy and the Kyzylorda province administration, carried out an assessment of ways to improve situation in all sectors, alongside with launching the rehabilitation of the Aral Sea coastal zone and capacity building program ("Helping Priaralie residents to help themselves"). Attention was paid to issues related to the development of small-scale businesses, public health, NGOs, social development, and water supply. The UNDP provided financial support to strengthen local administration and NGO capacity through training and equipment purchasing. In addition, subprojects presented by local citizens, NGO, and organizations in Kyzylorda province also received funding.

Since 1999, the program was focused on water supply and environmental management as well as on rehabilitation of a limited number of water structures in pilot settlements designated by local consulting committees. According to the specific conditions, the following projects were selected:

- *Development of potential abilities of water users for sustainable development in the settlement Zhankozha, Batyr-Kasalinsk district, Kyzylorda province*
- *Watering of Sartogay plot lands, settlement Abay*
- *Rehabilitation of agricultural lands in settlement Urkendeu*
- *Reconstruction of canals for protection of forest belts in settlements Maydakol and Tuktibayev*
- *Rehabilitation of forest belt in settlement Bozkol*
- *Rehabilitation of Karakol Lake and pastures in settlement of Kaukey, Aral district*
- *Filling of Makpal Lake, construction of sluice, and cleaning of canal Kenes*
- *Filling of the lake system Tushibas*
- *Water supply for the settlement Karateren*

The following projects are ongoing:

- *"Regulation of the Syr-Darya channel and conservation of the Northern Aral Sea" -phase 1. (*International Reconstruction and Development Bank - 85.79 million USD and Kazakhstan budget - 21.29 million USD), implementation period is from 2002 to 2006.

- *"Water supply for the city of Aralsk"* (Kuweit Fund of Arabic Economic Development - 13.65 million USD). Implementation period was from 2001 to 2004.

- *"Water supply for Kazalinsk/Novokazalinsk"* (German Bank KFW - 5.3 million USD). Implementation period was from 2001 to 2004.

- *"National IWRM and effective water management plan"* (Norwegian Government jointly with UNDP via GWP - 1.2 million USD). Implementation period is from 2004 to 2006.

From the view of applicability to IWRM objectives, the last project should be noted, as it is oriented toward developing a national plan for the transition to IWRM at the basin level. Through a system of workshops and training courses, having the maximum number of experts and stakeholders participating in a discussion, the project should elaborate on how to make the transition to the IWRM.

4. SELECTION OF SITES FOR IMPLEMENTATION OF THE IWRM

4.1 CRITERIA FOR SELECTION

According to the Terms of Reference, the National Work Groups (NWG) and the representatives of the provincial water management organizations (operating under the guidance of the national ministries for water resources and agriculture) were asked to prepare for each province of the project a list of potential pilot sites. These sites would be representative in terms of current problems, fulfilling certain criteria developed at the project initial stage, so that they could be considered as pilot sites for implementing the IWRM in the Amu-Darya and Syr-Darya lowlands.

The selected sites had to be capable of demonstrating an efficient water management at three levels: a) a hydro-boundary/irrigation system; b) Water User Association (WUA) and c) a farm. As such, they would allow for:

- Achieving an equitable and sustainable water supply, water distribution and its use – starting from the Basin Administration for Irrigation System down to the farm fields; with a priority given to drinking water demands and the environment
- Minimizing water losses resulting from uncoordinated actions of water hierarchy and failure in control and systematic enforcement
- Creating conditions for improvement of water productivity while using rational volumes of water per unit of production
- Creating a methodological basis to expand implementation of the IWRM

The following criteria with three priority levels were used for the assessment of potential sites:

1st priority level

Willingness and determination of the provincial authorities and water users who are members of an existing or newly created WUA located within a hydro-unit/irrigation system of a canal; including farmers/water users and all water sector players in the districts where sites can be considered for water management reform.

2nd priority level

Irrigated land area is within certain range for each level:

hydro-boundary/irrigation system: 10 to 100 thousand ha;
water user association: 1 to 5 thousand ha; and
private farm: 10 to 200 ha.

3rd priority level

Representativeness of the site for the irrigation/drainage system (hydro-boundary) and the canal or WUA, in terms of key indicators (on basis of comparing to the weighted average).

Alternative sites at all levels of hierarchy were considered, as described in Figure 4.1.

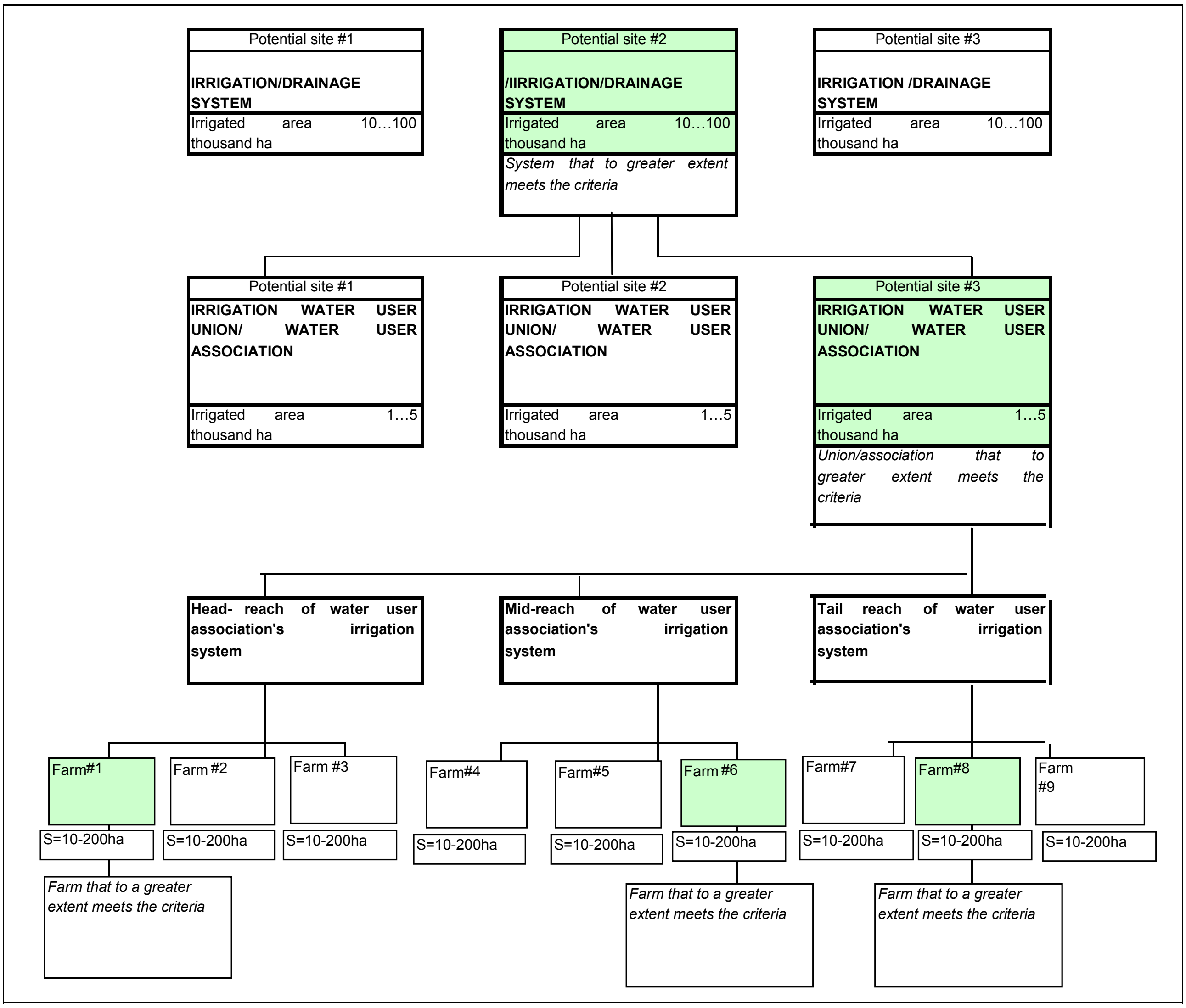

Fig.4.1 Chart for selecting pilot sites for "hydro-boundary/irrigation system – water user association – farms»

4.2 KHOREZM PROVINCE, UZBEKISTAN – THE AMU-DARYA LOWLANDS

4.2.1 Selection of hydro-boundary – irrigation & drainage system

Among the three alternatives for irrigation & drainage systems ("Tashsaka"; "Palvan-Gazavat"; "Karamazy-Kilichbay") suggested by Uzbekistan's NWG and described in ***Appendix 4a***, the ***irrigation system "Palvan-Gazavat"*** meets best the 'representativeness' criterion (Fig.4.2.). The irrigation system also meets the other criteria, particularly well the support of the IWRM principles. The provincial and district authorities, irrigation system administration, and all players in the water management system should be ready to implement it in the pilot sites. Regarding climatic, soil, and hydro-geological conditions, as well as a number of hydraulic structures, the selected system is representative for Khorezm province.

The general irrigated area under Palvan-Gazavat system is 61,700 ha with an unlined irrigation canals 574.2 km long. Main crops grown in the area are cotton and winter wheat, counting for 42.1% and 16% of total irrigated area, respectively. Only 37.1% of the lands are under gravity irrigation, while the rest, 62.9% is served by pumps/water-lift. From 2000 to 2003, water availability in the Palvan-Gazavat system averaged 79.4% (during low water years 2000 and 2001 it was 76.8% and 55.0%, respectively).

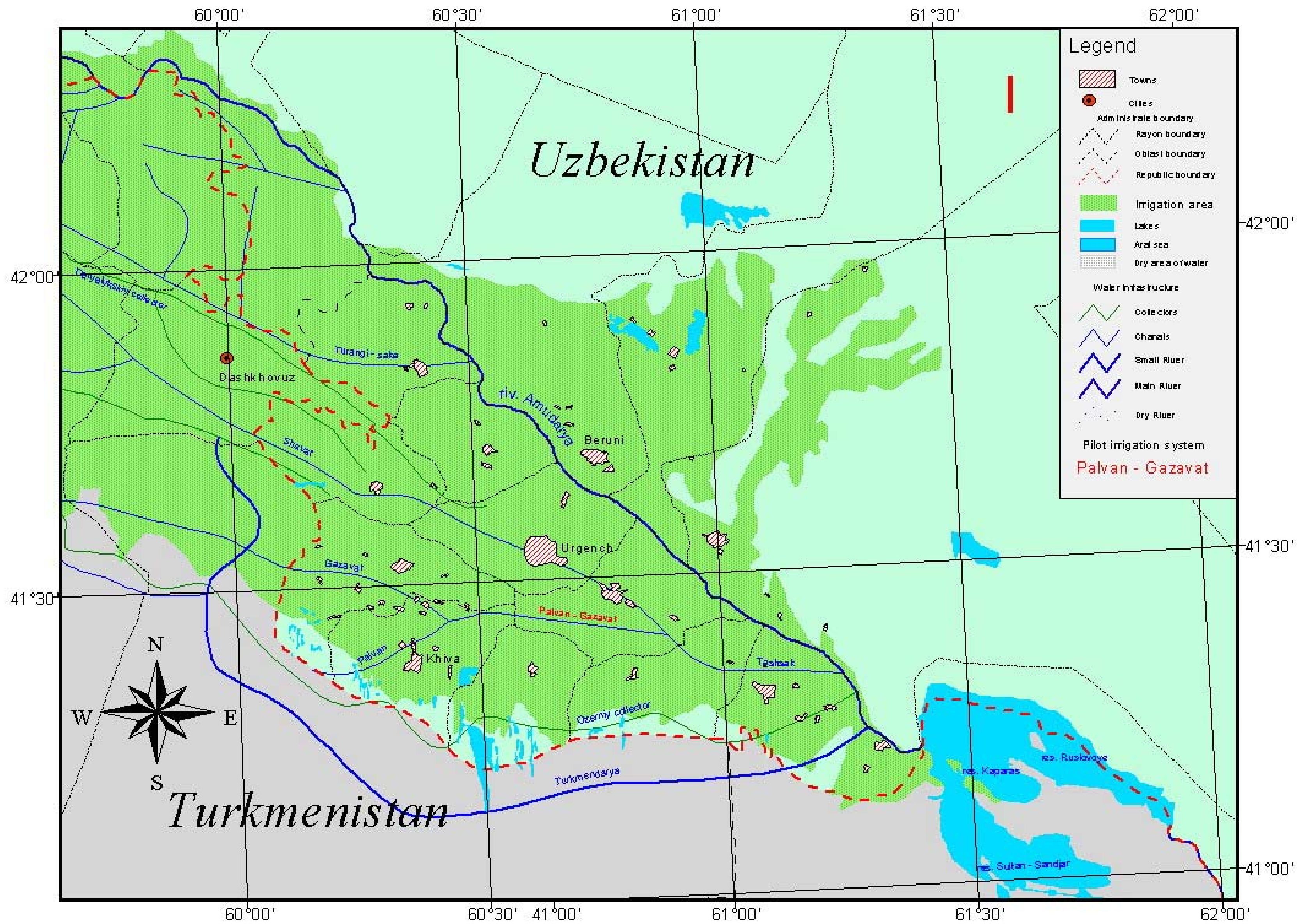

Fig.4.2. Schematic map of irrigation systems in Khorezm province, Uzbekistan

The irrigation system Palvan-Gazavat has 911 outlet structures, of which 183 are equipped with water meters). The irrigation area (weighted average) per outlet structure is 68 ha. The soils within the system are mainly comprised of meadow of VII - IX hydro-module zones. As for salinity, the soils are low saline over 47.2% of the area and medium saline over 37.8%, respectively. The soils belong to fertility/quality ('bonitet') classes classes II[1] (41% of the area) and III (42.8% of the area). During irrigation season the groundwater level varies from 0.5 to 1m over 35.7% of the area and 1 to 2 m over 57.5%, respectively.

4.2.2 Selection of a Water User Association

There are 9 Water User Associations operating within the boundaries of Palvan-Gazavat Administration of Irrigation Systems. Among the three WUAs examined - Mirab, Gouk-yab, and Shikh-yab - described in ***Appendix 4b***, the WUA Mirab (established on January 26, 2000), with irrigated area of 1426 ha meets best the 'representativeness' criteria (Table 4.1).

Table 4.1 Key indicators of WUA Mirab

Indicator	Amount	%
Total irrigated area (ha)	1426	
of which is: low saline	502	35.2
medium saline	800	56.1
strongly saline	124	8.7
Type of water intake for irrigated area (ha)		
Gravity flow	649	45.5
Pumped water lift	777	54.5
Total length of irrigation network (km)	150	
of which is a flumed network	1.6	1.06
Total length of collector-drainage network (km), of which:	42.9	
subsurface drainage	0.8	1.9
Number of outlets from inter-farm irrigation network, of which has:	39	
gauging stations	2	
Regulators	7	
Number of outlets from on-farm irrigation network, of which has:	145	
gauging stations	15	
Regulators	0	
Total number of pumping units, of which are:	12	
electric	11	
Partitioning / Check structures	4	

[1] Corresponds to the following quality scale: I class – 81-100 points (high fertility); II class – 61-80 points (increased fertility); III class – 41-60 class (medium fertility); IV level – 21-40 class (decreased fertility); V class – 1-20 points (low fertility).

Basic crops grown in WUA Mirab are cotton on 27.6% of the irrigated area, maize on 11.2%, and winter wheat on 6.7%, respectively. Lacking the appropriate control of water levels in the irrigated area, gravity flow accounts for 45.5% of irrigation, while the remaining 54.5% is served by pumps. From 2000 to 2003 the water availability in this WUA averaged 80.8% (in low water years 81% in 2000 and 67% in 2001). There are 340 irrigation plots within the territory of WUA Mirab, with an average plot covering an area of 4.2 ha. The soils belong primarily to low saline soils (35.2% of the area) and medium saline soils (56.1%). The soil fertility/quality classes are II covering 62% and III covering 25.3% of the total irrigated area. During the vegetation period the groundwater table varies, from 0.5 to1 m on 46.7% of the area and 1 to 2 m on 44.9%, respectively.

4.2.3 Selection of farms

Three groups of farms were examined within the WUA Mirab, accordingly with their location within the irrigation network, as described in ***Appendix 4c*:**

- The head: Farms Usta Yusuf, Matyakubov and Yakub Shura
- Mid-reach: Farms Oybek, Eshchan ata and Babadjanov
- The tail: Farms Usta Bekchan, Masharip ata and Inak

From the above farms the most representative for the three locations are:

- Farm Matyakubov
- Farm Oybek
- Farm Masharip ata

Farm Matyakubov. The irrigated area is 47.4 ha and the length of the (unlined) irrigation network is 4.5 km. Water is delivered to the entire area by pumps/lift irrigation. Cropping pattern in 2003 was: cotton on 53.6% and winter wheat 26.6% of the irrigated area. From 2000 to 2003, the water availability averaged 81.3% (including 81% in 2000 and 66% in 2001 as low water years). Groundwater table is for the most part between 1 to 2 m below the surface (on 44.5 % of the area) and from 2 to 3 m (on 27.9%). About 49% of the soils are of low salinity, and 39.2% of medium salinity. Regarding soil fertility, about 64.8% of the area falls into category II and 35.2% category III, respectively.

Farm Oybek. The irrigated area is 50.3 ha and the length of the (unlined) canal network is 5 km. The area is under lift irrigation. In the cropping pattern for 2003 cotton covered most of the area, accounting for 89.5%, and winter wheat occupied 8%. Between years 2000 and 2003 the water availability averaged 81.8% (67% and 79% in low water years 2000 and 2001, respectively). The groundwater table is at depth of 1 to 2 m on 37.8 % of the area and at 2.0 to 3.0 m on 44.9 %, respectively. About 41.7% of area belongs to lowly saline soils and 39.8% to medium saline soils. As for soil fertility, all soils belong to category II.

Farm Masharip ata. The irrigated area is 22.1 ha and the length of the (unlined) irrigation network is 1.8 km. The irrigated area is served by gravity flow. Cropping pattern for 2003 was cotton on 63.3% and winter wheat on 18.1% of the land. Water availability averaged 81.8% from 2000 to 2003 (81% and 68% in low-water years 2000 and 2001, respectively). Groundwater table is at depths of 1 to 2 m on 31.2 % of the land and 2.0-3.0 m on 44.8%, respectively. About 41.2% of soils are low in salinity and 41.6% are medium saline. As for soil fertility, the soils belong to category III.

4.3 DASHOGUZ VELAYAT (PROVINCE), TURKMENISTAN – THE AMU-DARYA LOWLANDS

4.3.1 Selection of a hydro-boundary / irrigation & drainage system

All three potential irrigation & drainage systems in Dashoguz province are interstate irrigation systems of canals "Shavat", "Gazavat", and "Klychbay" (Fig. 4.3). The irrigation system "Shavat" meets best the 'representativeness' criteria from those suggested by Turkmenistan's NWG, as shown in ***Appendix 4d***.

The irrigation system of canal "Shavat" is one of the most ancient irrigation systems in Khorezm oasis. The canal starts from a water divide at 34 km of the Dashsaka canal and then crosses border between Uzbekistan and Turkmenistan at the 78th km. The total length of the canal is 165 km, including the tail end of its inter-farm section; 87 km are within the boundaries of Dashoguz province. The canal serves the lands in Khanka, Urgench, Shavat districts of the Khorezm province and Niyazov, Yilanly, Akdepa etraps (districts) of the Dashoguz velayat (province). The capacity of the canal is 127 m^3/s at Turkmenistan's border (waterworks downstream at 78th km); average cross section width is 70 m and the depth 2.5 m.
The irrigated area within the boundaries of Dashoguz province was 98,000 ha in 2003. About 97% of the annual flow in the canal is for irrigation, while the rest is used for drinking water supply, industrial use, public utilities and other water needs. Starting in the hydrologic year 1999/2000, approximately 85% of the annual flow of canal "Shavat" has been taken from Dashoguz canal ("Turkmenderyasy") and then distributed among the 743 km of inter-farm canals equipped with different intake structures and water meters. From 2000 to 2003, the water availability in canal "Shavat" averaged 63% (only 34% and 42% in low water years 2000 and 2001, respectively).

Farms and irrigation systems within the command zone are not equipped with stationary pumping stations for water lift; however, when elevation of water is low in the system, portable pumps are used for irrigation on approximately 28% of the area. There are 185 outlets from canal "Shavat" to daykhan associations within the province boundary. Those outlets are equipped with head intakes and water meters. The average irrigated area per outlet is 530 ha.

The main crop grown in the command zone is cotton. A total of 45.4% of the lands were under cotton in 2003. About 64% of he soils in the Shavat belong to meadow desert soils of III, IV and V hydro-module zones. As to salinity, the soils are medium saline (64% of the total area). As to fertility, the soils fall into category III (49.8% of the area) and IV (25.9% of the area). The groundwater table depth varies during the growing season from 1 to 2 m on 25.9% and from 2 to 3 m on 50.4% of the land, respectively.

4.3.2 Selection of a Water User Association

From among the three examined daykhan associations - Cherkezov, Ashgabat, and Ersariyev - depicted in ***Appendix 4e***, the Cherkezov daykhan association with an irrigated area of 2913 ha met best the 'representativeness' criterion. The association is located on the left bank of the main canal Shavat and irrigated from inter-farm canal "Shikh-Sovma", which is actually the left branch of canal Shavat at DP-126 water divide on the border between Yilanly and Akdepa districts. The total area controlled by the association is 4924 ha, of which 2913 ha (or 59%) are irrigated, entirely by gravity flow, and used for agricultural production. The cropping pattern represents cotton on 46% and wheat on 30% of the area, respectively.

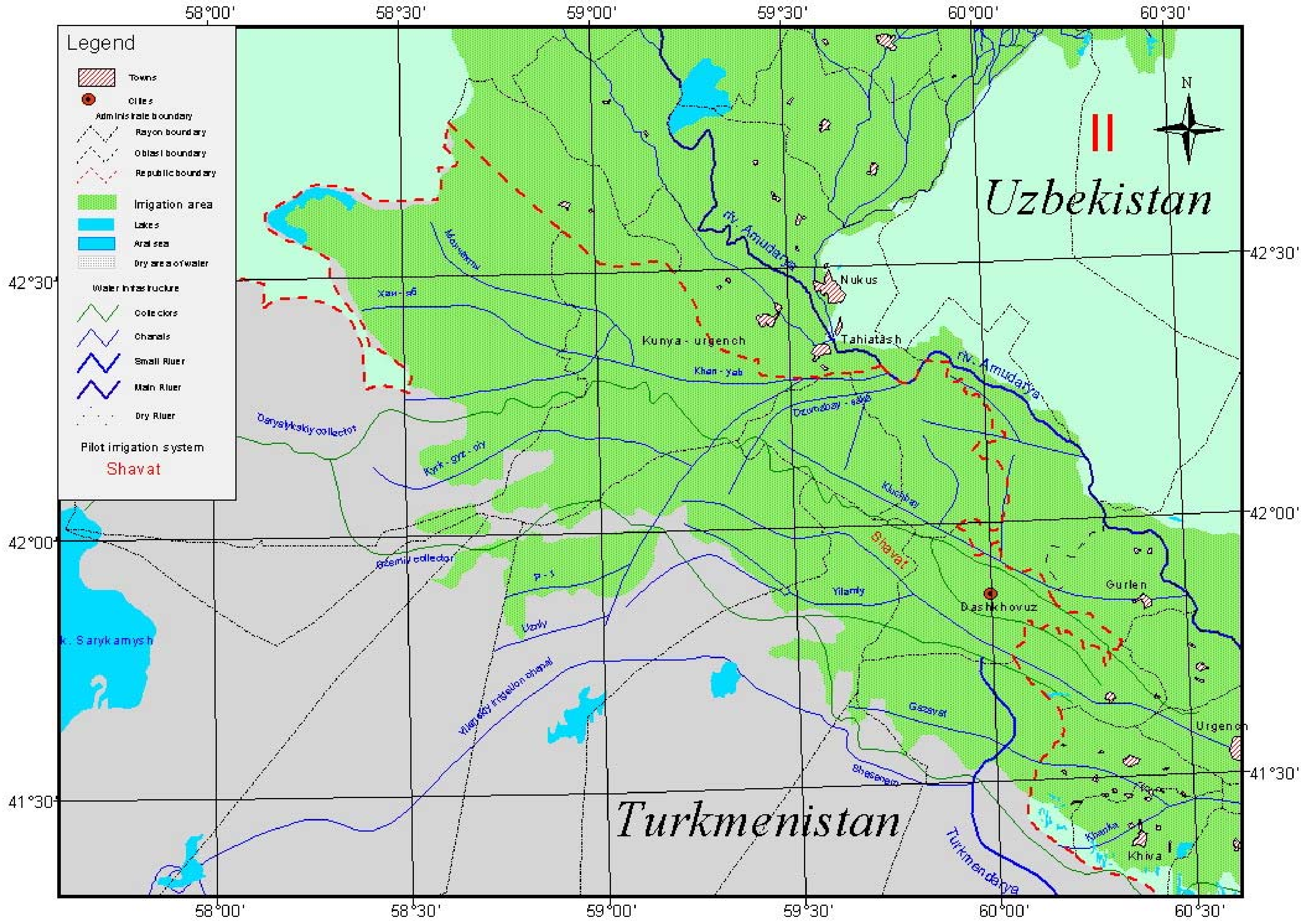

Fig.4.3 Schematic map of Dashoguz velayat (province), Turkmenistan

There are 454 irrigation plots within the territory of the daykhan association. The average irrigation plot is 6.4 ha. A total of 1008 water users are farmers who lease the land, with an average of 2.9 ha per farmer. From 2000 to 2003, the water availability in the association averaged 70% (including 38% and 50% in low water years 2000 and 2001). The soils consist of meadow desert zone (64% of the total irrigated area) of III, IV and V hydro-modules. As to salinity, the soils fall into medium saline (70% of the land area) category and belong to fertility quality classes III (50.1% of the area) and IV (24.8% of the area). The groundwater table depth varies from 1 to 2 m on 29.6% of the land and from 2 to 3 m on 49% during the growing season.

4.3.3 Selection of farms

There were 9 groups of farm sites examined in the Cherkezov daykhan association along the irrigation system, as shown in ***Appendix 4f***: 3 groups in the head, 3 in the mid-reach, and 3 in the tail end of the irrigation system. Among those groups the most representative are: in the head - site №2, in the mid-reach - site №5, and in the tail end of the system - site №9.

Site № 2. Nine farmers control an irrigated area of 25.5 ha. There are 3 irrigation plots served by 3 outlets from an (unlined) irrigation network with a length of 0.56 km. Water is supplied by a gravity flow. In 2003 the area grew cotton (49%) and wheat (51%). The weighted average water availability from 2000 to 2003 was 71.2%, which was 1.2% more than in the daykhan association (40% and 48% in low-water years 2000 and 2001, respectively). The irrigated lands consist primarily of meadow soils of the desert zone (77.3%). Groundwater is at depths of 1.5 to 2.0 m on 59.8% and from 2 to 3 m on 40.2% land area, respectively. The irrigated area has soils of hydro-module zones class III (35.1%) and class IV (64.9%). As for the degree of salinity, about 67% of the soils are mainly medium-saline; they belong to category III on 56.1% and IV on 29% of the land area, respectively.

Site № 5. Eight farmers control an irrigated area of 13.4 ha. There are three irrigation plots served by 3 outlets from unlined irrigation network, which is 0.6 km long. Water is supplied by gravity flow. In 2003, cotton was sown on the entire area of this site. The weighted average water availability during years 2000 to 2003 was 69.5%, which was 0.5% lower than in the daykhan association (40% and 49% in low water years 2000 and 2001, respectively). Meadow soils of the desert zone (72.5%) prevail within this site. The depth of groundwater is between 1.5 and 2 m below surface on 34% of the area and from 2 to 3 m on 41%, respectively. The irrigated area is represented by soils of hydro-module zones III and IV on 46.7% and 33.6% land area, respectively. As to salinity, 75% of the soils are medium-saline. The soils belong to fertility categories II and III covering 22.5% and 54.5% land area.

Site № 9. Twelve farmers control an irrigated area of 16.1 ha. There are six irrigation plots served by 6 outlets from irrigation network, which is unlined and 0.18 km long. Water is supplied by gravity flow. In 2003, cotton was sown on the entire area of the site. The weighted average water availability during years 2000 to 2003 was 66.3%, which was 3.7% lower than in the daykhan association (35% and 52% in low-water years 2000 and 2001, respectively). Meadow soils of the desert zone (71.1%) prevail in the site. Groundwater table depths are between 1.5 and 2 m on 55.2% of the land and 2 to 3 m on 44.8 % of the land area. The irrigated area has soils of hydro-module zones of category III (39.6%) and IV (60.4%). About 74% of the soils are medium-saline. As to soils fertility, 19.8% of the soils belong to category II and 54.3% to category III.

4.4 THE REPUBLIC OF KARAKALPAKSTAN, UZBEKISTAN - THE AMU-DARYA DELTA

4.4.1 Selection of a hydro-boundary / irrigation & drainage system

The three hydro-boundary/irrigation systems in Karakalpakstan are the irrigation systems of canals "Kyzketken-Kegeili", "Kuvanyshdjarma", and "Kattagar-Bozatou" (Fig.4.4). From these, the irrigation system "Kuvanyshdjarma" (Table 4.2) met to the greatest extent the 'representativeness' criteria, as depicted in ***Appendix 4g***. Within the irrigation system there are 190 outlets coming out of canal "Kuvanyshdjarma". The weighted average of land area irrigated by one outlet is 212 ha. During the years 2000 to 2003, the water availability in canal "Kuvanyshdjarma" averaged 64.5% (25.1% and 33.1% in low water years 2000 and 2001, respectively). The soils in canal's "Kuvanyshdjarma" command zone are mainly composed of meadow of the desert zone (62.5% of the total irrigated area) of V and VI hydro-modules. As to salinity, the soils are medium saline (47% of the total area) and low saline (41%). Regarding fertility, the soils belong to category IV (80% of the area). Groundwater table level varies between 2 and 3 m (83.4%) in most of irrigated area during the growing season.

Table 4.2 Key characteristics of the irrigation system of canal «Kuvanyshdjarma» (2003)

№	Indicator	Unit	Kuvanyshdjarma
1	Total irrigated area	ha	40370
2	Actual irrigated area, of which	ha	15260
	Cotton	ha	1550
	rice	ha	2850
	Household plots	ha	606
	Other	ha	10254
3	Abandoned land	ha	25110
4	Irrigation network length (up to farm inlets)	km	540.8
5	Number of water users		245
6	Number of outlets equipped with water meters		26

4.4.2 Selection of a Water User Association

Among the three examined alternative water user associations - Beldar, Dosnazarov-arna, and Biytaban - located within the zone of the irrigation system "Kuvanyshdjarma", and described in ***Appendix 4h***, WUA "Beldar" with an irrigated area of 3379 ha met best the 'representativeness' criterion. In this WUA the water availability averaged 64% from 2000 to 2003, and for the low water years 2000 and 2001 it was only 26% and 36%. The whole area of the WUA is irrigated by a gravity flow from canal «Doslyk» (head discharge – 6.0 m^3/s, canal length – 11.7 km, number of outlets – 16). The cropping pattern is winter wheat on 18%, cotton on 16%, and alfalfa on 7.7% of the irrigated land, respectively. The soils are primarily alluvial-meadow soils and belong to medium saline (48%) and low saline (40%) categories. The groundwater table level varies from 2 to 3 m on most of the irrigated area (82%) during the growing season. As for soils fertility, 54% of the soils belong to class IV.

4.4.3 Selection of farms

Three groups of alternative farms (arranged according to their location along the canal "Doslyk") were examined within the boundaries of WUA "Beldar" , listed in ***Appendix 4i:***

- at the head of the irrigation system : «Paluan ata»; «Berdibai ata»; «Tabyn Reyim»
- at mid-reach of the irrigation system: «Madreim ara»; «Elista»; «Amirbai ata»
- at the tail end of the irrigation system: «Begjan Sabyr»; «Nur Bakhram»; «Artykbai Esbosynov».

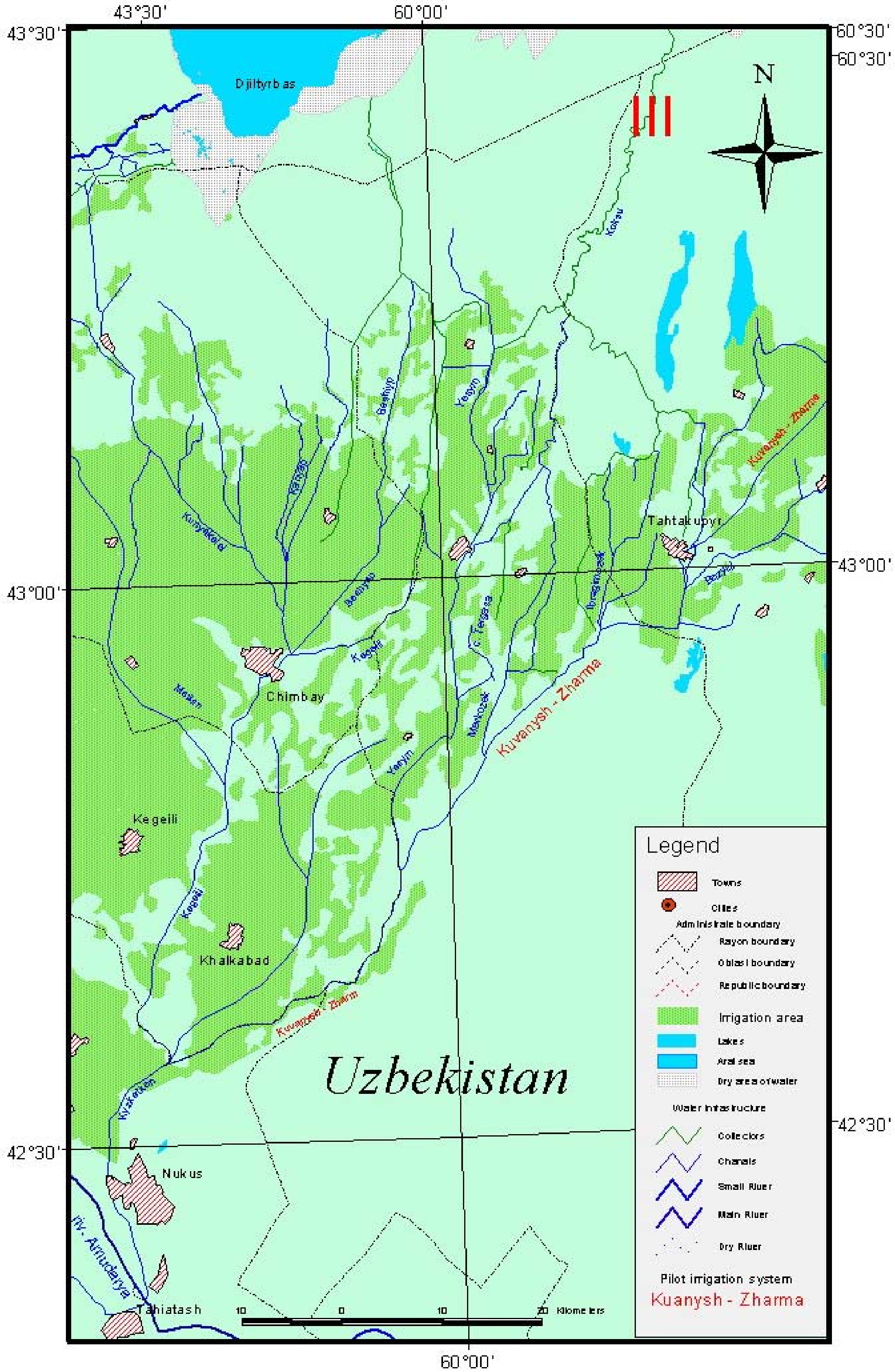

Fig. 4.4 Layout of the irrigation system « Kuvanyshdjarma »

Among those ***farms*** the most representative are:

- the head - «Tabyn Reyim»
- mid-reach - «Elista»
- the tail end - «Artykbai Esbosynov».

Tabyn Reyim. The farm has an irrigated area of 12.9 ha served by gravity flow through an earthen irrigation canal network 1 km long. In 2003 cotton was cultivated as the main crop on 93% of the land. Between 2000 and 2003 the water availability averaged 64.3%, and in the low water years 2000 and 2001 it was only 26.9% and 30.2%. The groundwater table depth is 1 to 2 m over the entire area. About 56% of the soils are medium saline, belonging mostly to fertility category IV.

Elista. The farm has an irrigated area of 47.5 ha, served by a gravity flow through an earthen canal irrigation network 0.4 km long. Cotton accounted for 61% of the area in 2003 cropping pattern. Water availability averaged 64.3% between 2000 and 2003, and was 27% and 30.1% in the low water years 2000 and 2001. The groundwater table is at depth of 1 to 2 m over the entire area. About 56% of the soils are medium saline. Regarding the fertility, the soils belong to class IV.

Artykbai Esbosynov. The irrigated area of the farm is 25 ha, entirely served by gravity flow through an earthen canal network 0.4 km long. Cotton as the main crop accounted for 100 % of the area in 2003. Water availability averaged 64.3% between 2000 and 2003, and was 26.8% and 30.2% in the low water years 2000 and 2001. The groundwater table depth is at 1 to 2 m over the entire land area. About 56% of the soils are medium saline. As to fertility, the soils belong to category IV.

4.5 KYZYLORDA PROVINCE, KAZAKHSTAN – THE SYR-DARYA DELTA

The NWG for Kazakhstan selected Kazalinsk district in Kyzylorda province as the pilot zone (Fig.4.5). The selection was made for the following reasons:

- The district is located at the lowest point of the Syr-Darya lowlands
- The last dam intake - Kazalinsk waterworks - is located in the district
- The district is important from the point of view of water allocation between the sectors of the economy and the wetlands of the Syr-Darya and the Aral Sea
- The district has a great water demand during the growing season, and, at the same time it suffers from floods during the winter
- There is a great competition for water amongst the key water uses – crop production, animal husbandry, fishery, and ecosystems
- There are no WUAs registered in the Ministry of Justice, and the territorial water management organization - KDP Kazalyvodkhoz - is poorly developed
- Irrigation schemes are scattered and the water supply and drainage network requires massive and large-scale repair and reconstruction
- Low efficiency in irrigation water and land use, unprofitable agricultural production
- Poorly applied agronomic and hydro-technical measures
- Insufficient awareness and involvement of water users in IWRM

4.5.1 Selection of a hydro-boundary / irrigation & drainage system

From the three alternatives for a pilot irrigation & drainage system in Kazalinsk district (“Kazalinsk left-bank”, “Kazalinsk right-bank”, and “Baskara”, depicted in ***Appendix 4j***, the “Kazalinsk right-bank” is the most representative in regard to the selection criteria, as shown Table 4.3 below.

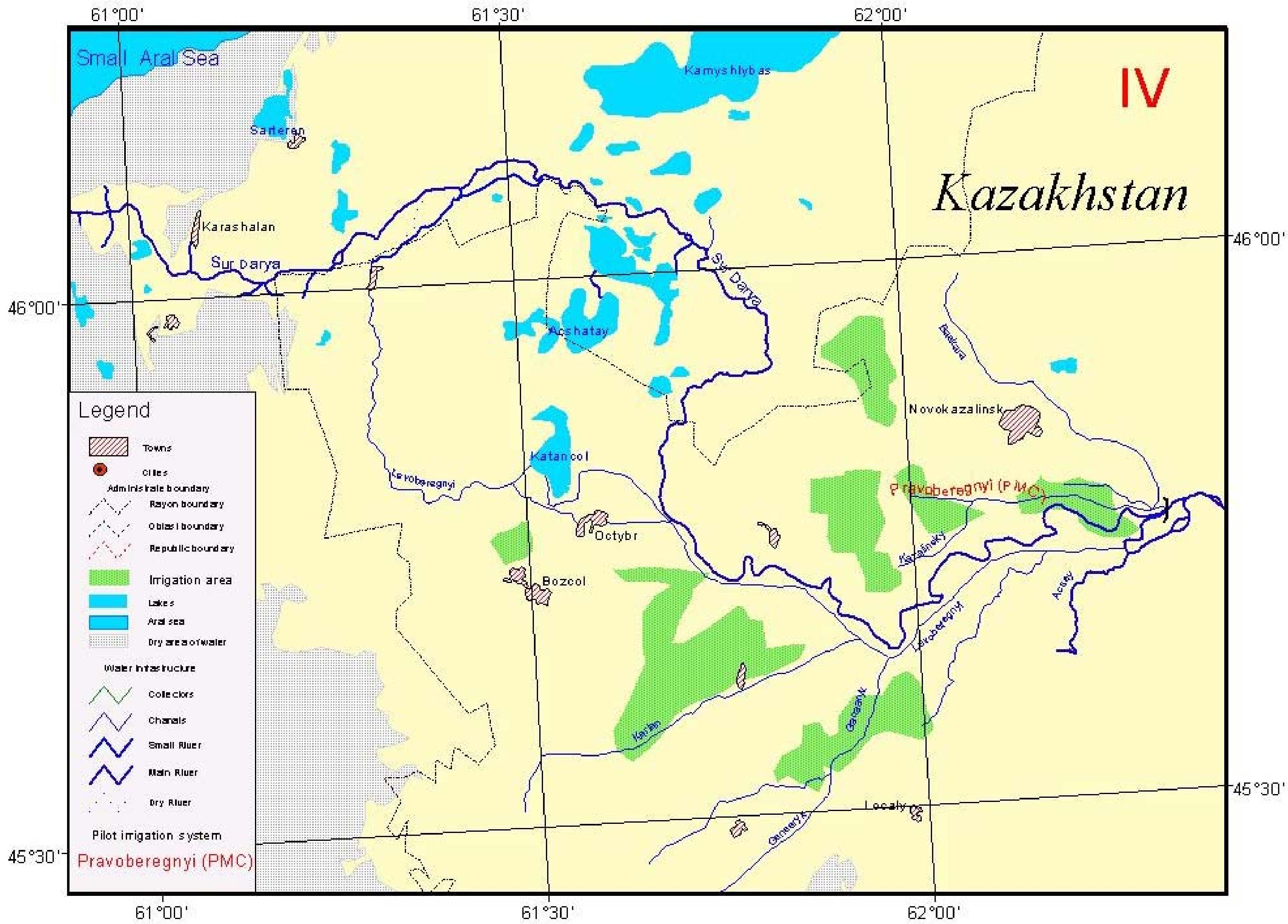

Fig. 4.5 Layout of the irrigation system of the Right-Bank (Pravoberegnyi) Main Canal, Kazalinsk waterworks

Table 4.3 Key characteristics of the Right-bank main canal irrigation system

№	Characteristic		Unit	RMC hydro-boundary /irrigation system
1	Water source			*The Syr-Darya*
2	Type of intake			*Dam*
3	Capacity of intake structure		m^3/s	30.0
4	Canal length, of which:		km	19.5
	- concrete-lined		km	0
	- earthen /unlined		km	19.5
5	Secondary canals			2
	Total length		km	19.4
6	Water withdrawal at the head of canal (2003)			
	- demand (plan)		Mm^3	168.87
	- actual		Mm^3	138.6
	- % actual of plan		%	82
7	Water supply to farms			
	- demand (plan)		Mm^3	143.5
	- actual		Mm^3	118.66
	- % actual of plan		%	83.0
8	Canal efficiency	*design*		0.85
		actual		0.86
9	Total volume of losses	*design*	Mm^3	25.37
		actual	Mm^3	19.92
10	Irrigation norm			
	- demand (gross)		thousand m^3/ha	22.08
	- actual (gross)		thousand m^3/ha	18.26
11	Number of hydro-structures, of which:			7
	Separators/traps			1
12	Number of water-measuring structures			0
	Necessary number of water-measuring structures			12
	Actual number of water-measuring structures			0
13	Irrigated area		ha	6497

The scheme is located on the right bank of the Syr-Darya and lies within the administrative boundaries of Kazalinsk district. Water is brought to the system through the right-bank regulator of Kazalinsk waterworks. The head part of the earthen right-bank main canal up to DP 19.5 is constructed for discharge of 30 m^3/sec (Table 4.4). Three inter-farm distributors P1, P2 and P3 deliver water to the farms. In 2004, the irrigated area was 8 260 ha. Drainage and discharge waters are collected by the inter-farm collectors into the main collector and are further discharged into local sinks. Three main collectors dispose of water from irrigated lands.

Table 4.4 Key characteristics of the Right-bank Main Canal (RMC)

Beginning of operation	Number of hydraulic structures	Irrigated area (design)	Head discharge (design)	Length	of which:	
				Total	Earthen	lined
		thousand ha	m^3/s	km	km	km
1946	29	11.3	30.0	52.9	52.9	0

4.5.2 Selection of a Water User Association

From the three examined associations - Zhalantos (1248 ha), Muratbatev (1074 ha), and Syr-Marjan (1160 ha) - located within the zone of the Kazalinsk Right-bank main canal, the association "Zhalantos" fits best the selection criteria, as shown in ***Appendix 4k***. The whole area of the association is served by gravity irrigation. The cropping pattern is represented by rice on 52.1% and perennial grass on 36.1%. The association has 4 irrigation sites, each about 312 ha. The soils are mainly alluvial-meadow (for 43.1% of the area) and meadow boggy (19.3%). As to salinity, about 70% of the soils are medium saline. The groundwater table level varies from 0.5 to 1 m on 32% and from 2 to 3 m on 30% of the irrigated area during the growing season.

4.5.3 Selection of farms

Three groups of farms within the boundaries of the association "Zhalantos", as described in ***Appendix 4l***, were examined, each group accordingly with the required location along the irrigation system:

- at the head: «Kashakbai» (83 ha); «Kadyr» (130 ha); «Baymakhanov» (25 ha)
- at mid-reach: «Atameken» (160 ha); «Temir» (30 ha); «Darkhan» (60 ha)
- at the tail end: «Zhankoja» (155 ha); «Shakien» (110 ha); «Shyli» (50 ha).

Among those farms the most representative are:

- the head: «Kadyr»
- mid-reach: «Atameken»
- the tail end: « Zhankoja ».

"Kadyr". The farm has an irrigated area of 130 ha and earthen canal irrigation network 14 km long. The irrigation over the entire area is by gravity flow. The cropping pattern for 2003 was: rice on 53.8% and perennial grass on 38.5%. Water availability was on the average 85.5% between 2000 and 2003. The groundwater table is at depth from 2 to 3 m on 71% of the irrigated area. The soils are lowly saline on 53% and medium saline on 27 % of the irrigated area, respectively.

"Atameken". The irrigated area is 160 ha, served by gravity flow. The length of the earthen canal irrigation network is 8 km. Cropping pattern for 2003 was: perennial grass on 62.5% and rice on 37.5% of the area. Water availability averaged 89.5 % over 2000-2003. Groundwater depth is from 2 to 3 m (70%). The soils are low saline on 50% and medium saline on 34 % of the irrigated area respectively.

"Zhankoja". The irrigated area is 155 ha, served by gravity flow. The length of unlined canal irrigation network is 16 km. The cropping pattern for 2003 was: grain crops on 51.6% and perennial grass on 32.3% of the area. Water availability averaged 90.5% from 2000 to 2003. The groundwater table depth is at 2 to 3 m on 76% of the irrigated area. The soils are lowly saline on 45% and medium saline on 35% of the irrigated area, respectively.

5. ACTION PLAN AND FUTURE ACTIVITES

Proposals for future activities concerning the project completion and development of Integrated Water Resources Management in the Amu-Darya and Syr-Darya lowlands are shown in the tables 5.1-5.6. They are formulated as two groups:

- General measures including organization of launching the project; organization of public participation and communication with official decision makers; organization of exchange of experience; and organization of training of specialists in water management organizations

- Measures for three levels of hierarchy of water management:

I level – privately owned farms/leased plots
II level – associations/groups of water users
III level – irrigation systems of main and inter-farm canals

A distinctive place in the proposed project takes up the issue of securing sustainable water supply for lowlands and deltas in regard to its quantity and quality, especially during the years of different water availability. To express the crucial importance of organization of the trans-boundary water management for the tail-end areas of the lowlands, a separate packet of activities and outcomes was prepared for each river as level IV management.

The project is foreseen as 3-year project, with budget for activities and measures for three levels of hierarchy of water management that can be achieved in the 3-year period. The plan of activities is shown in Annexes 5.1 to 5.6. It is envisaged, that all work be completed by local staff, under supervision and guidance of national coordinators. The methodological work would be headed by a Regional group of experts under leadership of the SIC ICWC. The preliminary budget for the part of work planned done under the leadership of SIC ICWC is US$ 1,762, 769 (as below in Table 5.7a, b) and described in details in Annex 5.7.

Table 5.7a Budget for the project «Transition to IWRM in Amu-Darya and Syr-Darya lowlands and deltas»
(for local staff and expenses)

№	Project activities	Total, US$	I year	II year	III year	Note
I	PERSONNEL	868 200	260 460	347 280	260 460	Annex 5.7
II	LOCAL TRAVEL	186 050	55 815	74 420	55 815	
III	OPERATIONAL EXPENSES	127 840	42 613	42 613	42 613	
IV	EQUIPMENT	108 300	108 300			
V	MATERIALS	26 400	10 000	8 200	8 200	
	TOTAL RECURRENT COSTS	**1 316 790**	**477 188**	**472 513**	**367 088**	
	OVERHEAD EXPENSES	131 679	47 719	47 251	36 709	
VI	SEMINARS	165 000	57 000	51 000	57 000	
VII	SUBCONTRACTS	62 800	18 840	25 120	18 840	
VIII	UNFORESEEN EXPENSES	72 500	21 750	29 000	21 750	
IX	SERVICING OF BILLS	14 000	5 000	4 500	4 500	
	TOTAL COSTS	**1 762 769**	**627 497**	**629 385**	**505 887**	
	including:					
	Regional working group	**705 048**	**234 120**	**259 033**	**211 895**	

№	Project activities	Total, US$	I year	II year	III year	Note
	National working groups	**1 057 722**	**393 377**	**370 352**	**216 134**	
	NWG Kazakhstan	*248 957*	*93 087*	*86 900*	*68 970*	
	NWG Kyrgyzstan	*37 150*	*12 922*	*13 507*	*10 722*	
	NWG Tajikistan	*74 300*	*25 843*	*27 013*	*21 443*	
	NWG Turkmenistan	*248 957*	*93 087*	*86 900*	*68 970*	
	NWG Uzbekistan	*448 359*	*168 438*	*156 032*	*123 888*	

Table 5.7b Budget for the project «Transition to IWRM in Amu-Darya and Syr-Darya lowlands and deltas»
(for Directions and Components)

Level	Directions and Components	Total, US$
	Project management	83 900
I Level	Private Farms/Leaseholds	298 700
II Level	Water User Associations/Unions/Cooperatives	418 200
III Level	Irrigation System Administrations for mains and inter-farm canals	478 000
IV-1 Level	Trans-Boundary Water Management for the Amu-Darya Basin	234 000
IV-2 Level	Trans-Boundary Water Management for the Syr-Darya Basin	250 000
	TOTAL COSTS	1 762 800

Total preliminary estimate of budget including participation of international experts is approximately US$3,525,500.

PLAN OF ACTIVITIES FOR PROJECT "IWRM IN AMU-DARYA AND SYR-DARYA LOWLANDS AND DELTAS"

Table 5.1 GENERAL MEASURES

Objectives and principles	Expected results	Activity	Performance indicators
A) Organizational measures to launch the project	• Establishment of institutional framework for project implementation and the project financial, technical and material support	• Development of detailed work plan	• Detailed project work plan.
		• Development of agreement between the key agencies in participating countries on institutional and technical support for implementation of IWRM	• Protocol agreement between the key agencies in participating countries regarding institutional and technical support for implementation of IWRM
		• Selection of project executors at national and regional levels	• Complete staff of local and regional project executors
		• Approval of the detailed work plan and budget for I year (first stage) of works	• Detailed work plan and budget for I year (first stage) of works
		• Development and approval of TOR's for project executors	• Terms of Reference for project executors
		• Arranging financial and payment procedures.	• Opening of project financing
		• Establishment of communication system between the executors • Equipping the project executors with office equipment, communication facilities, etc.	• Workplaces equipped with communication facilities and office equipment
		• Preparation and holding of initiation workshop for National and Regional project executors	• Start-up workshop for primary project executors.
B) Securing public participation at bottom–up in matters of decisions related to key aspects of IWRM implementation. Social mobilization	• Creation of a system of Public Councils for IWRM, including water users, water-management institutions, and allied sector institutions, water-related research institutes, NGOs at different hierarchical levels of water management • Development and approval of suggestions of the Public Councils on matters concerning transition to IWRM • Public awareness on project development	• Development and adoption of Regulations for Public Councils promoting IWRM at different hierarchical levels of water management; • Development of program for workshops to explain the IWRM principles for the members of Public Councils at different water hierarchical levels • Organization and holding of workshops to explain the IWRM principles to the members of Public Councils at different water hierarchical levels	• Initial /start-up workshops for explanation of IWRM principles for the members of Public Councils at different water hierarchical levels

Objectives and principles	Expected results	Activity	Performance indicators
		• Organization of work of public councils to promote IWRM in BWOs, provinces, irrigation systems, and WUAs	• Systematic and effective work meetings of Public Councils • Number of participants • Representation of various groups of water users and consumers
		• Organization of sociological surveys to find out the public opinion on IWRM aspects and to estimate a degree of farmer involvement in IWRM process	• Results of sociological surveys and estimations • Estimations of the degree of farmer involvement in IWRM processes
		• Creation of public opinion regarding necessity and possibility of rational water and natural resources use	• Promotion of rational water and natural resources use in mass media through examples of project sites; publications - number of periodicals • Library of project publications and its dissemination among project participants • Web-page of IWRM Downstream Project
C) Establishment of links with decision makers	• Open dialogue between IWRM Public Councils and decision-makers • Joint search and identification of ways promoting IWRM	• Preparation of monthly newsletters on project progress and government decisions related to water sector to keep IWRM Public Councils and decision makers informed • Open discussion of the key aspects of IWRM development and organization of dialogue between IWRM Public Councils and decision-makers	• Degree of participation in joint "round-table" meetings • Number of joint "round-table" meetings • Effectiveness of "round-table" meetings • Extent, to which political climate is favorable for undertaking necessary actions, by executive authorities, that contribute to solution of legal and economic issues of IWRM
		• Development of a concept (first draft) for transfer to integrated water management in Amu-Darya and Syr-Darya lowlands	• First draft concept for transfer to integrated water management in Amu-Darya and Syr-Darya lowlands
		• Open discussion of the concept (first draft) for transfer to integrated water management in Amu-Darya and Syr-Darya downstream	• Extent to which the public participated in discussion of the concept
		• Adoption of final version of the concept according to comments made.	• The concept for transfer to integrated water management in Amu-Darya and Syr-Darya lowlands

Objectives and principles	Expected results	Activity	Performance indicators
D) Organization of sharing of experience with other projects	• IWRM-related methodologies taken from past or ongoing projects on and adapted to specific features of downstream zones	• Adaptation of IWRM-related methodologies taken from the following projects: WARMAP; "ISEAM"; CIRMAN-ARAL; A-2 GEF; “Best practices”, Climate change, IWRM Ferghana Valley, etc., based on specific features of Amu-Darya and Syr-Darya downstream and deltas	• Cooperation between IWRM-related projects and avoidance of duplication • IWRM Downstream Project’s Database, which is accessible for water users at different water hierarchical levels
E) Training of staff from water-management institutions and WUAs and capacity building of farmers	• Specialists of different hierarchical levels in water and agriculture, who have been trained in use of IWRM principles in practices and in rational methods of water and natural resources use	• Development of target training programs and a series of presentations dedicated to various groups of water hierarchy • Organizing and holding training and field days for project participants	• Number of trained persons and of training sites for farmers • Number of workshops to share an experience and number of field trips to similar projects’ sites
		• Sharing experience in IWRM implementation between given project and other similar projects	• Work meetings and discussions among up-, mid-, and downstream water users in the Amu-Darya and Syr-Darya basins

Table 5.2 LEVEL I: PRIVATE FARMS/ LEASEHOLDS

Objectives	Expected results	Activity	Performance indicators
Ia To estimate and analyze the actual productivity of irrigated agriculture and efficiency of water use in agriculture	• Passports of field-indicators (I part) with basic initial data that characterizes actual irrigation productivity as well as water use and agricultural production efficiency • Proposals for improving and developing information and functional relationships, horizontal and vertical, at farm and leasehold levels	• The first stage of developing passports for field-indicators located at the head, mid-point and end-tail of irrigation systems within WUA profiles (topography, soils, groundwater regime, land salinity degree, length and configuration of irrigation and collector-drainage infrastructures, irrigation and collector-drainage water salinity, agro-economic indicators, etc.)	• Set of passports for field-indicators located at the head, mid-point and tail of irrigation systems within WUA profiles, with basic initial data for database
		• Assessment and analysis of legal environment for enabling farmer activities and their involvement in water management • Assessment and analysis of farmers’ functional and information relationships with vertical “water hierarchy” and adjacent management hierarchies	• Basic indicators and results of sociological surveys characterizing initial situation and extent to which farmers are involved in water management

Objectives	Expected results	Activity	Performance indicators
Ib To build appropriate technical, organizational and institutional capacities for successful project implementation under component Private farms/lease holdings	• Results of monitoring of irrigation practices; actual irrigation productivity and water use and agricultural production efficiency, with assessments and analyses • Field staff trained in monitoring and measurement methodology • Database of ground observations under component «Private farms» • Public awareness on IWRM and active public participation in water management processes	• Inventory of irrigation and collector-drainage infrastructure in key private farms; development of appropriate measures to improve serviceability of the infrastructure	• List of priority measures for improving serviceability of irrigation and collector-drainage infrastructure and their cost
		• Organization and equipping of inflow and outflow measurement and control points	• Number of inflow and outflow measurement and control points
		• Preparation of fields, irrigation and collector-drainage infrastructure for implementation of recommendations	• Key fields prepared for implementation of recommendations
		• Adaptation and completion of monitoring procedure for basic agricultural production and water use factors, and of agro-economic assessments of water and land productivity	• Adapted monitoring procedure and forms
		• Development of database structure under component "Private farms", including GIS elements • Preparation of appropriate mapping data for GIS databases and association of fields with GIS System	• Operational Database for component «Private farms»
		• Development of training program for field staff in monitoring methods • Holding the training in monitoring methods	• Number of field staff trained in monitoring methodology and controlled parameter measurement
		• Organization and implementation of monitoring over agricultural production factors in field-indicators located at the head, mid-point, and the tail of irrigation systems within WUA profiles	• Basic parameters characterizing actual agricultural production and water use efficiency
		• Development of training programs for farmers in national legislation bases related to water and land use, nature conservation, and IWRM principles • Training for farmers from pilot and neighboring farms in the legislation bases	• Number of farmers trained and their preparedness for active participation in IWRM principles dissemination

Objectives	Expected results	Activity	Performance indicators
		• Development of training programs for raising farmers' juridical knowledge on various aspects of their activity • Raising juridical awareness of farmers on various aspects of their activity and activating public participation in water management	• Number of farmers, from key fields and neighboring private farms, trained in legal aspects. • Extent to which farmers participate dissemination of IWRM principles
		• Maintenance of database on component «Private farms»	• Technical, operational, and agro-economic indicators of water use and agricultural production, with assessments and analysis
Ic Develop and implement in recommendations for improving land and water productivities in the key project fields	• Recommendations for improving land-water productivity as well as their implementation in the key project fields • Field staff, farmers, from the key fields and neighboring private farms, trained on how to improve water use and agricultural production efficiency • Passports of field-indicators (II part) • Farmers from the key fields and neighboring private farms that gained legal knowledge	• Development of recommendations for increasing land-water productivity as well as for water saving methods in the key project fields • Second stage (II part) of preparing field passports (inclusion of recommendations on fertilizer application norms, irrigation depths and dates, irrigation technique elements, etc.)	• Planned and feasible technical, operational, and agro-economic indicators of water use and agricultural production
		• Development of training program for field staff and farmers from the key fields and neighboring private farms in ways of improving land-water productivity and in water conservation methods • Training of field staff and the farmers in ways of improving land-water productivity and in water conservation methods	• Number of field staff and farmers from key fields and neighboring private farms trained in ways of improving land-water productivity and in water conservation methods
		• Organization of monitoring of implementation of recommendations in field-indicators located in at the head, mid-point and tail of irrigation systems within WUA contours • Adaptation of water conservation recommendations and methods to conditions of the key project fields	• Technical, operational, and agro-economic indicators of water use and agricultural production as obtained as a result of recommendations

Objectives	Expected results	Activity	Performance indicators
Id Approbate recommendations during 2 years and ensure that progress is achieved in improving land and water productivities	• Improvement of water-land productivity • Adjusted and improved methods and software	• Systematic implementation of a set of measures for water conservation and rational water use, testing of selected measures during 2 years, and expanding zone of their application • Revision of methodological documents • Adjustment and improvement of models	• Extent to which potential land and water productivities are approached
Ie Prepare recommendations for expanding application of the achieved results in downstream area	• Recommendations for expanding application of the achieved results in lowlands	• Development of recommendations for using the project results under different natural-economic conditions in downstream area by using GIS and RS in order to comprehensively estimate reserves in water use and possibility of increasing water use efficiency towards the potential land-water productivity	• Creation of conditions for dissemination of obtained results in big scale and for further development of IWRM in lowlands areas
		• Preparation of proposals on creating and functioning of extension services for farmers; • DSS preparation (Decision Support System for private farm level) • Creation of pilot extension services for farmers	• Number of pilot extension services for farmers

Table 5.3 LEVEL II: WATER USER ASSOCIATIONS/UNIONS/COOPERATIVES

Objectives and principles	Expected results	Activity	Performance indicators
IIa Evaluate and analyze the actual conditions, in which existing or developing WUAs function and the influence of these conditions on water use efficiency and water distribution uniformity	• Results of initial evaluations and analyses of the state of irrigation and collector infrastructure, and of operational and financial-economic activity of WUA • Proposals on improvement of WUA sustainability • Proposals on improvement and development of information and functional relationships, both horizontal and vertical, for "WUA" level	• Development and preparation of WUA PASSPORTS (current water management circuit (internal and external relationships), WUA structure, irrigated area layout, linear schemes and layout of irrigation and collector-drainage network, technical characteristics of this network, cropping patterns, soils and hydromodule zoning of the terrain, soil salinity, groundwater regime, the state of operating hydrometry, provision with machinery, office equipment, etc.)	• WUA passports containing basic raw information for Database • Degree of water resources manageability (water use efficiency and water distribution uniformity) and actual (starting) efficiency of WUA activity

Objectives and principles	Expected results	Activity	Performance indicators
		• Evaluation and analysis of WUA's legal environment and of involvement of WUA's members in water management • Evaluation and analysis of functional and information relationships with vertical water hierarchy and associated management hierarchies • Analysis of current situation in established WUA, their shortcomings, problems and development of proposals to overcome the above	• Major indicators and results of sociological surveys conducted in WUA and of current situation analysis, practical recommendations on how to solve present problems
		• Studying the extent to which population supports transition to IWRM	• Major indicators resulted from sociological surveys and questioning of various population groups
		• Establishment of initiative work groups at each WUA (social mobilization)	• Number of established and operational initiative work groups
IIb Build necessary technical capacity for successful implementation of the project's block "WUA" and monitoring	• Pilot WUA that are ready to implement IWRM • Project executors trained in monitoring methods • WUA's staff and members trained in different aspects of WUA activity	• Inventory of irrigation and collector-irrigation network of key WUAs and development of measures to improve infrastructure serviceability and measurability • Development of proposals on first-priority works necessary for improvement of irrigation and collector-irrigation network serviceability • Necessary Feasibility Studies of first-priority works for technical improvement of the network	• Composition and cost of the first-priority measures for improvement of irrigation and collector-irrigation network serviceability
		• Organization and equipping of inflow and outflow measurement and control points	• Number of inflow and outflow measurement and control points
		• Provision of WUAs with equipment and office facilities required for successful functioning	• Technical and organizational capacities for WUA functioning
		• Organization and equipping of meteoparameter and reference crop evapotranspiration measurement points	• Number of meteoparameter and reference crop evapotranspiration measurement points

Objectives and principles	Expected results	Activity	Performance indicators
		• Development of training programs for project executors in WUA activity monitoring methods • Training in WUA activity monitoring methods	• Number of executors trained in WUA activity monitoring methods
		• Organization and performance of monitoring	• Major indicators characterizing actual efficiency of WUA and rationality of water use within WUA contours
		• Development (using experience gained in similar projects) of training workshop programs on different aspects of WUA activities • Cycle of training workshops for managers, specialists and members of WUA	• Number of WUA specialists and members trained and their readiness to take active part in IWRM implementation
IIc Arrange discussions among all stakeholders on WUA functioning options and make mutually agreed decisions regarding selection of the more reasonable options, based on principles of effective water use, equitable water distribution and efficient land use	• Agreed decisions on reorganization/improvement of WUA and on creation of conditions promoting effective WUA functioning	• Organization of public discussions on WUA activities and on ways of increasing its effectiveness and sustainability • Identification of possible options for WUA improvement • Organization of public discussions on possible WUA functioning options and elaboration of mutually agreed decisions • Approval of work plan and measures by local authorities	• Extent to which the public is involved in water distribution and degree of consistency among different water management actors and executive governments
IId Develop and approve the required documents and provisions, including temporal regulations enabling all necessary activities under the current national legislations	• Package of documents regulating WUA activities during project implementation • Adapted water consumption and water use plan models • Database for block “WUA”	• Development of required institutional, level and financial-economic regulations • Preparation of documents regulating WUA activities during project implementation • Development of regulations on WUA activities under IWRM	• Institutional capacity enabling WUA activities under the current national legislations
		• Selection and approval by stakeholders of water distribution method (time-, volume-based, etc.)	• Water distribution method selected and approved by WUA members and the public

Objectives and principles	Expected results	Activity	Performance indicators
		• Adaptation/finishing of water consumption and water use plan models • Development of water use adjustment models • Development of database structure, including GIS elements, for block "WUA" • Preparation of necessary mapping data for GIS and RS databases and association of WUA areas with GIS system	• Operational model and database, including GIS elements, for block "WUA"
		• Development of training programs for WUA staff in water management improvement methods • Training of WUA staff in water management improvement methods	• Number of WUA staff trained in methods for improvement of water management and use
IIe Approbate the suggested recommendations on organization of WUA activities and their financial and legal improvement in pilot WUAs.	• WUA formation/improvement • Creating conditions for sustainable functioning of WUA according to developed plan • Testing results of temporal regulations and of day-to-day water distribution model • Approved day-to-day water distribution models • Database for block "WUA"	• Regular meetings for WUA members with participation of public and representatives of executive authorities Deciding the issues of WUA financing and WUA members involvement in maintenance of irrigation and drainage infrastructure.	• Mutually agreed decisions that promote conditions for sustainable operation of WUA
		• More precise definition of irrigated crop areas and of areas to be leached • Estimating possibilities of applying water rotation between private farms • Notification on procedures for WUA staff in developing water distribution and use plan and its approving by planning and management authorities	• Mutually agreed water distribution and use plans
		• Testing of developed day-to-day water distribution model and its adaptation to specific conditions (water availability, deviation of meteoelements from the mean long-term values, etc.) • Day-to-day water distribution plan and control over its implementation	• Operating day-to-day water distribution model

Objectives and principles	Expected results	Activity	Performance indicators
		• Systematic implementation, during two years, of a set of measures for water conservation and rational water use, testing of the selected measures and extension of their application zone • Assessment and analysis of achieved results	• Extent to which planned indicators of water use efficiency and water distribution uniformity are achieved • WUA staff trained in application of water distribution and use models and able to work independently
		• Development of Database for block "WUA: and its linking with "Private farms" and "Irrigation System Administrations" Databases	• Operating, aggregated Database including GIS elements
IIf Prepare corrected proposals for Governments on development and sustainable functioning of WUA.	• Set of institutional, engineering, financial, and economic documents on establishment and functioning of WUA	• Summarizing two-year WUA activities	• Prospective feasible indicators of water use efficiency and water distribution uniformity
		• Preparing proposals on amending or adjusting legislative documents in order to increase WUA efficiency • Development and suggesting of the most effective, as applied to specific downstream conditions, WUA's organizational frameworks • Developing proposals on improvement of WUA's financial relationships (both external and internal)	• A set of proposals and recommendations aimed at sustainable and efficient WUA operation (first draft prepared for discussion among the public and executive authorities)
		• Holding discussions on the set of proposals and recommendations aimed at sustainable and efficient WUA operation among the public and executive authorities • Adopting final set of proposals and recommendations	• The set of proposals and recommendations adopted as a result of discussion among the public and executive authorities
		• Preparing recommendations on how to apply the developed programs, mathematical models and Databases in WUA activities.	• A set of manuals for users, translated into Uzbek, Turkmen and Kazakh languages
		• Preparing the advanced training program for WUA's staff and Board	• the advanced training program for WUA's staff and Board, aimed at sustainable and efficient WUA operation

Table 5.4 LEVEL III: IRRIGATION SYSTEM ADMINISTRATIONS FOR MAIN AND INTER-FARM CANALS

Objectives and principles	Expected results	Activity	Performance indicators
IIIa Evaluate and analyze actual conditions of Irrigation System Administrations for Main and Inter-farm Canals (ISA MIC) and their impact on increase of water use efficiency and water distribution equity	• Results of initial evaluations and analyses of ISA MIC state regarding various aspects of their activity	• Development and preparation of PASSPORTS for ISA MIC (existing water resources management pattern within irrigation system (internal and external relationships, interaction with Administrations of Collector-Drainage Networks/ Hydrogeological and Land Reclamation services, Pumping Station Administrations, WUAs, Public Services, etc.), water distribution management structure, linear schemes and layout of irrigation and collector-drainage network, technical parameters of canals, collectors, and hydrostructures (design and actual), cropping patterns, soils and hydromodule zoning of the terrain, soil salinity, groundwater regime, the state of operating hydrometry, provision with machinery, office equipment, etc.)	• Passports of Irrigation System Administrations for Mains and Inter-farm Canals containing basic raw information for Database • Degree of water resources manageability (water use efficiency and water distribution equity) and actual (starting) efficiency of ISA MIC activity
		• Studying the extent to which water users, operational staff, local executive authorities, social organizations and others support transition to IWRM	• Major indicators resulted from sociological surveys and questioning of different water system's actors
		• Establishment of initiative work groups at each Pilot Canal Administration (social mobilization)	• Number of established and operational initiative work groups
IIIb Build appropriate technical and institutional capacities for successful implementation of the project's block "Irrigation System Administrations of Main and Inter-farm Canals" and monitoring	• Pilot ISA MIC prepared technically and institutionally for implementation of IWRM principles; • Project executors trained in monitoring methods; • ISA MIC staff trained in different aspects of activity. • Stirring up public participation in water resources management	• Inventory of the main and inter-farm irrigation and collector-drainage infrastructure and development of measures to improve infrastructure serviceability and measurability; • Development of proposals on first-priority works necessary for improvement of the main and inter-farm irrigation and collector-irrigation network serviceability	• Composition and cost of the first-priority measures for improvement of irrigation and collector-irrigation network serviceability

Objectives and principles	Expected results	Activity	Performance indicators
		• Organization and equipping of water diversion, delivery, and transit measurement and control points in the main and inter-farm canals and of water disposal measurement and control points in collector-drainage network	• Number of equipped water diversion, delivery, and transit measurement and control points in the main and inter-farm canals and of water disposal measurement and control points in collector-drainage network
		• Provision of Irrigation System Administrations for pilot Main and Inter-farm Canals with equipment and office facilities required for successful fulfillment of water management functions	• Technical and organizational capacities for fulfillment of water management functions
		• Development of training programs for executors in Irrigation System Administrations' activity monitoring methods; • Training of executors in monitoring methods	• Number of staff trained in monitoring methods
		• Organization and performance of monitoring	• Major indicators characterizing actual efficiency of Irrigation System Administrations and water distribution equity under established water withdrawal limits and water availability
		• Organization of public discussions on ISA activities and on ways of increasing its effectiveness and sustainability • Identification of possible options for ISA improvement and development of mutually agreed solutions • Approval of work plan and measures by executive authorities	• Extent to which the public is involved in water distribution and degree of consistency among different water management actors and executive governments

Objectives and principles	Expected results	Activity	Performance indicators
IIIc Develop concepts and key regulations of transition to integrated water resources management in pilot Irrigation Systems of Amu-Darya and Syr-Sarya downstream and submit them for approval of local executive authorities and social organizations in downstream zone and of relevant governmental bodies	• Organizational framework of IWRM development, principles and regulations of transition to IWRM, prepared for approval by decision-makers • Recommendations on IWRM costs sharing between government and local budgets and water users • Approaches to preparing plans for water allocation, distribution, and their revision and adjustment according to established water withdrawal limits and water availability	• Development of organizational framework options for pilot Irrigation Systems in Amu-Darya and Syr-Darya downstream • Selection of organizational framework options for pilot Irrigation Systems in Amu-Darya and Syr-Darya downstream and submission for approval by local executive authorities and social organizations in downstream zone and of relevant governmental bodies • Development of recommendations on IWRM costs sharing between government and local budgets and water users	• Organizational capacity promoting effective activities in pilot Irrigation Systems in Amu-Darya and Syr-Darya downstream within the framework of current national laws
		• Organization of discussions and approval of organizational framework options for pilot Irrigation Systems in Amu-Darya and Syr-Darya downstream and of Recommendations on IWRM costs sharing between government and local budgets and water users	• Extent to which the public takes active part in activities of water-management Councils of Irrigation System Administrations
		• Development of approaches to preparing plans for water allocation, distribution, and their revision and adjustment according to established water withdrawal limits and water availability	• Planned reduction of unproductive water losses, particularly at the interfaces between hierarchical levels • Improvement of the degree of water distribution equity
IIId Develop and adapt a set of models for planning and management of the systems of downstream pilot main and inter-farm canals.	• Adapted software for estimation of water consumption, planning and operational adjustment of water distribution based on established water limits and water availability	• Refinement of hydromodule zoning in downstream area using GIS and RS; • Identification of zones, which are most subjected to stress due to unequal water distribution	• Refined hydromodule zoning maps for irrigated areas

Objectives and principles	Expected results	Activity	Performance indicators
		• Development of software package, using SIMIS and other programs, for evaluation of water consumption and for planning and on-line adjustment of water distribution according to the established water limits and water availability	• First version of operating software
		• Adaptation of the first version of the set of models for planning and management of the systems of pilot main and inter-farm canals to specific conditions of the pilot Irrigation Systems	• Increased degree of water manageability
IIIe Work through concepts and key regulations of transition to integrated water resources management in pilot Irrigation Systems of Amu-Darya and Syr-Sarya downstream under conditions of WUAs and pilot private farms located in command areas of these systems	• ISA MIC staff trained in application of the software package in practice and able to work independently	• Testing and experimental application of the software package for evaluation of water consumption and for planning and on-line adjustment of water distribution according to the established water limits and water availability	• Calibrated, on the basis of actual data, models ready for application in practice
		• Development of manuals on application of the software package and of training programs for ISA MIC staff; • Training of ISA MIC staff in application of the software package in practice	• Number of ISA MIC staff able to work independently with the software package in order to solve water resources and water demand management tasks in practice
IIIf Prepare revised proposals for decision makers on expanding zones of IWRM implementation in Amu-Darya and Syr-Sarya downstream	• Set of legal, institutional, engineering, financial, and economic documents, revised according to results of pilot implementation, promoting transition to IWRM in Amu-Darya and Syr-Darya downstream	• Summarizing two-year activities under the block “Irrigation Systems of Main and Inter-farm Canals” and revision of developed organizational framework and regulations based on experimental results	• Prospective feasible indicators of water use and water demand management efficiency and water distribution equity

Objectives and principles	Expected results	Activity	Performance indicators
		• Preparing proposals on amending or adjusting legislative documents in order to increase efficiency of Irrigation Systems of the Main and Interfarm canals under transition to IWRM • Development and suggesting of the most effective, as applied to specific downstream conditions, organizational frameworks for downstream IWRM • Developing proposals on improvement of ISA MIC's financial relationships with the state budget and water consumers	• A set of proposals and recommendations aimed at sustainable and efficient IWRM system operation (first draft prepared for discussion among the public and executive authorities)
		• Holding discussions on the set of proposals and recommendations aimed at sustainable and efficient IWRM system operation among the public and executive authorities; • Adopting final set of proposals and recommendations	• The set of proposals and recommendations aimed at sustainable and efficient IWRM system operation and adopted as a result of discussions among the public and executive authorities
		• Development of advanced training program for ISA MIC staff and Water-Management Council members	• Advanced training program for ISA MIC staff and Water-Management Council members aimed at sustainable and efficient IWRM system operation

Table 5.5 LEVEL IV-1: TRANS-BOUNDARY WATER MANAGEMENT FOR THE AMU-DARYA BASIN

Objectives and principles	Expected results	Activity	Performance indicators
IV-1a Evaluate natural and anthropogenic flow variability and refine amounts of water resources available for a use	• Evaluation of the Amu-Darya flow, available for use in years with different water availability, particularly under low-water conditions	• More accurate assessment of natural water resources of the Amu-Darya and its integral parts	• Indicators that characterize natural flow variability and probability of low water and flood
		• Based on a long-term observation data, more accurate designation of river-flow losses in years with different water availability and in different river sections	• Specified methodology for calculating flow losses accounted for by evaporation and percolation in the river channel and reservoirs, for years with different water availability and in different river sections • Calculation methods to consider losses in estimating available river water resources

Objectives and principles	Expected results	Activity	Performance indicators
		• More accurate designation of volumes and regimes of return flow in the Amu-Darya in years with different water availability in different river sections	• Possible options of formation and disposal of collectors' flow
IV-1b Specify demand for water intake from the Amu-Darya and its tributaries, accordingly with the regime of releases and their flow	• Assessment of environmental demand for the river flow in years with different water availability, particularly under low-water conditions	• More accurate designation of the minimum share of the Priaralie related to the releases to lowlands (Darganata station) and to the river delta (Samanbai station)	• Maintenance of lake system in the Amu-Darya delta • Consideration of demand of Large Aral • Consideration of flow losses
		• More accurate designation of the ecological demand for water from the river along the river channel in years with different water availability	• Designated procedure for assessment of environmental demand (sanitary releases, releases to Priaralie, and to canals)
	• Specified demand for water from the Amu-Darya – for current situation and future	• Evaluation of the system for drinking water supply and more accurate definition of drinking water demand in the Amu-Darya lowlands (Dashoguz, Khorezm, Karakalpakstan)	• Joint use of surface water and groundwater • Assessment of water quantity and quality • Indicators for pipelines Tuyamuyun-Nukus-Chimbai-Tahtakupyr, Tuyamuyun -Urgench-Mangit
		• More accurate designation of water withdrawal for irrigation from the Amu-Darya and its tributaries	• Assessment of variants • Consideration of Afghanistan's demand
		• More accurate designation of hydropower demand for water from river Vaksh and the Amu-Darya – pressure head, releases, required HEPS load	• Assessment of variants, including sale of electric power • Consideration of new stations (Rogun HEPS, etc.)
		• Analysis of regime of regulating the flow by reservoirs	• Comprehensive assessment of variants (drinking water supply, hydropower, irrigation) • Consideration of river and in-system reservoirs located on canals
	• Designated needs for functioning of interstate irrigation systems	• Evaluation of operation of the interstate irrigation systems in the Amu-Darya lowlands in years with different water availability	• Evaluation of indicators of availability, uniformity and stability of water supply • Evaluation along the length of the river and the canals

Objectives and principles	Expected results	Activity	Performance indicators
IV-1c Prepare proposals for Rules for controlling the flow of the Amu-Darya	• Recommendations for rational releases to Priaralie and adherence to environmental releases along the river in years with different water availability	• Calculations defining rational environmental releases and associated requirements and limitations for river and reservoir regimes	• Calculations of variants • Criteria for selecting rational variants
	• Recommendations for flow regulation by reservoirs in years with different water availability	• Development of a set of models for flow regulation in the Amu-Darya basin	• Adapted set of computer programs executing models of flow regulation in the Amu-Darya river basin
		• Development of recommendations for rational distribution of regulating functions between reservoirs of Vaksh-Amu-Darya cascade in years with different water availability	• Recommendations for seasonal and long-term regulation of in-stream and in-system reservoirs • Set of objective functions reflecting interests of various water users and consumers
		• Evaluation of inflow to the Amu-Darya lowlands for years with different water availability (Darganata station)	• Variants of water use, disposal and flow regulation
		• Development of recommendations on rational control of reservoirs in Tuyamuyun waterworks in years with different water availability	• Consideration of interests of drinking water supply, power engineering and irrigated agriculture • Minimizing of water losses • Decreased siltation of in-stream reservoir in the Tuyamuyun waterworks
	• Recommendations for an improvement of drinking water quality and water supply regimes in years with different water availability	• Development of a set of models for computation of water-salt regimes in rivers and reservoirs in Amudarya basin	• Adapted set of computer programs for computation of water-salt regimes in rivers and reservoirs in the Amu-Darya basin
		• Development of variants of water-salt balances in Amudarya river and reservoirs of Tuyamuyun waterworks, selection of rational variants	• Volumes of water supply by outlets from different sources, under various variants of collector-flow disposal (Amu-Darya upstream, midstream) • Achievements or approaching norms of water quality standards

Objectives and principles	Expected results	Activity	Performance indicators
	• Recommendations for rational allocation of flow among irrigation systems and on water supply regimes in the Amu-Darya lowlands in years with different water availability	• Development of a set of models for rational allocation of the Amu-Darya flow	• Calculations of return flow formation and water productivity for annual and future outlook, taking into account relations between the river and planning zone • Possibility of assessing the impact of management in the downstream zone and neighboring countries, to identify probable effects and achieve consensus
		• Development of water balances and rational schemes of water delivery in irrigation systems in years and seasons with different water availability to regulate management system	• Regimes ensuring minimum water losses in all levels, proportional distribution of water shortage (during low water years), flood relief (in high water years), water delivery stability • Creating conditions for improvement of water productivity
	• Proposals for Rules to control the Amu-Darya flow in years with different water availability	• Preparation of proposal package for Management Rules, including recommendations for regime of water releases, flow regulation and allocation, and improvement of drinking water quality	• Linking of upstream, midstream and downstream zones of the Amu-Darya • Set of integrated indicators of estimates of regime for river, reservoir and releases • Creating conditions for guaranteed water supply • Calculated values for environmental water demand of the river, nature and deltas • Calculated values for available water resources for years with different water availability • Sequence of operation of the system of reservoirs, regime of water releases and their accumulation in different years of water availability • Order of water distribution of water resources in years of different water availability

Objectives and principles	Expected results	Activity	Performance indicators
		• Reviewing the package of proposals for Management Rules and concluding it accordingly with comments received	• Number of potential users and stakeholders involved in the review of proposals
IV-1d Create institutional and legal prerequisites for application of Management Rules for Amu-Darya river flow	• Proposals on improvement of the system of monitoring of water quality and quantity in the Amu-Darya basin	• Development of proposals for arrangement of additional sites for measurement and monitoring of water use in Amu-Darya, as well as for technical improvement of existing sites and control stations	• Justification of monitoring sites location, composition of measurements and equipment • Improved of system of flow accounting and forecasting through supplying technical equipment
		• Development of proposals for an improvement of information exchange	• Information exchange between the hydro-meteorological services and BWO
	• Establishment of institutional and legal preconditions to enable implementation of Management Rules for flow of the Amu-Darya	• Development of provision for Management Rules for the Amu-Darya	• Procedure and order for approving the Rules • Organizational scheme for introduction of the Rules into the current structure of river regime and planning of operation of infrastructure • Legal support – draft agreements, contract and addenda to existing legal documents
		• Development of provisions for public Council (Board) of BWO "Amu-Darya"	• Involvement of the Council (Board) in the river planning and management • Inclusion of representatives of all countries into the Council (Board), as well as representatives of provinces located in the basin, major water users, hydromet service, hydropower and delta systems • Enhanced cooperation based on IWRM principles
		• Development of provision for financial relations	• Procedure of financial relations between country-participants regarding management of river flow, distribution, and regulation

Objectives and principles	Expected results	Activity	Performance indicators
		• Development of provision for responsibility	• Responsibility of all countries and major water users to follow regimes and Management Rules for river flow
		• Development of provision for establishment of special branches at BWO "Amu-Darya"	• Subdivison responsible for monitoring and management of the quality of water in the river and return water
		• Development of recommendations for improvements of functioning of BWO "Amu-Darya"	• Specifics of operation of the BWO "Amu-Darya" during the extreme years (water shortage, flood)
		• Preparation of training program	• Consultations with professionals and representatives of BWO "Amu-Darya" and Ministries
	• Training in Management Rules for flow of the Amu-Darya in years with different water availability	• Preparation and holding of a series of training workshops and round-tables on the Management Rules for the flow of the Amu-Darya	• Number of trainees • Readiness of BWO "Amu-Darya" and staff of the Ministries to apply the Management Rules for the flow of the Amu-Darya

Table 5.6 LEVEL IV-2: TRANS-BOUNDARY WATER MANAGEMENT FOR THE SYR-DARYA BASIN

Objectives and principles	Expected results	Activity	Performance indicators
IV-2a Assessment of flow variability (natural and anthropogenic) and available water resources in the Syr-Darya basin	• Assessment of the available water resources in the Syr-Darya basin	• Specification of volume of water resources within the Syr-Darya river basin for different water years (low, high)	• Indicators of natural variability of the river flow, probability of floods and dry years • •
		• On basis of long-term data, refinement of flow losses in water bodies and sections of the Syr-Darya for different water years	• Methodology of calculating losses by evaporation and percolation in different sections of the river for years of different flow probability • Calculation of losses and flow losses
		• Specification of volumes and regimes of return water in the Syr-Darya basin for different water years • Change of the river flow regime along with increased flow regulation, change of consumption priorities and water diversion volume	• Study of flow volume used for consumption without return

Objectives and principles	Expected results	Activity	Performance indicators
IV-2b Countries' specification of volume of water diversion from the Syr-Darya and releases from reservoirs having trans-boundary effect	• Assessment of ecologic needs for water from rivers within the Syr-Darya basin for years of different flow availability	• Specification of water needs by the Kazakh Priaralie for releases from the Syr-Darya to lowlands and its delta.	• Sustainability of the environment in the lowlands and delta of the Syr-Darya • Water need for Small Aral Sea • Flow losses volume along the river channel
		• Calculation of ecologic requirements for the Syr-Darya flow by its different sections for years of different flow availability	• Methodology of ecologic and sanitary flow needs for bodies and delta of the Syr-Darya
	• Specification of water demand from rivers of within the Syr-Darya basin: as status-quo and in perspective	• Assessment of systems for drinking water supply and drinking water demand in the Syr-Darya lowlands (Kyzyl-Orda)	• Options for rational water use of surface and groundwater • Assessment of amount of drinking water and its quality
		• Specification of needs for water for irrigation from Syr-Darya basin for different development scenarios	• Specified volumes of water diversions by countries within the Syr-Darya basin.
		• Specification of water need for hydropower from Syr-Darya basin (Toktogul hydropower station etc.) • Analysis of flow regulation regime of large reservoirs	• Comprehensive assessment of water use by key sectors of the economy and environment for different options of development
	• Definition of ecologically allowable water volumes for years of different water years	• Balance of water resources and needs for different river sections for different years	• Proposals for trans-boundary water volume diversions which are allowed for years of different flow probability
IV-2c Preparation of proposals for Rules of flow management in the Syr-Darya basin	• Analysis of actual water distribution and releases along the river for the last 15 years	• Assessment of functioning of the interstate water infrastructure and irrigation systems in the Syr-Darya basin	• Indicators of water supply reliability and steadiness; • Assessment of water availability of the river and irrigation systems • Criteria for rational options for releases and selection of restrictions • Calculated variants for releases and restrictions
	• Improvement of a set of models in the basin, for various regimes of releases and intakes	• Modeling of the regulation of the river flow (seasonal and long-term)	• Computer programs for models of flow regulation of rivers within the basin
		• Specification of requirements to Naryn-Syr-Darya cascade of reservoirs, including Arnasai	• Requirements of the of the Naryn-Syr-Darya cascade of reservoirs for regulating the flow

Objectives and principles	Expected results	Activity	Performance indicators
		• Definition of operational regime of the cascade with regard to: - Arnasai, Rezaksai and Kekgulsai - Arnasai, Rezaksai, Kegkulsai and Koksarai - Kambarata 1 and Kambarata 2	• Options for water consumption, withdrawal and flow regulation
		• Development of proposals for rational management of reservoirs within the river basin	• Recommendations for coordination of interests to provide water supply for drinking, hydropower and irrigated agriculture
	• Recommendations for drinking water quality and regime of water delivery	• Modeling of water-salt balance of the river and reservoirs	• Set of computer programs for calculation of salt balance of the river and reservoirs on the Syr-Darya
		• Optimal options of water-salt balance for the Syr-Darya and reservoirs	• Volumes of water delivered along the river, pipelines and groundwater • Options for collector flow and drainage disposal
	• Recommendations for rational distribution of flow in the irrigation systems and regime of water delivery, including lowlands and Arnasai	• Modeling of rational water distribution along the Syr-Darya • Water balance and rational plans for water supply to irrigation systems for years of different flow probability and for 'in-season' flow distribution	• Recommendations for regulating the flow, with regard for the return flow and increase in water productivity • Regime to minimize water losses and optimize water distribution under conditions of water deficit and excess • Formulation of conditions for increase in water productivity
	• Proposals for development of Rules for management of flow on the Syr-Darya for years of different flow probability	• Preparation of set of proposals for Rules on trans-boundary water management including recommendations for flow regulation and distribution, and improvement of drinking water quality	Set of measures on: • Coordination of upper, middle and lower reaches requirements • Set of indicators of river flow and reservoir operation regime • Conditions formation for guaranteed water supply • Water requirements of natural complex, river and its delta • Calculation of available water resources use • Optimal regime of reservoir system operation • Recommended order of water resources distribution among riparian countries

Objectives and principles	Expected results	Activity	Performance indicators
		• Model of Water Power Consortium (WPC) activity concerning financial mechanism for stabilizing river flow of irrigation and hydropower sub-sectors	• WPC participation in stabilization of the flow regime within the basin.
IV-2d Creation of organizational and legal preconditions for joint management of trans-boundary water resources and their mutually beneficial use in the Syr-Darya basin	• Development of a package of normative-legal acts to improve regional organizational structure for management of trans-boundary water resources in the Syr-Darya basin	Preparation of draft normative-legal acts: • Agreements on main principles of joint water resources management, use and protection • Ecologic flow of the Syr-Darya, accounting for the Northern Priaralie and the Aral Sea; • Rules for management of water resources within the Syr-Darya basin Assistance to the Governments in drafting Agreements: 1. Improvement to 1998 Agreement 2. Establishment of International WPC	Drafts of normative-legal acts agreed upon with authorized representatives: • Draft Agreement on main principles of joint water resources management, use and protection within the Syr-Darya basin • Draft Agreement on Syr-Darya river ecologic flows, accounting for the Northern Priaralie and the Aral Sea; • Draft Rules for water resources management within the Syr-Darya basin Proposals for draft agreements: 1. Improvement to 1998 Agreement 2. Establishment of International Water-power consortium
		• Preparation of project Provision of Public Council of the 'BWO Syrdarya'	• Draft Provision of Public council of the 'BWO Syrdarya'
	• Training in 'Rules for management of water resources of the Syr-Darya basin	• Drafting training program • Preparation and conducting of workshops series and round tables on Rules for management of water resources within the Syr-Darya river basin	• Training reports

Annexes: Chapter 1

ANNEX 1.1

ANNUAL AVERAGE PARAMETERS FROM CLIMATOLOGICAL STATIONS IN THE LOWLANDS OF AMU-DARYA AND SYR-DARYA

Month, year	Average monthly t°C	Max. month t°C		Min month t°C		Precipitation monthly mm	Precipitation cummulative mm	RH %	Wind speed,m/sec		Sunshine hours	Sun radiation, MDg/m²	ETo Penmann Mantith mm/month
		Aver.	abs.	Aver.	abs.				weather vane	h=2 m			
Meteo station Urghench High 100 m Height of the weather vane 11 m (K=0.76)													
1	-3.9	1.1	22	-8	-27	7	7	77	3.6	2.74	4.2*)	6.7	16.8
2	-2.5	4.3	26	-6.1	-28	10	17	73	4	3.04	5.5	10	24.4
3	4.8	11.6	32	0	-20	18	35	67	4.2	3.19	6.1	12.8	55.9
4	14.3	21.3	38	8.1	-6	16	51	54	4.1	3.12	7.7	18.8	113.5
5	21.6	28.8	41	14.3	3	9	60	41	3.8	2.89	10.6	24.6	188.2
6	26.3	33.4	44	18.4	8	4	64	37	3.6	2.74	12.1	27.4	220
7	28.1	35.3	45	20.5	12	2	66	41	3.2	2.43	12.4	27.3	222.7
8	25.7	33	42	18.1	10	1	67	45	3	2.28	12	24.4	187.1
9	19.4	27.3	39	12	-3	2	69	49	2.7	2.05	10.5	19.8	119.9
10	11.4	19.2	35	4.9	-8	4	73	56	2.7	2.05	8.2	13.4	66.1
11	3.8	10.2	28	-1.3	-20	10	83	66	3.2	2.43	5.5	8.2	31.7
12	-1.8	2.6	19	-5.4	-26	11	94	78	3.4	2.58	3.4	5.5	16.7
	12.3	19.0	45	6.3	-28	94	94	57	3.5	2.63	8.2	16.6	1263.0
Meteo station Nuckus High 75 m Height of the weather vane 11 m (K=0.76)													
1	-5.4	-0.5	18	-9.6	-34	8	8	79	3.8	2.89	4.2*)	6.4	14.2
2	-3.4	2.3	25	-8.1	-31	10	18	75	4	3.04	5.5	9.7	21.6
3	3.9	10.5	32	-1.3	-25	15	33	67	4.4	3.34	6.1	13.5	53.1
4	13.3	20.8	37	6.7	-7	17	50	54	4.6	3.50	7.7	18.6	111.8
5	21	28.6	41	13.2	1	12	62	44	4.4	3.34	10.6	24.4	186.9
6	25.8	33.4	44	17.1	6	5	67	42	4.1	3.12	12.1	27.2	219
7	27.7	35.2	45	19.4	9	4	71	45	3.9	2.96	12.4	27.1	228.8
8	25.2	33.2	43	17	7	2	73	48	3.8	2.89	12	24.6	192.1
9	19	27.3	39	11	-3	3	76	52	3.4	2.58	10.5	19.4	121.6
10	10.8	18.6	34	3.9	-9	8	84	58	3.2	2.43	8.2	13	64.8
11	2.8	9.4	26	-2.3	-24	7	91	68	3.3	2.51	5.5	7.8	28.4
12	-3.2	1.6	20	-7	-28	11	102	80	3.5	2.66	3.4	5.2	13.9
	11.5	18.4	45	5.0	-34	102	102	59	3.9	2.94	8.2	16.4	1256.2
Meteo station: Kyzyl -Orda High: 128 m Height of the weather vane 11 m (K=0.76)													
1	**-9.4**	-4.7		**-13.3**		14	14	**78**	4.5	3.4	4.1	5.7	**11.4**
2	-7.5	-2.1		-11.6		14	28	77	4.8	3.6	5.5	9.1	16.0
3	0.9	7.2		-3.6		**17**	45	71	4.9	3.7	6.2	13.1	42.5
4	11.8	19.1		5.4		17	62	51	5.3	**4.0**	8.7	19.4	113.5
5	19.5	27.1		11.8		12	74	39	4.7	3.6	11.2	24.9	191.1
6	24.3	32.0		16.3		6	80	36	4.0	3.0	**12.1**	**26.9**	**215.3**
7	**26.3**	**34.1**		18.4		5	85	**37**	3.7	**2.8**	12.0	26.2	223.4
8	23.8	31.8		15.6		3	88	37	3.9	3.0	11.6	23.6	197.1
9	17.1	25.5		9.1		4	92	42	3.8	2.9	9.7	17.9	124.7
10	8.6	16.3		2.0		9	101	54	3.7	2.8	6.7	10.9	62.7
11	0.2	6.1		-4.5		13	114	70	3.9	3.0	4.5	6.5	24.4
12	-6.4	-2.3		-10.3		15	129	78	4.2	3.2	**3.5**	**4.8**	12.3
	9.1	15.8		2.9		129	129	56	4.3	3.3	8.0	15.8	1 234.4

*) - Here and further there are the data of the meteo station Takhiotash

APPROXIMATE WATER-SALT BALANCE OF THE SURFACE WATER IN THE LOWLANDS OF AMU-DARYA

ANNEX 1.2.

Region	Years	Water for irrigation	Mineralisation of irrigation water	Entry/Inflow of salts	Collector-drainage water	Mineralisation of sewage-drainage waters	Share of collector-drainage waters in the total volume of irrigation water	Export of salts,	Accumulation (+) - Export (-) of salts	Specific accumulation (+) - Export (-) of salts
		Mm^3	g/l	thousn. t	Mm^3	g/l	%	thousn. t	thousn. t	t/ha
Khorezm	1980	6230	0.87	5420	3192	2.72	51	8682	-3261	-17.8
	1985	5284	0.90	4756	3251	2.47	62	8031	-3275	-15.9
	1990	4622	0.91	4206	2740	3.72	59	10193	-5987	-23.8
	1995	4203	0.86	3614	3105	2.29	73	7111	-3497	-13.6
	1999	5300	0.82	4346	3895	2.48	74	9660	-5314	-20.4
	2000	3224	0.91	2934	1660	3.28	52	5443	-2510	-9.6
	2001	2179	0.94	2049	895	2.75	41	2462	-413	-1.6
	2002	3762	0.84	3160	2870	2.08	76	5969	-2809	-10.8
	2003	4591	0.80	3673	3081	2.00	67	6162	-2490	-9.5
Dashoguz	1980	6157	0.69	4248	1012	3.94	16	3987	+ 261	+1.2
	1985	6891	0.75	5168	1183	3.88	17	4590	+ 578	+2.1
	1990	5779	0.80	4623	1158	3.83	20	4435	+ 188	+0.6
	1995	7287	0.84	6121	1645	3.85	23	6333	- 212	-0.5
	1999	5121	0.86	4404	1001	4.17	20	4174	+ 230	+0.6
	2000	3113	0.90	2802	662	4.66	21	3085	- 283	-0.7
	2001	3472	0.93	3229	573	4.87	17	2791	+ 438	+1.2
	2002	6167	0.94	5797	1076	5.08	17	5466	+ 331	+0.8
	2003	6547	0.92	6024	1249	5.05	19	5307	+ 717	+1.7
Karakalpakstan	1980	8645	1.08	9298	2771	3.39	32	9397	-100	-0.3
	1985	8548	0.80	6889	2943	2.76	34	8143	-1254	-2.8
	1990	7436	1.20	9068	2331	4.22	31	9870	-803	-1.6
	1995	6513	1.15	7196	1876	3.29	29	6553	+642	+2.7
	1999	7801	1.12	8697	2737	3.57	35	9762	-1065	-2.1
	2000	3595	1.27	4547	1572	4.31	44	6779	-2232	-4.5
	2001	2173	1.40	3040	590	4.19	21	2473	+567	+1.1
	2002	5812	1.01	5888	1202	3.12	21	3751	+2137	+4.3
	2003	8030	1.10	8809	2250	3.05	28	6850	+1959	+3.9

Annexes: Chapter 4

Annex 4a

Khorezm province (Uzbekistan)
Selection of hydro land reclaiming/irrigation system

№	Indicator	Unit	Khorezm province	Hydro land reclaiming/ irrigation system of canal Tashsaka	**Hydro land reclaiming/ irrigation system of canal P.Gazavat**	Hydro land reclaiming/ irrigation system of canal Kilichboy
1	**Total water withdrawal, of which: (2003)**					
	Irrigated agriculture*	%	97.7	94.5	**98.6**	100.0
	Rural water supply	%	0	0	**0**	0
	Pastures	%	0	0	**0**	0
	Fishery	%	0.7	1.1	**1.4**	0
	Drinking water supply	%	1.2	4.4	**0**	0
	Industry	%	0	0	**0**	0
	Public utility	%	0.4	0	**0**	0
	Other sectors	%	0	0	**0**	0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	13.4	13.1	**14.2**	14.9
	2001	thousand m^3/ha	9.5	10.2	**9.7**	11.4
	2002	thousand m^3/ha	15.4	15.0	**15.2**	18.4
	2003	thousand m^3/ha	18.4	19.4	**18.8**	18.9
3	**Water availability**					
	2000	%	72.9	76.7	**76.8**	80.0
	2001	%	53.9	62.8	**55.0**	64.5
	2002	%	85.3	85.0	**85.0**	92.5
	2003	%	100.3	98.5	**100.8**	97.5
4	**Length of irrigation network (up to outlets)**	km	2416.3	659.2	**574.2**	206.2
	of which:					
	unlined	%	89.1	80.8	**90.4**	92.8
	antifiltration coating	%	10.9	19.2	**9.6**	7.2
5	**Cropping pattern in 2003 (%% of total irrigated area)**					
	Crop №1 cotton	%	41.0	39.0	**42.1**	42.8
	Crop №2 wheat	%	15.4	14.6	**16.0**	11.2
	Crop №3 rice	%	10.8	12.4	**4.7**	18.3
	Crop №4 vegetables and cucurbits	%	2.6	1.8	**2.8**	3.7
	Crop №5 corn	%	0.2	0.1	**0.2**	0.3
	Other crops	%	30.0	32.0	**34.2**	23.7
	Including household plots	%	15.0	18.0	**17.6**	10.7

№	Indicator	Unit	Khorezm province	Hydro land reclaiming/ irrigation system of canal Tashsaka	**Hydro land reclaiming/ irrigation system of canal P.Gazavat**	Hydro land reclaiming/ irrigation system of canal Kilichboy
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	37.0	40.2	**37.1**	41.0
	Pumped water lift	%	63.0	59.8	**62.9**	59.0
7	**Mean irrigated area per outlet**	ha	91.2	101.4	**67.7**	100.6
8	Number of outlets		2801	698	**911**	320
	of which equipped with gauging devices		620	202	**183**	138
9	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	0	0	**0**	0
	Low saline	%	56.2	60.1	**47.2**	56.3
	Medium saline	%	31.4	29.0	**37.8**	29.4
	Heavy saline	%	12.4	10.9	**15.0**	14.3
10	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 -1 m	%	47.0	58.3	**35.7**	70.3
	1 - 2 m	%	48.2	39.0	**57.5**	28.3
	2 - 3 m	%	4.3	2.7	**5.6**	1.4
	3 - 5 m	%	0.5	0	**1.2**	0
	> 5 m	%	0	0	**0**	0
11	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	2.3	0.4	**2.3**	0
	II class	%	35.4	33.2	**41.0**	34.9
	III class	%	42.7	39.0	**42.8**	56.7
	IV class	%	18.9	25.7	**13.9**	8.4
	V class	%	0.7	1.7	**0**	0

Annex 4b

Khorezm province (Uzbekistan)
Irrigation system of canal «Palvan-Gazavat»
Selection of water user association

№	Indicator	Unit	Irrigation system of canal P.Gazavat	**WUA "Mirab"**	WUA "Gauk-yab"	WUA "Shikh-yab"
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%	98.6	**100.0**	100.0	100.0
	Other sectors	%	1.4	**0**	0	0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	14.2	**10.5**	12.2	10.5
	2001	thousand m^3/ha	9.7	**7.4**	6.4	6.5
	2002	thousand m^3/ha	15.2	**12.0**	17.6	12.6
	2003	thousand m^3/ha	18.8	**14.5**	16.0	14.1
3	**Water availability**					
	2000	%	76.8	**81.0**	67.0	84.4
	2001	%	55.0	**67.0**	51.0	67.2
	2002	%	85.0	**75.0**	81.0	85.9
	2003	%	100.8	**100.0**	101.0	101.9
4	**Length of irrigation network (from outlets to water user association to farm inlets)**	km	574.2	**150.0**	79.3	156.0
	of which:					
	unlined	%	90.4	**98.9**	85.9	95.0
	antifiltration coating	%	9.6	**0**	0	0
	ferroconcrete flumes	%	0	**1.1**	14.1	5.0
5	**Cropping pattern in 2003 (%% of total irrigated area)**					
	crop №1 cotton	%	42.1	**27.6**	40.7	35.0
	crop №2 wheat	%	16.0	**6.7**	16.1	29.6
	crop №3 rice	%	4.7	**1.0**	8.0	4.4
	crop №4 vegetables and cucurbits	%	2.8	**4.2**	2.9	0.1
	crop №5 corn	%	0.2	**11.2**	7.5	
	Other crops	%	34.2	**49.3**	24.7	30.9
	Including household plots	%	17.6	**36.3**	2.0	20.8
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	37.1	**45.5**	84.9	45.0
	Pumped water lift	%	62.9	**54.5**	15.1	55.0
7	**Mean area of irrigated plot**	ha	4.0	**4.2**	8.6	3.8
	Number of irrigated plots		15554	**340**	161	490

№	Indicator	Unit	Irrigation system of canal P.Gazavat	**WUA "Mirab"**	WUA "Gauk-yab"	WUA "Shikh-yab"
8	**Mean irrigated area per water user**	ha	23.4	**15.0**	23.1	12.3
9	Number of water users		2656	**95**	61	150
	Number of outlets to water users, equipped with gauging devices		183	**15**	17	0
10	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	0	**0**	0	0
	Low saline	%	47.2	**35.2**	43.3	31.3
	Medium saline	%	37.8	**56.1**	35.7	49.2
	Heavy saline	%	15.0	**8.7**	21.0	19.5
11	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 -1 m	%	35.7	**46.7**	48.4	36.7
	1 - 2 m	%	57.5	**44.9**	42.9	58.2
	2 - 3 m	%	5.6	**8.4**	8.7	5.1
	3 - 5 m	%	1.2	**0**	0	0
	> 5 m	%	0	**0**	0	0
12	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	2.3	**0**	44.8	0
	II class	%	41.0	**62.1**	14.3	31.3
	III class	%	42.8	**25.3**	40.9	47.3
	IV class	%	13.9	**12.6**	0	21.4
	V class	%	0	**0**	0	0

Annex 4c

Khorezm province (Uzbekistan)
Water user association «Mirab»
Selection of farms

№	Indicator	Unit	Water user association **Mirab**	Head reach of irrigation system			Mid-reach of irrigation system			Tail reach of irrigation system		
				Farm **"Usta Yusuf"**	Farm **"A.Matyakubov"**	Farm **"Yakub Shura"**	Farm **"Oybek"**	Farm **"Eshchan ota"**	Farm **"K.Babajon"**	Farm **"Usta Bekchan"**	Farm **"Masharip ota"**	Farm **"Inak"**
1	**Weighted average unit water withdrawal for irrigation**											
	2000	thousand m^3/ha	10.5	7.6	**7.2**	7.5	**7.5**	7.5	7.6	7.5	**7.5**	7.5
	2001	thousand m^3/ha	7.4	5.3	**5.3**	5.4	**5.3**	5.3	5.3	5.3	**5.4**	5.3
	2002	thousand m^3/ha	12.0	8.7	**8.7**	8.7	**8.7**	8.7	8.7	8.7	**8.6**	8.7
	2003	thousand m^3/ha	14.5	10.4	**10.4**	10.5	**10.5**	10.4	10.5	10.4	**10.4**	10.4
2	**Water availability**											
	2000	%	*	81	**81**	80	**81**	80	81	81	**81**	80
	2001	%	*	66	**66**	65	**67**	67	67	67	**68**	66
	2002	%	*	78	**78**	79	**79**	78	78	78	**78**	78
	2003	%	*	100	**100**	100	**100**	100	100	100	**100**	100
3	**Length of irrigation network (from farm inlets)**	**km**	**150.0**	0.7	**4.5**	0.8	**5**	1.2	3.2	4.0	**1.8**	2.4
	of which:											
	unlined	%	98.9	100.0	**100.0**	100.0	**100.0**	100.0	100.0	100.0	**100.0**	100.0

№	Indicator	Unit	Water user association **Mirab**	Head reach of irrigation system			Mid-reach of irrigation system			Tail reach of irrigation system		
				Farm **"Usta Yusuf"**	Farm **"A.Matyakubov"**	Farm **"Yakub Shura"**	Farm **"Oybek"**	Farm **"Eshchan ota"**	Farm **"K.Babajon"**	Farm **"Usta Bekchan"**	Farm **"Masharip ota"**	Farm **"Inak"**
	antifiltration coating	%	0	0	**0**	0	**0**	0	0	0	**0**	0
	ferroconcrete flumes	%	1.1	0	**0**	0	**0**	0	0	0	**0**	0
4	**Cropping pattern in 2003 (%% of total irrigated area)**											
	crop №1 cotton	%	27.6	34.2	**53.6**	0	**89.5**	76.2	74.4	61.7	**63.3**	22.2
	crop №2 wheat	%	6.7	34.2	**26.6**	32.5	**8.0**	19.0	18.5	12.3	**18.1**	13.3
	crop №3 rice	%	1.0	0	**12.2**	7.5	**0**	0	0	7.4	**0**	17.8
	Other crops	%	64.7	31.6	**7.6**	60.0	**2.5**	4.8	7.1	18.6	**18.6**	46.7
	Including household plots	%	36.3	0	**0**	0	**0**	0	0	0	**0**	0
5	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**											
	Gravity flow	%	45.5	17.1	**0**	25.0	**0**	0	0	0	**100**	100
	Pumped water lift	%	54.5	82.9	**100**	75.0	**100**	100	100	100	**0**	0
6	**Irrigated area of farm**	ha	1426	11.7	**47.4**	8.0	**50.3**	10.5	33.6	40.5	**22.1**	22.5
7	Number of outlets from the irrigation network of water user association to farms		145	2	**4**	2	**2**	1	4	3	**3**	2
	incl. number of outlets equipped with gauging devices		15	0	**1**	0	**1**	0	0	0	**0**	0
8	**Salinity of irrigated lands (% of irrigated area)**											

№	Indicator	Unit	Water user association **Mirab**	Head reach of irrigation system			Mid-reach of irrigation system			Tail reach of irrigation system		
				Farm **"Usta Yusuf"**	Farm **"A.Matyakubov"**	Farm **"Yakub Shura"**	Farm **"Oybek"**	Farm **"Eshchan ota"**	Farm **"K.Babajon"**	Farm **"Usta Bekchan"**	Farm **"Masharip ota"**	Farm **"Inak"**
	Non-saline	%	0	0	**0**	0	**0**	0	0	0	**0**	0
	Low saline	%	35.2	25.7	**49.8**	51.3	**41.7**	72.4	42.6	38.5	**41.2**	16.9
	Medium saline	%	56.1	58.1	**39.2**	48.7	**39.8**	18.1	51.2	59.3	**41.6**	70.2
	Heavy saline	%	8.7	16.2	**11.0**	0	**18.5**	9.5	6.2	2.2	**17.2**	12.9
9	**Groundwater depth (April-September) (% of irrigated area)**											
	0,5 -1 m	%	46.7	0	**27.6**	0	**11.9**	0	0	0	**24.0**	31.6
	1 - 2 m	%	44.9	36.8	**44.5**	70.0	**37.8**	60.0	53.6	75.1	**31.2**	59.6
	2 - 3 m	%	8.4	63.2	**27.9**	30.0	**44.9**	40.0	39.9	24.9	**44.8**	8.8
	3 - 5 m	%	0	0	**0**	0	**5.4**	0	6.5	0	**0**	0
	> 5 m	%	0	0	**0**	0	**0**	0	0	0	**0**	0
10	**Bonitet according to the site quality scale (% of irrigated area)**											
	I class	%	0	0	**0**	0	**0**	0	0	0	**0**	0
	II class	%	62.1	100	**64.8**	100	**100**	100	100	64.7	**0**	64.4
	III class	%	25.3	0	**35.2**	0	**0**	0	0	35.3	**100**	35.6
	IV class	%	12.6	0	**0**	0	**0**	0	0	0	**0**	0
	V class	%	0	0	**0**	0	**0**	0	0	0	**0**	0

Annex 4d

Dashoguz province (Turkmenistan)

Selection of hydro land reclaiming/irrigation system

№	Indicator	Unit	Dashoguz velayat (province)	**Irrigation system of canal Shavat**	Irrigation system of canal Gazavat	Irrigation system of canal Klych-bai
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%	97	**97**	97	97
	Rural water supply	%	0	**0**	0	0
	Pastures	%	0	**0**	0	0
	Fishery	%	0	**0**	0	0
	Drinking water supply	%	0.5	**0.5**	0.5	0.5
	Industry	%	0.5	**0.5**	0.5	0.5
	Public utility	%	1.0	**1.0**	1.0	1.0
	Other sectors	%	1.0	**1.0**	1.0	1.0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	7.4	**4.8**	5.8	7.3
	2001	thousand m^3/ha	9.1	**6.3**	7.9	8.2
	2002	thousand m^3/ha	15.0	**12.7**	13	15.6
	2003	thousand m^3/ha	15.4	**13.2**	14.7	16.1
3	**Water availability**					
	2000	%	46	**34**	40	55
	2001	%	49	**42**	50	48
	2002	%	88	**84**	84	90
	2003	%	93	**92**	100	99
4	**Length of irrigation network (up to outlets)**	km	3096	**743**	342	295
	of which:					
	unlined	%	100	**100**	100	100
	antifiltration coating	%	0	**0**	0	0
5	**Cropping pattern in 2003 (% of total irrigated area)**					
	Crop №1- cotton	%	42.8	**45.4**	46.5	47.3
	Crop №2-wheat	%	32.8	**29.2**	29.7	32
	Crop №3- rice	%	4.4	**1.5**	2	1.4
	Crop №4-alfalfa	%	2.7	**0.4**	0.3	0.7
	Crop № 5 -corn	%	1.7	**1.9**	2.1	1.6
	Other crops	%	15.6	**21.6**	19.4	17
	Including household plots	%	9.7	**13.4**	12.1	10.6

№	Indicator	Unit	Dashoguz velayat (province)	**Irrigation system of canal Shavat**	Irrigation system of canal Gazavat	Irrigation system of canal Klych-bai
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**	%	100	**100**	100	100
	Gravity flow	%	69	**72**	76	64
	Pumped water lift	%	31	**28**	24	36
7	**Mean irrigated area per outlet**	ha	459	**530**	388	402
8	Number of outlets to daykhan associations		898	**185**	116	107
	of which equipped with gauging devices		898	**182**	116	107
9	**Salinity of irrigated lands (% of irrigated area)**	%	100	**100**	100	100
	Non-saline	%	0	**0**	0	0
	Low saline	%	15	**14**	15	18
	Medium saline	%	58	**64**	61	57
	Heavy saline	%	27	**22**	24	25
10	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5-1.0 m	%	7	**8.2**	9	11.1
	1-2 m	%	24.4	**25.9**	26.3	27.6
	2-3 m	%	48.8	**50.4**	51.8	49.5
	3-5 мм	%	12.3	**10.7**	9.4	8.4
	More than 5.0 m	%	7.5	**4.8**	3.5	3.4
11	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	0	**0**	0	0
	II class	%	16.2	**15.7**	17.5	15.6
	III class	%	52.2	**49.8**	51.9	55.3
	IV class	%	24.8	**25.9**	23	24.1
	V class	%	6.8	**8.6**	7.6	5

Annex 4e

Dashoguz province (Turkmenistan)
Irrigation system of canal «Shavat»
Selection of water user association

№	Indicator	Unit	Irrigation system of canal «Shavat»	**Cherkezov daykhan association**	Daykhan association "Ashgabat"	Ersariev daykhan association
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%	97	**99**	99	99
	Other sectors	%	3.0	**1.0**	1.0	1.0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	4.8	**5.9**	5	5.4
	2001	thousand m^3/ha	6.3	**8.3**	6.9	7.3
	2002	thousand m^3/ha	12.7	**13.7**	11.7	12.5
	2003	thousand m^3/ha	13.2	**14.1**	12.3	13
3	**Water availability**					
	2000	%	34	**38**	32	35
	2001	%	42	**50**	41	44
	2002	%	84	**98**	86	91
	2003	%	92			
4	**Length of irrigation network (from farm inlets to outlets to sites)**	km	743	**30**	35	43
	of which:					
	unlined	%	100	**100**	100	100
	antifiltration coating	%	0	**0**	0	0
5	**Cropping pattern in 2003 (%% of total irrigated area)**					
	crop №1- cotton	%	45.4	**46**	43	44
	crop №2-wheat	%	29.2	**30**	28	29
	crop №3-corn	%	1.9	**0.8**	1.7	2
	crop №4- rice	%	1.5	**2.3**	1.4	1.4
	crop № 5 -alfalfa	%	0.4	**0.6**	1.2	2.5
	Other crops	%	21.6	**20.3**	24.7	21.1
	Including household plots	%	13.4	**11.7**	12.1	11
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	72	**84**	67	62

№	Indicator	Unit	Irrigation system of canal «Shavat»	**Cherkezov daykhan association**	Daykhan association "Ashgabat"	Ersariev daykhan association
	Pumped water lift	%	28	**16**	33	38
7	**Mean area of irrigated plot**	ha	5.5	**6.4**	6.2	5.5
	Number of irrigated plots		17745	**454**	474	764
8	**Mean irrigated area per water user (farmer)**	ha	2.3	**2.9**	2.6	2.2
9	Number of water users (farmers)		42625	**1008**	1140	1890
	Number of outlets to water users (farmers), equipped with gauging devices		17745	**202**	474	764
10	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	0	**0**	0	0
	Low saline	%	14	**16**	15	12
	Medium saline	%	64	**70**	67	64
	Heavy saline	%	22	**14**	18	24
11	**Groundwater depth (April-September) (% of irrigated area)**					
	0,5-1,0 m	%	8.2	**8**	6.5	7.5
	1-2 m	%	25.9	**29.6**	35.7	30.2
	2-3 m	%	50.4	**49**	44.7	49.5
	3-5 m	%	10.7	**9.1**	8.6	9.7
	more than 5,0 m	%	4.8	**4.3**	4.5	3.1
12	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	0	**0**	0	0
	II class	%	15.7	**19.1**	14	20.5
	III class	%	49.8	**50.4**	52.3	56
	IV class	%	25.9	**24.8**	25.7	16.3
	V class	%	8.6	**5.7**	8	7.2

Annex 4f

Dashoguz province (Turkmenistan)
Cherkezov daykhan assocation
Selection of farms

№	Indicator	Unit	Cherkezov daykhan association	Head reach of daykhan association			Mid-reach of daykhan association			Tail reach of daykhan association		
				Site № 1	**Site № 2**	Site № 3	Site № 4	**Site № 5**	Site № 6	Site № 7	Site № 8	**Site № 9**
1	**Weighted average unit water withdrawal for irrigation**											
	2000	thousand m^3/ha	5.9	6	**6.4**	6.1	6.1	**6.2**	5.7	5.9	5.6	**5.4**
	2001	thousand m^3/ha	8.3	8.4	**8**	8.4	7.9	**8.1**	8.6	7.9	8.4	**8.5**
	2002	thousand m^3/ha	13.7	14.5	**14.1**	13.9	14.2	**14**	13.8	14.6	13.9	**13.6**
	2003	thousand m^3/ha	14.1	15.0	**15.2**	14.3	14.6	**14.3**	15	14.2	13.7	**13.1**
2	**Water availability**											
	2000	%	38	39	**40**	39	39	**40**	37	38	36	**35**
	2001	%	50	51	**48**	51	47	**49**	52	47	51	**52**
	2002	%	88.0	93	**91**	89	91	**90**	89	93	89	**87**
	2003	%	98	104	**106**	99	102	**99**	104	99	95	**91**
3	**Length of irrigation network (from outlets to irrigated sites)**	km	30	0.45	**0.56**	0.21	0.6	**0.6**	0.75	0.45	0.4	**0.18**
	of which:											
	unlined	%	100	100	**100**	100	100	**100**	100	100	100	**100**
	antifiltration coating	%	0	0	**0**	0	0	**0**	0	0	0	**0**
4	**Cropping pattern in 2003 (%% of total irrigated area)**											
	crop №1- cotton	%	46	0	**49**	0	100	**100**	100	100	100	**100**
	crop №2-wheat	%	30	100	**51**	100	0	**0**	0	0	0	**0**
	crop №3- rice	%	2.3	0	**0**	0	0	**0**	0	0	0	**0**
	Other crops	%	20.3	0	**0**	0	0	**0**	0	0	0	**0**

№	Indicator	Unit	Cherkezov daykhan association	Head reach of daykhan association			Mid-reach of daykhan association			Tail reach of daykhan association		
				Site № 1	**Site № 2**	Site № 3	Site № 4	**Site № 5**	Site № 6	Site № 7	Site № 8	**Site № 9**
	Including household plots	%	11.7	0	**0**	0	0	**0**	0	0	0	**0**
5	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**											
	Gravity flow	%	100	100	**100**	100	100	**100**	100	100	100	**100**
	Pumped water lift	%	0	0	**0**	0	0	**0**	0	0	0	**0**
6	**Irrigated area of site (group of farmers)**	ha	2913	16	**25.5**	13.4	21	**13.1**	16.5	17.8	8	**16.1**
	Number of farmers per site		1008	2	**9**	5	12	**8**	11	10	6	**12**
7	Number of outlets from the irrigation network of daykhan association to the sites		454	1	**3**	3	3	**3**	1	1	2	**6**
	incl. number of outlets equipped with gauging devices		454	1	**3**	3	3	**3**	1	1	2	**6**
7.	**Salinity of irrigated lands (% of irrigated area)**											
	Non-saline	%	0	0	**0**	0	0	**0**	0	0	0	**0**
	Low saline	%	16	17	**18**	20	12	**14**	16	20	21	**19**
	Medium saline	%	70	65	**67**	70	75	**75**	67	70	70	**74**
	Heavy saline	%	14	18	**15**	10	13	**11**	17	10	9	**7**
8.	**Groundwater depth (April-September) (% of irrigated area)**											
	0.5-1.0 m	%	8	0	**0**	0	0	**0**	0	0	0	**0**
	1-1.5 m	%	11.8	0	**0**	0	27.5	**25**	26.1	0	0	**0**
	1.5-2.0 m	%	17.8	54.6	**59.8**	55.9	31.9	**34**	34.1	56.7	55	**55.2**

№	Indicator	Unit	Cherkezov daykhan association	Head reach of daykhan association			Mid-reach of daykhan association			Tail reach of daykhan association		
				Site № 1	**Site № 2**	Site № 3	Site № 4	**Site № 5**	Site № 6	Site № 7	Site № 8	**Site № 9**
	2-3 m	%	49	45.4	**40.2**	44.1	40.6	**41**	39.8	43.3	45	**44.8**
	3-5 m	%	9.1	0	**0**	0	0	**0**	0	0	0	**0**
	more than 5.0 m	%	4.3	0	**0**	0	0	**0**	0	0	0	**0**
11.	**Bonitet according to the site quality scale (% of irrigated area)**											
	I class	%	0	0	**0**	0	0	**0**	0	0	0	**0**
	II class	%	19.1	7.4	**8.4**	9.7	21.6	**22.5**	20.9	24.6	22.6	**19.8**
	III class	%	50.4	55	**56.1**	55.6	57	**54.5**	51.5	48.5	50.4	**54.3**
	IV class	%	24.8	30.8	**29**	24.7	19.9	**19.4**	23.6	23.2	22.5	**17.9**
	V class	%	5.7	6.8	**6.5**	10	1.5	**3.6**	4	3.7	4.5	**8**

Annex 4g

The Republic of Karakalpakstan (Uzbekistan)

Selection of hydro land reclaiming/irrigation system

№	Indicator	Unit	Republic of Karakalpakstan	**Irrigation system of canal Kuvanyshjarma**	Irrigation system of canal Kyzketken-Kegeili	Irrigation system of canal Bozatou
1	**Total water withdrawal, of which:**					
	Irrigated agriculture*	%	95.0	**98.0**	99.0	93.0
	Rural water supply	%	0.05	**0**	0	0
	Pastures	%	0	**0**	0	0
	Fishery	%	2.0	**0**	0	5.0
	Drinking water supply	%	0	**0**	0	0
	Industry	%	0.05	**1.0**	0	0
	Public utility	%	2.9	**0**	0	0
	Other sectors	%	0	**1.0**	1.0	2.0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	9.3	**3.4**	5.7	8.2
	2001	thousand m^3/ha	5.5	**4.5**	1.4	4.9
	2002	thousand m^3/ha	12.6	**13.7**	9.2	17.4
	2003	thousand m^3/ha	15.3	**13.8**	14.3	16.7
3	**Water availability**					
	2000	%	57.0	**25.1**	35.0	40.0
	2001	%	46.2	**33.1**	21.0	36.0
	2002	%	85.0	**99.8**	80.0	100.0
	2003	%	100.0	**100.0**	100.0	100.0
4	**Length of irrigation network (up to outlets)**	km	3609.0	**540.8**	456.2	563.9
	of which:					
	unlined	%	100.0	**100.0**	100.0	100.0
	antifiltration coating	%	0	**0**	0	0
5	**Cropping pattern in 2003 (% of total irrigated area)**					
	Crop №1 ***cotton***	%	18.2	**20.9**	9.0	0
	Crop №2 ***rice***	%	12.6	**22.2**	9.0	13.0
	Crop №3 ***wheat***	%	12.1	**12.8**	1.0	7.0
	Crop №4 ***alfalfa***	%	6.8	**15.2**	7.0	5.0
	Crop №5 ***corn***	%	2.0	**2.0**	8.0	0
	Other crops	%	41.9	**25.4**	56.0	72.0
	Including household plots	%	6.4	**1.5**	11.0	3.0
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	75.0	**91.0**	95.0	20.0
	Pumped water lift	%	25.0	**9.0**	5.0	80.0
7	**Mean irrigated area per outlet**	ha	246.6	**18.0**	380.0	18.0

№	Indicator	Unit	Republic of Karakalpakstan	**Irrigation system of canal Kuvanyshjarma**	Irrigation system of canal Kyzketken-Kegeili	Irrigation system of canal Bozatou
8	**Number of outlets**		1878	**190**	227	263
	of which equipped with gauging devices		1231	**120**	180	140
9	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	14.8	**0**	39.0	18.0
	Low saline	%	33.9	**41.0**	29.0	38.0
	Medium saline	%	38.4	**47.0**	19.0	31.0
	Heavy saline	%	12.9	**12.0**	13.0	13.0
10	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 - 1 m	%	1.5	**0**	6.0	7.0
	1 - 2 m	%	22.0	**16.6**	70.0	19.0
	2 - 3 m	%	24.1	**83.4**	19.0	38.0
	3 - 5 m	%	38.1	**0**	5.0	35.0
	> 5 m	%	14.3	**0**	0	1.0
11	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	0	**0**	11.0	6.0
	II class	%	0.6	**0**	41.0	35.0
	III class	%	7.4	**20.0**	35.0	39.0
	IV class	%	71.2	**80.0**	10.0	20.0
	V class	%	20.8	**0**	3.0	0

Annex 4h

The Republic of Karakalpakstan (Uzbekistan)
Irrigation system of canal «Kuvanyshdjarma»
Selection of water user association

№	Indicator	Unit	Irrigation system of canal Kuvanyshdjarma	**WUA Beldar**	WUA Dosnazarov-arna	WUA Biytaban
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%	98.0	**100.0**	100.0	100.0
	Other sectors	%	2.0	**0**	0	0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	3.4	**1.5**	4.8	3.8
	2001	thousand m^3/ha	4.5	**1.8**	8.2	4.0
	2002	thousand m^3/ha	13.7	**6.0**	17.1	19.0
	2003	thousand m^3/ha	13.8	**6.0**	17.2	19.1
3	**Water availability**					
	2000	%	25.1	**26.0**	28.0	20.0
	2001	%	33.1	**30.0**	48.0	21.0
	2002	%	99.8	**100.0**	99.8	99.5
	2003	%	100.0	**100.0**	100.0	100.0
4	**Length of irrigation network (from outlets to water user association to farm inlets)**	km	540.8	**3.8**	3.4	4.6
	of which:					
	unlined	%	100.0	**100.0**	100.0	100.0
	antifiltration coating	%	0	**0**	0	0
	ferroconcrete flumes	%	0	**0**	0	0
5	**Cropping pattern in 2003 (%% of total irrigated area)**					
	crop №1 ***cotton***	%	20.9	**16.0**	4.6	4.2
	crop №2 ***rice***	%	22.2	**0**	39.2	27.4
	crop №3 ***wheat***	%	12.8	**18.0**	12.5	7.9
	crop №4 ***alfalfa***	%	15.2	**7.7**	21.6	16.4
	crop №5 ***corn***	%	2.0	**2.7**	1.6	1.6
	Other crops		25.4	**53.6**	19.3	41.2
	Including household plots		1.5	**2.0**	1.2	1.3
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	91.0	**100.0**	80.0	100
	Pumped water lift	%	9.0	**0**	20.0	0
7	**Mean area of irrigated plot**	ha	18.0	**15.0**	20	20
	Number of irrigated plots		1431	**1299**	1134	1341
8	**Mean irrigated area per water user**	ha	4007.0	**3379.0**	4083	4560
9	Number of water users		245	**119**	48	78
	Number of outlets to water users, equipped with gauging devices		26	**16**	4	6
10	**Salinity of irrigated lands (% of irrigated area)**					

№	Indicator	Unit	Irrigation system of canal Kuvanyshdjarma	**WUA Beldar**	WUA Dosnazarov-arna	WUA Biytaban
	Non-saline	%	0	**0**	0	0
	Low saline	%	41.0	**40.0**	41.0	43.0
	Medium saline	%	47.0	**48.0**	52.0	42.0
	Heavy saline	%	12.0	**12.0**	7.0	15.0
11	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 - 1 m	%	0	**0**	0	0
	1 - 2 m	%	16.6	**18.0**	10.0	22.0
	2 - 3 m	%	83.4	**82.0**	90.0	78.0
	3 - 5 m	%	0	**0**	0	0
	> 5 m	%	0	**0**	0	0
12	**Bonitet according to the site quality scale (% of irrigated area)**					
	I class	%	0	**0**	0	0
	II class	%	0	**0**	0	0
	III class	%	0	**0**	0	0
	IV class	%	100	**100**	100	100
	V class	%	0	**0**	0	0

Annex 4i

The Republic of Karakalpakstan (Uzbekistan)
Water user association «Beldar»
Selection of farms

№	Indicator	Unit	WUA"Beldar"	Head of irrigation system			Mid-reach of irrigation system			Tail end of irrigation system		
				Farm Paluan ata	Farm Berdibay ata	Farm **Tabyn Reyim***	Farm **Elista***	Farm Madreim ata	Farm Amirbay ata	Farm Begjan Sabyr	Farm Nur Bakhram	Farm **Artykbay Esbosymov***
1	**Weighted average unit water withdrawal for irrigation**											
	2000	thousand m^3/ha	1.5	1.3	1.3	**1.3**	**1.1**	0.8	1.3	1.2	1.3	**1.3**
	2001	thousand m^3/ha	1.8	1.4	1.4	**1.5**	**1.2**	1.0	1.4	1.3	1.4	**1.4**
	2002	thousand m^3/ha	6.0	9.8	9.7	**9.9**	**9.1**	8.2	9.7	9.5	9.8	**9.8**
	2003	thousand m^3/ha	6.0	9.8	9.8	**9.9**	**9.1**	8.2	9.7	9.5	9.8	**9.8**
2	**Water availability**											
	2000	%	26.0	26.7	26.7	**26.9**	**27.0**	26.8	27.0	27.0	26.8	**26.8**
	2001	%	30.0	30.1	30.1	**30.2**	**30.1**	30.1	30.1	30.1	30.1	**30.2**
	2002	%	100	100	100	**100**	**100**	100	100	100	100	**100**
	2003	%	100	100	100	**100**	**100**	100	100	100	100	**100**
3	**Length of irrigation canals (from farm inlets)**	km	3.8	2.0	0.8	**1.0**	**0.4**	0.6	0.8	0.8	0.5	**0.4**
	of which:											
	Earthen	%	100	100	100	**100**	**100**	100	100	100	100	**100**
	Lined	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	ferroconcrete flumes	%	0	0	0	**0**	**0**	0	0	0	0	**0**
4	**Cropping pattern in 2003 (% of total irrigated area)**			43.4	59.8	**80.0**	**86.3**	94.7	86.3	94.3	79.8	**100**
	Crop №1 ***cotton***	%	16	21.7	48.7	**93**	**61**	-	32.0	62.9	44.7	**100**
	Crop №2 ***rice***	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	Crop №3 ***wheat***	%	18	0	0	**0**	**0**	84.2	6.4	0	0	**0**

№	Indicator	Unit	WUA"Beldar"	Head of irrigation system			Mid-reach of irrigation system			Tail end of irrigation system		
				Farm Paluan ata	Farm Berdibay ata	Farm **Tabyn Reyim***	Farm **Elista***	Farm Madreim ata	Farm Amirbay ata	Farm Begjan Sabyr	Farm Nur Bakhram	Farm **Artykbay Esbosymov***
	Other crops	%	64	21.7	11.1	**7**	**25.3**	10.5	47.9	31.4	35.1	**-**
	Including household plots	%	2	0	0	**0**	**0**	0	0	0	0	**0**
5	**Type of water supply for irrigation in 2003 (% of irrigated area)**											
	Gravity flow	%	100	100	100	**100**	**100**	100	100	100	100	**100**
	Pumped irrigation	%	0	0	0	**0**	**0**	0	0	0	0	**0**
6	**Irrigated area of farm**	ha		23	45.2	**12.9**	**47.5**	28.5	31.3	31.8	31.3	**25**
7	**Number of outlets in WUA from the irrigation canals to farms**			1	1	**1**	**2**	1	1	1	1	**1**
	incl. number of outlets equipped with measuring devices			0	0	**0**	**0**	0	0	0	0	**0**
8	**Salinity of irrigated lands (% of irrigated area)**											
	Non-saline	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	Low saline	%	40	48	49	**44**	**53**	51	57	55	54	**50**
	Medium saline	%	48	52	51	**56**	**47**	49	43	45	46	**50**
	Heavy saline	%	12	0	0	**0**	**0**	0	0	0	0	**0**
9	**Groundwater depth for April-September (% of irrigated area)**											
	0.5-1 m	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	1-2 m	%	18	100	100	**100**	**100**	100	100	100	100	**100**
	2-3 m	%	82	0	0	**0**	**0**	0	0	0	0	**0**
	3-5 m	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	> 5 m	%	0	0	0	**0**	**0**	0	0	0	0	**0**
10	**Fertility scale (% of irrigated area)**											
	I	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	II	%	0	0	0	**0**	**0**	0	0	0	0	**0**
	III	%	0	0	0	**0**	**0**	0	0	0	0	**0**

№	Indicator	Unit	WUA"Beldar"	Head of irrigation system			Mid-reach of irrigation system			Tail end of irrigation system		
				Farm Paluan ata	Farm Berdibay ata	Farm **Tabyn Reyim***	Farm **Elista***	Farm Madreim ata	Farm Amirbay ata	Farm Begjan Sabyr	Farm Nur Bakhram	Farm **Artykbay Esbosymov***
	IV	%	100	100	100	**100**	**100**	100	100	100	100	**100**
	V	%	0	0	0	**0**	**0**	0	0	0	0	**0**

Annex 4j

Kyzylorda province (Kazakhstan)
Selection of hydro land reclaiming/irrigation system

№	Indicator	Unit	Kyzylorda province	**Hydro land reclaim ing/irrigation system of RMC**	Hydro land reclaim ing/irrigation system of LMC	Hydro land reclaim ing/irrigation system of canal Baskara
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%	98.3	**100**	100	100
	Rural water supply	%	0.2	**0**	0	0
	Pastures	%	0.1	**0**	0	0
	Fishery	%	0.7	**0**	0	0
	Drinking water supply	%	0.0	**0**	0	0
	Industry	%	0.2	**0**	0	0
	Public utility	%	0.4	**0**	0	0
	Other sectors	%	0.0	**0**	0	0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	20.86	**18.81**	19.11	18.70
	2001	thousand m^3/ha	19.72	**17.35**	18.46	20.02
	2002	thousand m^3/ha	18.62	**17.32**	20.15	18.21
	2003	thousand m^3/ha	20.63	**17.45**	17.79	19.53
3	**Water availability**					
	2000	%	80	**82**	89	81
	2001	%	91	**87**	96	70
	2002	%	85	**81**	98	58
	2003	%	99	**79**	96	98
4	Length of main canals	km	2286	**19.5**	51.2	32.75
	of which:					
	unlined	%	100	**100**	100	100
	antifiltration coating	%	0	**0**	0	0
5	**Cropping pattern in 2003**					
	crop N1 Rice	%	43.3	**45.4**	30.6	31.6
	crop N2 Corn	%	0.8	**0.8**	2.3	0.9
	crop N3 Perennial grass	%	25.9	**27.2**	34.8	12.8
	crop N4 Vegetables and cucurbits	%	9.1	**15.4**	13.1	28.2
	crop N5 Orchards	%	0.6	**0.2**	0.0	0.0
	Other crops	%	17.4	**11.1**	19.2	26.5
	Including household plots	%	3.0	**0.0**	0.0	0.0
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	99	**100**	100	100
	Pumped water lift	%	1	**0**	0	0
7	**Mean irrigated area per outlet**	ha		**250**	636	506
8	**Number of outlets**			**26**	15	4
	of which equipped with gauging devices			**15**	15	4

№	Indicator	Unit	Kyzylorda province	**Hydro land reclaim ing/irrigation system of RMC**	Hydro land reclaim ing/irrigation system of LMC	Hydro land reclaim ing/irrigation system of canal Baskara
9	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	0	**0**	0	0
	Low saline	%	53	**45**	46	47
	Medium saline	%	21	**25**	23	26
	Heavy saline	%	26	**30**	31	27
10	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 -1 m	%	8	**4**	6	1
	1- 2 m	%	64	**71**	68	51
	2-3 m	%	28	**25**	26	48
	3-5 m	%	0	**0**	0	0
	>5 m	%	0	**0**	0	0

Annex 4k

Kyzylorda province (Kazakhstan)
Irrigation system of the Right-bank main canal, Kazalinsk waterworks
Selection of water user association

№	Indicator	Unit	Irrigation system of RMC	**Water user association «Zhalan tos»**	Water user association «Murat bayev»	Water user association «Syr-Marjan»
1	**Total water withdrawal, of which:**					
	Irrigated agriculture	%		**100**	100	100
	Other sectors	%		**0**	0	0
2	**Weighted average unit water withdrawal for irrigation**					
	2000	thousand m^3/ha	20.86	**14.48**	16.94	17.84
	2001	thousand m^3/ha	19.72	**17.23**	16.02	17.51
	2002	thousand m^3/ha	18.62	**17.47**	16.81	17.80
	2003	thousand m^3/ha	20.63	**17.13**	18.03	19.33
3	**Water availability**					
	2000	%	82	**83**	80	88
	2001	%	87	**79**	88	85
	2002	%	81	**88**	85	89
	2003	%	79	**87**	90	86
4	**Length of irrigation network (from outlets to water user association to farm inlets)**	km		**22.0**	28.0	11.0
	of which:					
	unlined	%	100	**100**	100	100
	antifiltration coating	%	0	**0**	0	0
5	**Cropping pattern in 2003**					
	crop N1 rice	%	45.4	**52.1**	79.1	57.8
	crop N2 perennial grass	%	27.2	**36.1**	9.3	17.2
	crop N3 vegetables and cucurbits	%	15.4	**0.0**	2.8	0.0
	crop N4 corn	%	0.8	**0.0**	0.9	0.0
	crop N5 orchards	%	0.2	**0.0**	0.0	0.0
	Other crops	%	11.1	**11.9**	7.8	25.0
	Including household plots	%	0.0	**0.0**	0.0	0.0
6	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**					
	Gravity flow	%	100	**100**	100	100
	Pumped water lift	%		**0**	0	0
7	Mean area of irrigated plot	ha	250	**312**	268	580
	Number of irrigated plots		26	**4**	4	2
8	Mean irrigated area per water user	ha		**250**	268	387
9	Number of water users			**5**	4	3
	Number of outlets to water users, equipped with gauging devices			**4**	3	2

№	Indicator	Unit	Irrigation system of RMC	**Water user association «Zhalan tos»**	Water user association «Murat bayev»	Water user association «Syr-Marjan»
10	**Salinity of irrigated lands (% of irrigated area)**					
	Non-saline	%	0	**0**	0	0
	Low saline	%	45	**0**	0	20
	Medium saline	%	25	**70**	72	45
	Heavy saline	%	30	**30**	28	35
11	**Groundwater depth (April-September) (% of irrigated area)**					
	0.5 -1 m	%	4	**32**	47	71
	1- 2 m	%	71	**10**	13	14
	2-3 m	%	25	**30**	28	15
	3-5 m	%	0	**28**	12	0
	>5 m	%	0	**0**	0	0

Annex 41

Kyzylorda province (Kazakhstan)
Water user association «Zhalantos»
Selection of farms

№	Indicator	Unit	Water user association «Zhalantos»	Head reach of irrigation system			Mid-reach of irrigation system			Tail reach of irrigation system		
				Farm Kashakbay	**Farm Kadyr**	Farm Baymakhanov	**Farm Atameken**	Farm Temit	Farm Darkhan	**Farm Zhankoja**	Farm Shakien	Farm Shieli
1	**Weighted average unit water withdrawal for irrigation**											
	2000	thousand m^3/ha	14.48	19.50	**20.40**	19.80	**19.50**	19.60	18.95	**18.70**	19.15	17.65
	2001	thousand m^3/ha	17.23	20.70	**19.95**	18.60	**19.20**	19.80	19.10	**19.45**	18.70	18.20
	2002	thousand m^3/ha	17.47	19.82	**18.90**	18.90	**17.60**	18.70	18.70	**18.80**	18.55	17.95
	2003	thousand m^3/ha	17.13	18.26	**18.60**	17.90	**18.36**	19.67	18.50	**18.95**	18.63	17.36
2	**Water availability**											
	2000	%	83	86	**87**	85	**82**	85	67	**89**	88	85
	2001	%	79	91	**90**	90	**92**	92	93	**90**	93	93
	2002	%	88	87	**85**	84	**86**	84	86	**85**	85	86
	2003	%	87	98	**80**	95	**98**	99	97	**98**	99	98
3	**Length of irrigation network (from farm inlets)**	km	22.0	10.0	**14.0**	3.0	**8.0**	2.0	15.0	**16.0**	14.0	15.0
	of which:											
	unlined	%	100	100	**100**	100	**100**	100	100	**100**	100	100
	antifiltration coating	%	0.0	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
	ferroconcrete flumes	%	0.0	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
4	**Cropping pattern in 2003 (%% of total irrigated area)**											
	crop N1 rice	%	52.1	48.2	**53.8**	80.0	**37.5**	83.3	83.3	**12.9**	0.0	0.0
	crop N2 grain crops	%	0.0	0.0	**7.7**	0.0	**0.0**	0.0	0.0	**51.6**	0.0	0.0
	crop N3 perennial grass	%	36.1	0.0	**38.5**	0.0	**62.5**	0.0	0.0	**32.3**	90.9	40.0
	Other crops	%	11.9	51.8	**0.0**	20.0	**0.0**	16.7	16.7	**3.2**	9.1	60.0

№	Indicator	Unit	Water user association «Zhalantos»	Head reach of irrigation system			Mid-reach of irrigation system			Tail reach of irrigation system		
				Farm Kashakbay	**Farm Kadyr**	Farm Baymakhanov	**Farm Atameken**	Farm Temit	Farm Darkhan	**Farm Zhankoja**	Farm Shakien	Farm Shieli
	Including household plots	%	0.0	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
5	**Type of water sypply to irrigated lands (2003) (% of irrigated area)**											
	Gravity flow	%	100	100	**100**	100	**100**	100	100	**100**	100	100
	Pumped water lift	%		0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
6	**Irrigated area of farm**	ha		83	**130**	25	**160**	30	60	**155**	110	50
7	**Number of outlets from the irrigation network of water user association to farms**			1	**1**	1	**1**	1	1	**1**	1	1
	incl. number of outlets equipped with gauging devices			1	**1**	1	**1**	1	1	**1**	1	1
8	**Salinity of irrigated lands (% of irrigated area)**											
	Non-saline	%	0	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
	Low saline	%	0	45	**53**	47	**50**	46	51	**45**	48	50
	Medium saline	%	70	32	**27**	28	**34**	31	28	**35**	36	35
	Heavy saline	%	30	23	**20**	25	**16**	23	21	**20**	16	15
9	**Groundwater depth (April-September) (% of irrigated area)**											
	0.5 -1 m	%	32	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0
	1- 2 m	%	10	2	**2**	3	**5**	3	4	**4**	5	4
	2-3 m	%	30	48	**71**	68	**70**	74	71	**76**	76	68
	3-5 m	%	28	50	**27**	29	**25**	23	25	**20**	19	28
	>5 m	%	0	0.0	**0.0**	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0

Annexes: Chapter 5

WORK SCHEDULE FOR PROJECT "TRANSITION TO IWRM IN THE AMU-DARYA AND SYR-DARYA LOWLANDS AND DELTAS"

Annex 5.1

GENERAL MEASURES

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A)	Development of detailed work plan	■																																				
	Development of agreement on institutional and technical support for implementation of IWRM amongst the key agencies in participating countries	■	■	■	■	■																																
	Selection of project executors at national and regional levels		■	■																																		
	Approval of the detailed work plan and budget for 1 year (first stage) of works		■	■																																		
	Development and approval of ToR's for project executors			■																																		
	Arranging financing and payment procedures		■																																			
	Establishment of communication system between the executors. Equipping the project executors with office equipment, communication facilities, etc.	■	■	■																																		
	Preparation and holding of a start-up workshop for National and Regional project executors			■																																		
B)	Development and adoption of Regulations for Public Councils promoting IWRM at different hierarchical levels of water management				■																																	
	Development of workshop programs for explanation of IWRM principles for the members of Public Councils at different water hierarchical levels				■			■			■			■			■			■			■			■			■			■			■			
	Organization and holding of workshops to explain the IWRM principles to members of Public Councils at different water hierarchical levels					■			■			■			■			■			■			■			■			■			■			■		
	Organizational management of public councils promoting IWRM in BWOs, provinces, irrigation systems, and WUAs.					■	■	■	■	■	■	■	■	■																								
	Organization of social surveys to know public opinion on IWRM aspects and to estimate the degree of farmer involvement in IWRM process				■			■			■			■			■			■			■			■			■			■			■			■
	Formulating of public opinion to make changes towards neednd possibility of rational water and nature use			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
C)	**Preparation of monthly newsletters on project progress and on government decisions relating to water sector to keep IWRM Public Councils and decision makers informed**																																					
	Open discussion of the key aspects of IWRM development and organization of dialogue between IWRM Public Councils and decision-makers																																					
	Development of a concept (first draft) for transfer to IWRM in the Amu-Darya and Syr-Darya lowlands																																					
	Adoption of final version of the concept according to comments made																																					
D)	**Adaptation of IWRM-related methodologies taken from the following projects: WARMAP; "ISEAM"; CIRMAN-ARAL; A-2 GEF; "Best practices", Climate change, IWRM Fergana Valley, etc., based on specific features of Amu-Darya and Syr-Darya lowlands and deltas.**																																					
E)	**Organizing training and holding field days for project participants**																																					
	Sharing experience in IWRM implementation between the project and other similar projects																																					

Annex 5.2

I. Level - PRIVATE FARMS/LEASEHOLDS

Stages	Activity	Months since the project beginning																																		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Ia	First stage of passportization of fields (indicators) located at the head, mid-point, and tail end of irrigation systems within the WUA																																					
	Evaluation and analysis of legal environment for farmers and their involvement in water management																																					
	Evaluation and analysis of farmers' functional and informational relationship with the 'vertical water hierarchy' and associated management hierarchies																																					
Ib	Inventory and status of irrigation and collector-drainage infrastructure in the key private farms and development of measures to improve the infrastructure functioning																																					
	Organization and equipping of inflow and outflow measurement and control points for the associated volumes																																					
	Preparation of fields and irrigation & drainage infrastructure for implementing recommendations																																					
	Adaptation and finishing of procedures for monitoring of key factors of agricultural production and water use and of agro-economic evaluations of productivity of land and water																																					
	Development of database structure, including GIS elements for block "Private farms"																																					
	Preparation of necessary mapping data for GIS and RS databases and association of fields with GIS system																																					
	Development of training programs in monitoring methods for field staff																																					
	Training of field staff in monitoring methods																																					
	Organization and performance of monitoring of agricultural production factors in fields (indicators) located at the head, mid-point, and tail end of irrigation systems within the WUAs																																					
	Development of farmers' training program related to national legislation in water and land use, nature conservation, and IWRM principles																																					
	Training of farmers in the pilot areas and adjacent plots in national legislation related to water and land use, nature conservation, and IWRM principles																																					
	Development of training programs to increase legal knowledge of farmers relevant to various aspects of their activities																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Building up capacity and legal knowledge of farmers on various aspects of their activity and activation of public involvement in water management			■												■												■										
	Maintenance of database for block "Private farms".										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Ic	Development of recommendations to improve land and water productivity and water conservation methods in key project fields												■	■																								
	Second stage (II part) of field passport preparation (inclusion of recommendations on fertilizer application, irrigation application and schedule, irrigation technique, etc.)													■	■																							
	Development of training program in improvement of land and water productivity and water conservation methods for field staff and farmers of key and adjacent fields														■																							
	Training of field staff and farmers of key and adjacent fields in improvement to land and water productivity improvement and water conservation methods															■												■										
	Training of field staff in monitoring methods																■																					
	Organization and execution of monitoring to implement recommendations in field-indicators located at the head, mid-point, and tail end of irrigation systems within WUAs																■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Adaptation of recommendations and water conservation methods to specific conditions of key project fields																	■	■	■	■	■	■															
Id	Systematic implementation of a set of measures for water conservation and rational water use, testing of the selected measures and extension of their application zone, in course of 2 years																■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	Correction of methodological documents																								■	■												
	Correction and improvement of models																								■	■												
Ie	Development of recommendations on application of the developed models in various natural and economic conditions of teh lowlands, including GIS and RS for comprehensive assessment of the reserves in water use and the potential for increased efficinecy in water and land productivity																										■	■	■	■	■							
	Preparing proposals for establishment and operation of extension services for farmers																													■	■							
	Development of DSS (decision support system for private farm level)																													■	■	■	■					
	Establishment of experimental extension services for farmers																										■	■	■	■	■	■	■	■	■	■	■	■

Annex 5.3

II. Level - WATER USER ASSOCIATIONS/UNIONS/COOPERATIVES

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
IIa	**Development and preparation of WUAs' Passports**																																					
	Evaluation and analysis of WUAs' legal environment and involvement of WUAs members in water management																																					
	Evaluation and analysis of functional and informational relationship with bodies and entities of the "vertical water hierarchy' and associated management hierarchies																																					
	Analysis of current situation in established WUAs, their shortcomings, problems and development of proposals to overcome the problems																																					
	Studying the extent to which population supports transition to IWRM																																					
	Establishment of initiative working groups at each WUA (social mobilization)																																					
IIb	**Inventory of irrigation and collector-drainage canals in key WUAs and development of measures for improvement of infrastructure to better operate and measure water**																																					
	Development of proposals of first-priority works necessary to improve functioning of irrigation and collector-drainage network																																					
	Preparation of technical-economic basis to make the technical improvements in irrigation and drainage network																																					
	Organization and provision of measuring devices for inflow and outflow at the control points																																					
	Provision of WUAs with equipment and office facilities required for successful functioning																																					
	Organization and equipping of weather station to measure meteo-parameter and reference crop evapotranspiration																																					
	Development of training programs and methods for project executors to monitor WUA activities																																					
	Training of executors in methods monitoring WUAs activities																																					
	Organization and performance of monitoring																																					
	Development (using experience gained in similar projects) of program for workshops on different aspects of WUA activities																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Cycle of training workshops for managers, specialists and members of WUA																																					
IIc	Organization of public discussions on WUA activities to increase their effectiveness and sustainability																																					
	Identification of possible options for WUAs improvement																																					
	Organization of public discussions on options for WUAs functioning and elaboration of mutually agreed-on decisions																																					
	Approval of work plan and measures by local authorities																																					
IId	Development of necessary institutional, legal and financial-economic regulations																																					
	Preparation of documents regulating WUA activities during project implementation																																					
	Development of regulations on WUA activities under IWRM																																					
	Selection and approval by stakeholders of water distribution method (time-, volume-based, etc.)																																					
	Adaptation & conclusion of models for water consumption and water use planning																																					
	Development of water use adjustment models																																					
	Development of database, including GIS elements for block "WUA"																																					
	Preparation of necessary mapping data for GIS and RS database and adaptation of WUAs areas to the GIS system																																					
	Development of training programs for WUA staff in water management improvement methods																																					
	Training of WUA staff in water management improvement methods																																					
IIe	Regular meetings for WUA members with participation of public and representatives of executive authorities																																					
	Solution of issues related to funding of WUA activities and involvement of WUA members in maintenance of irrigation and drainage infrastructure																																					
	More precise definition of irrigated crop areas and of areas to be leached																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Estimating possibilities of applying water rotation between private farms																																					
	Methodological assistance to WUAs staff regarding preparation of a plan for water use and water distribution and their approval by planning And management authorities																																					
	Testing of developed water distribution model and its adaptation to specific conditions (water availability, deviation of meteoparameters from the mean long-term values, etc.)																																					
	Realization of the Plan of operation and water distribution, and and control of its implementation																																					
	Systematic implementation (during two years) of a set of measures for water conservation and rational water use, testing of the selected measures and extension of the zone of their application																																					
	Assessment and analysis of achieved results																																					
	Development of database for block "WUA and its linkage with databases for "Private farms" and "Irrigation System Administrations"																																					
IIf	Summarizing of two-year WUAs activities																																					
	Preparing proposals on amending or adjusting legislative documents to increase WUAs efficiency																																					
	Development and proposal of the most effective organizational structures of WUAs, which would be best applicable to the specific conditions of the lowlands																																					
	Developing proposals for improvement of WUA's financial relationships, both external and internal																																					
	Holding discussions regarding the set of proposals and recommendations aimed at sustainable and efficient WUA operation among the public and executive authorities																																					
	Adopting final set of proposals and recommendations																																					
	Preparation of recommendations on how to apply in practice developed programs, mathematical models and databases in WUA activities																																					
	Preparation of capacity building and training program for WUAs staff and WUAs management																																					

Annex 5.4

III. Level - IRRIGATION SYSTEM ADMINISTRATIONS FOR MAINS AND INTER-FARM CANALS

Stages	Activity	Months since the project beginning																																		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
IIIa	Development and preparation of Passports for Management of Mains and Inter-farm Canals of the Irrigtaion Systems																																					
	Inspection of the extent of support toward transition to IWRM by water users, operational staff, local executive authorities, and social organizations																																					
	Establishment of initiative working groups at each Pilot Canal Administration (social mobilization)																																					
IIIb	Inventory of the main and inter-farm irrigation and collector-drainage infrastructure and development of measures to improve the functioning and measuring properties of this infrastructure																																					
	Development of proposals for first-priority works necessary to improve the functioning of the main and inter-farm irrigation and collector-drainage																																					
	Organization and equipping of points for water diversion, delivery, and transit measurement in the main and inter-farm canals, as well as drainage and water disposal by collector-drainage network																																					
	Provision of equipment and office facilities to Irrigation System Administrations for pilot Main and Inter-farm Canals, so that they can successfully fulfill water management functions																																					
	Development of training programs for executors in Irrigation System Administrations (ISA) to better monitor their activities																																					
	Training of executors in monitoring methods																																					
	Organization and performance of monitoring																																					
	Organization of public discussions on ISA activities and on ways to become more effective																																					
	Identification of possible options for ISA improvement and development of mutually agreed solutions																																					
	Approval of work plan and measures by executive authorities																																					
IIIc	Development of options for organizational framework for pilot Irrigation Systems in the Amu-Darya and Syr-Darya lowlands																																					
	Selection of options for organizational framework for pilot Irrigation Systems in the Amu-Darya and Syr-Darya lowlands and submission for approval by local executive authorities, local governmental bodies and social organizations in lowlands zone																																					
	Development of recommendations on cost-sharing for IWRM by the government, local budgets and water users																																					
	Organization of discussions and approval of options for organizational framework for pilot Irrigation Systems in the Amu-Darya and Syr-Darya lowlands and of recommendations for the cost sharing for IWRM by the government, local budgets, and water users																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Development of approaches to prepare plans for water allocation, distribution, their revision, and adjustment according with the established water withdrawal limits and water availability																																					
IIId	**Refinement of hydromodule zoning in the lowlnads using GIS and RS**																																					
	Identification of zones, which are most subjected to stress due to unequal water distribution																																					
	Development of software package (using SIMIS and other program) to evaluate water consumption and plan an on-line adjustment of water distribution accordingly with the established water limits and water availability																																					
	Adaptation of the first version of the set of models - for planning and management of the systems of pilot main and inter-farm canals - to specific conditions of the pilot Irrigation Systems																																					
IIIe	**Testing and experimental application of the software package to evaluate water consumption and plan an on-line adjustment of water distribution accordingly with the established water limits and water availability**																																					
	Development of manuals on application of the software package and of training programs for ISA MIC staff																																					
	Training of ISA MIC staff in applyiing the software package in practice																																					
IIIf	**Summarizing two-year activities under the block “Irrigation Systems of Main and Inter-farm Canals” and revising the developed organizational framework and regulations based on experimental results**																																					
	Preparing proposals for amending or adjusting legislative documents to increase efficiency of Irrigation Systems of Main and Interfarm canals under transition to IWRM																																					
	Development and recommendations of most effective, organizational framework for the IWRM for conditions of the lowlands																																					
	Developing proposals for improvement of ISA MIC’s financial relationships with the state budget and water consumers																																					
	Holding discussions with opublic and executive authorities in reagrd to a set of proposals and recommendations aimed at sustainable and efficient IWRM																																					
	Adopting final set of proposals and recommendations																																					
	Development of capacity building and advanced training program for ISA MIC staff and Water Management Council members																																					

Annex 5.5

IV-1 Level - TRANS-BOUNDARY WATER MANAGEMENT FOR THE AMU-DARYA BASIN

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
IV-1a	**More accurate assessment of natural water resources of the Amu-Darya and its integral parts**																																					
	Based on a long-term observation data, more accurate designation of river-flow losses in years with different water availability and in different river sections																																					
	More accurate designation of volumes and regimes of return flow in the Amu-Darya in years with different water availability in different river sections																																					
IV-1b	**More accurate designation of the minimum share of the Priaralie related to the releases to lowlands (Darganata station) and to the river delta (Samanbai station)**																																					
	More accurate designation of the ecological demand for water from the river along the river channel in years with different water availability																																					
	Evaluation of the system for drinking water supply and more accurate definition of drinking water demand in the Amu-Darya lowlands (Dashoguz, Khorezm, Karakalpakstan)																																					
	More accurate designation of water withdrawal for irrigation from the Amu-Darya and its tributaries																																					
	More accurate designation of hydropower demand for water from river Vaksh and the Amu-Darya – pressure head, releases, required HEPS load																																					
	Analysis of regime of regulating the flow by reservoirs																																					
	Evaluation of operation of the interstate irrigation systems in the Amu-Darya lowlands in years with different water availability																																					
IV-1c	**Development of a set of models for flow regulation, computation of water-salt regimes in rivers and reservoirs in Amu-Darya basin**																																					
	Development of recommendations for rational distribution of regulating functions between reservoirs of Vaksh-Amu-Darya cascade in years with different water availability																																					
	Development of recommendations on rational control of reservoirs in Tuyamuyun waterworks in years with different water availability																																					
	Development of variants of water-salt balances, recommendations on rational control of reservoirs Amudarya basin in years with different water availability																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	Development of water balances and rational schemes of water delivery in irrigation systems in years and seasons with different water availability to regulate management system																																					
	Preparation of proposal package for Management Rules, including recommendations for regime of water releases, flow regulation and allocation, and improvement of drinking water quality																																					
	Reviewing the package of proposals for Management Rules and concluding it accordingly with comments received																																					
IV-1d	Development of proposals for arrangement of additional sites for measurement and monitoring of water use in Amu-Darya, as well as for technical improvement of existing sites and control stations																																					
	Development of institutional and legal preconditions to enable implementation of Management Rules for flow of the Amu-Darya																																					
	Preparation of training program																																					
	Preparation and holding of a series of training workshops and round-tables on the Management Rules for the flow of the Amu-Darya																																					

Annex 5.6

IV-2 Level - TRANS-BOUNDARY WATER MANAGEMENT FOR THE SYR-DARYA BASIN

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
IV-2a	Specification of volume of water resources within the Syr-Darya river basin for different water years (low, high)																																					
	On basis of long-term data, refinement of flow losses in water bodies and sections of the Syr-Darya for different water years																																					
	Specification of volumes and regimes of return water in the Syr-Darya basin for different water years· Change of the river flow regime along with increased flow regulation, change of consumption priorities and water diversion volume																																					
IV-2b	Specification of water needs by the Kazakh Priaralie for releases from the Syr-Darya to lowlands and its delta																																					
	Calculation of ecologic requirements for the Syr-Darya flow by its different sections for years of different flow availability																																					
	Assessment of systems for drinking water supply and drinking water demand in the Syr-Darya lowlands (Kyzyl-Orda)																																					
	Specification of needs for water for irrigation from Syr-Darya basin for different development scenarios																																					
	Specification of water need for hydropower from Syr-Darya basin (Toktogul hydropower station etc.).Analysis of flow regulation regime of large reservoirs																																					
	Balance of water resources and needs for different river sections for different years																																					
IV-2c	Assessment of functioning of the interstate water infrastructure and irrigation systems in the Syr-Darya basin																																					
	Modeling of the regulation of the river flow (seasonal and long-term)																																					
	Specification of requirements to Naryn-Syr-Darya cascade of reservoirs, including Arnasai																																					
	Definition of operational regime of the cascade with regard to:- Arnasai, Rezaksai and Kekgulsai- Arnasai, Rezaksai, Kegkulsai and Koksarai- Kambarata 1 and Kambarata 2																																					
	Development of proposals for rational management of reservoirs within the river basin																																					
	Modeling of water-salt balance of the river and reservoirs																																					
	Optimal options of water-salt balance for the Syr-Darya and reservoirs																																					

Stages	Activity	Months since the project beginning																																				
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	· Modeling of rational water distribution along the Syr-Darya. Water balance and rational plans for water supply to irrigation systems for years of different flow probability and for 'in-season' flow distribution																																					
	Preparation of set of proposals for Rules on trans-boundary water management including recommendations for flow regulation and distribution, and improvement of drinking water quality																																					
	Model of Water Power Consortium (WPC) activity concerning financial mechanism for stabilizing river flow of irrigation and hydropower sub-sectors																																					
IV-2d	Preparation of draft normative-legal acts: Agreements on main principles of joint water resources management, use and protection; Ecologic flow of the Syr-Darya, accounting for the Northern Priaralie and the Aral Sea;Rules for management of water resource																																					
	Preparation of project Provision of Public Council of the 'BWO Syrdarya'																																					
	Drafting training program																																					
	Preparation and conducting of workshops series and round tables on Rules for management of water resources within the Syr-Darya river basin																																					

ANNEX 5.7.

DETAILED COSTS - 'Transition to IWRM in Amu-Darya and Syr-Darya lowlands and deltas'

#	Project activities	TotaL, $	I year	II year	III year
I	**STAFF**	**868 200**	**260 460**	**347 280**	**260 460**
	Regional work group	**357 400**	**107 220**	**142 960**	**107 220**
	National work groups	**510 800**	**153 240**	**204 320**	**153 240**
	Kazakhstan	118 100	35 430	47 240	35 430
	Kyrgyzstan	20 000	6 000	8 000	6 000
	Tajikistan	40 000	12 000	16 000	12 000
	Turkmenistan	118 100	35 430	47 240	35 430
	Uzbekistan	214 600	64 380	85 840	64 380
II	**LOCAL TRAVEL**	**186 050**	**55 815**	**74 420**	**55 815**
	Regional work group	**82 675**	**24 803**	**33 070**	**24 803**
	National work groups	**103 375**	**31 013**	**41 350**	**31 013**
	Kazakhstan	24 900	7 470	9 960	7 470
	Kyrgyzstan	3 500	1 050	1 400	1 050
	Tajikistan	7 000	2 100	2 800	2 100
	Turkmenistan	24 900	7 470	9 960	7 470
	Uzbekistan	43 075	12 923	17 230	12 923
III	**CURRENT COSTS**	**127 840**	**42 613**	**42 613**	**42 613**
	Regional work group	**17 400**	**5 800**	**5 800**	**5 800**
	National work groups	**62 440**	**20 813**	**20 813**	**20 813**
	Kazakhstan	16 840	5 613	5 613	5 613
	Kyrgyzstan	1 000	333	333	333
	Tajikistan	2 000	667	667	667
	Turkmenistan	16 840	5 613	5 613	5 613
	Uzbekistan	**25 760**	8 587	8 587	8 587
	Asquisition cosmic foto	**48 000**	**16 000**	**16 000**	**16 000**
IV	**EQUIPMENT**	**108 300**	**108 300**		
	Regional work group	**19 750**	**19 750**		
	National work groups	**88 550**	**88 550**		
	Kazakhstan	21 475	21 475		
	Kyrgyzstan	2 000	2 000		
	Tajikistan	4 000	4 000		
	Turkmenistan	21 475	21 475		
	Uzbekistan	39 600	39 600		
V	**MATERIALS**	**26 400**	**10 000**	**8 200**	**8 200**
	National work groups	**26 400**	**10 000**	**8 200**	**8 200**
	NWG Uzbekistan	13 200	5 000	4 100	4 100
	NWG Turkmenistan	6 600	2 500	2 050	2 050
	NWG Kazakhstan	6 600	2 500	2 050	2 050
	SUBTOTAL CURRENT COSTS	**1 316 790**	**477 188**	**472 513**	**367 088**
	Regional work group	**525 225**	**173 573**	**197 830**	**153 823**
	National work groups	**791 565**	**303 616**	**274 683**	**213 266**
	Kazakhstan	187 915	72 488	64 863	50 563
	Kyrgyzstan	26 500	9 383	9 733	7 383
	Tajikistan	53 000	18 767	19 467	14 767
	Turkmenistan	187 915	72 488	64 863	50 563
	Uzbekistan	336 235	130 489	115 757	89 989
	OUVERHEAD EXPENSES	**131 679**	**47 719**	**47 251**	**36 709**
	Regional work group	**52 523**	**17 357**	**19 783**	**15 382**
	National work groups	**79 157**	**30 362**	**27 468**	**21 327**
	Kazakhstan	18 792	7 249	6 486	5 056
	Kyrgyzstan	2 650	938	973	738
	Tajikistan	5 300	1 877	1 947	1 477
	Turkmenistan	18 792	7 249	6 486	5 056
	Uzbekistan	33 624	13 049	11 576	8 999

#	Project activities	TotaL, $	I year	II year	III year
VI	**SEMINARS**	**165 000**	**57 000**	**51 000**	**57 000**
	Regional	**66 000**	**24 000**	**18 000**	**24 000**
	National	**99 000**	**33 000**	**33 000**	**33 000**
	Kazakhstan	20 250	6 750	6 750	6 750
	Kyrgyzstan	6 000	2 000	2 000	2 000
	Tajikistan	12 000	4 000	4 000	4 000
	Turkmenistan	20 250	6 750	6 750	6 750
	Uzbekistan	40 500	13 500	13 500	13 500
VII	**SUBCONTRACTS**	**62 800**	**18 840**	**25 120**	**18 840**
	Regional	**11 800**	**3 540**	**4 720**	**3 540**
	National	**51 000**	**15 300**	**20 400**	**15 300**
	Kazakhstan	13 000	3 900	5 200	3 900
	Kyrgyzstan	1 000	300	400	300
	Tajikistan	2 000	600	800	600
	Turkmenistan	13 000	3 900	5 200	3 900
	Uzbekistan	22 000	6 600	8 800	6 600
VIII	**UNFORESEEN EXPENSES**	**72 500**	**21 750**	**29 000**	**21 750**
	Regional	**35 500**	**10 650**	**14 200**	**10 650**
	National	**37 000**	**11 100**	**14 800**	**11 100**
	Kazakhstan	9 000	2 700	3 600	2 700
	Kyrgyzstan	1 000	300	400	300
	Tajikistan	2 000	600	800	600
	Turkmenistan	9 000	2 700	3 600	2 700
	Uzbekistan	16 000	4 800	6 400	4 800
IX	**BILLS PAYMENT**	**14 000**	5 000	4 500	4 500
	TOTAL COSTS	**1 762 769**	**627 497**	**629 385**	**505 887**
	including:				
	Regional work group	**705 048**	**234 120**	**259 033**	**211 895**
	National work groups	**1 057 722**	**393 377**	**370 352**	**293 992**
	Kazakhstan	248 957	93 087	86 900	68 970
	Kyrgyzstan	37 150	12 922	13 507	10 722
	Tajikistan	74 300	25 843	27 013	21 443
	Turkmenistan	248 957	93 087	86 900	68 970
	Uzbekistan	448 359	168 438	156 032	123 888