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WATER RESOURCES OF KAZAKHSTAN
in the new millennium

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Executive Summary

Kazakhstan—being integrated into the global economy—has chosen amelioration of environment as one of its main priorities to further the country's sustainable development.

Water is the most essential natural and economic resource, and the key element of the ecosocial system. Water scarcity affects many countries by causing unsustainable development of national economies. Water supply and pollution issues in the Republic go beyond national boundaries. Leading international experts consider that current disagreements over the use of transboundary water sources may affect national and regional security. This was indicated by the President Nursultan Nazarbaev in his book *Critical Decade*: "The presence of a number of potential conflicts may be referred to as challenges to stability in the Central Asian region: it is evident that water deficiency will continue to be topical in the long term"…"There are predictions that by 2015 one half of the Earth's population will experience shortages of pure water".

According to a water availability indicator Kazakhstan has scarce reserves of renewable water resources. This may become a serious limiting factor for development of Kazakhstan's very rich natural reserves, its economy as well as its sustainable development.

Its geographical position, continental climate, aridity and its relief peculiarities contribute to a specific nature of formation and regimes of surface water resourses in Kazakhstan. Thesecause uneven distribution of water resources by seasons and by territory.

The complexity of problems of the country's water supply is determined by the fact that almost half of the stored water resources of Kazakhstan are formed outside its boundaries, resulting in dependence on neighboring countries in terms of water supply. Underground waters are also distributed unevenly across the territory, and their quality and quantity vary from area to area. Agriculture is the main consumer of water, accounting for 75% of the total volume. Industry consumes an average of 18-22%, whereas the annual use of water for domestic and municipal needs is up to 7% of total consumption.

The problem of provision of high quality drinking water is yet to be solved in Kazakhstan. Adequate provision of piped water is on average no more than 75%. Of late, provision of drinking water from decentralized sources – wells, open reservoirs, and *aryks* – has been on the increase.

It can, therefore, be stated that water supply and sewerage systems in Kazakhstan are in a critical state: they do not ensure sufficient water supply, the water supply is not reliable and is of low quality; utilization of water sources and the cleaning of sewage are becoming more and more inefficient, hence the low quality of water results in an increase in the spread of diseases.

Lack of water resources, territorial and seasonal unevenness of their distribution in combination with frequent arid summers and intense competition for water can create potential conflicts. During the Soviet period these were considered to be 'local', but now they are of international concern, and, if not regulated, may cause ethnic instability and regional tension.

Joint control and protection of transboundary rivers is a complicated international problem, since economic and political interests of countries located in one river basin, as a rule, do not coincide. Finding a compromise on legal and economic aspects of the regional cooperation on international waterways is a long process, requiring a political dialogue to be based on international legal regulations as well as practices of bilateral and multilateral cooperation within the framework of joint basin commissions or committees.

Despite numerous water-related problems over the last decade, the government of Kazakhstan has taken measures to help ameliorate this critical situation. As of 2002, it resumed financing of the water sector and allocated 2,320 million tenge in the current year, making up 6,003.89 million tenge (15.4 mln US dollars) in total. The national Program *Drinking Water,* passed by the government, commits to investment 115.1 billion tenge (40 mln US dollars) to implement the program until 2010.

Further socio-economic development of the country and solution of various ecological problems will be determined to a great extent by a water policy of the state for development and control of water management in the country. The radical economic reforms taking place in the country - including in the area of water management - make certain demands on water policy as well. Provision of water to economic sectors and natural systems should be increased with regards to the available share of water resources and their rational use.

Water resources should be regarded as a constituent part of one hydrological process in the water catchment area of each river basin. Under present conditions the river systems are a natural complex of interdependent entities, which as a whole make up the basin water management system. The aim of control over such systems is to ensure, on a legal, engineering and ecological basis, optimal conditions for formation, distribution, use and protection of water resources.

The modern concept of water consumption presupposes not only the regulatory needs for water and its quality, but also conservation of natural ecological systems within the boundaries of the entire river basin, which is of special importance in the use of transboundary rivers.

A key role in conservation of the integrity of the river basin ecosystem is played by the ecological regulation of water quality. Achievement of water quality should be the object of water policy fixed in national legislation and in agreements on transboundary rivers. Control over the demand for water and its quality, considering ecosystems criteria, should be a basis for national water policy.

Institutional transformations in the water sector should provide a 'level-headed' solution of socio-economic issues and problems of restoration and preservation of water resources potential of the river basins. The regulating role of the State in all these matters is fundamental, and the economic activity of industrial, agricultural and other enterprises should not reduce the ecosystems potential.

The national strategy of water use is to be aimed, first of all, at protection of water and the implementation of efficient water saving technologies in all spheres of water management. This will decrease a volume of water consumption and sewage discharge.

National water conservation plans should have a systematic approach to all aspects of water use, thus creating a basis for transition to integrated management of water resources.

Implementation of agreed national activities for preservation of the resource potential of the river system and its ecological security is the main objective for regional water strategy and policy.

Rapprochement between neighboring countries in terms of national policies and strategies, in the sphere of protection and use of transboundary waterways, should be made on the basis of general provisions, which are found in international conventions and principles for the use and protection of transboundary waterways. National strategies for protection and use of water resources should stipulate a transition to ecosystem control over water resources, unification of criteria and purpose-oriented indicators of water quality, application of concerted methods of data collection and exchange of information. To coordinate all these, a regional basin organization should be created to promote interstate cooperation and to pursue common water policy in the river basin.

This publication aims to analyze the data and give information to the general public on water supply in Kazakhstan: its condition, reserves, practices of the use, and critical problems. These make it possible to asses the role and significance of fresh water, which is the country's most important resource.

When preparing this publication we have used materials of national reports on the Republic of Kazakhstan, regional reports on Central Asia, and materials of international and national programs. Statistical data and other official sources of the Republic of Kazakhstan have also been used.

The authors and UNDP would like to thank all those who helped and contributed to the publication: national experts, representatives of NGOs, international organizations, national institutions.

Foreword by Anatoliy Ryabtsev
Chairman of the Water Resources Committee under the Ministry of Agriculture of the Republic of Kazakhstan

Water is the pivot of life on Earth. There is no substance that can substitute for it. Although over 70% of the earth is covered with water, fresh water accounts for only 1% of water resources on the planet. The world's population and production volume grow every year, and so, irrevocably, does water consumption, giving a particular edge to the worldwide water supply problem.

Water deficit has become one of the most serious challenges of the present millennium, causing environmental degradation, shrinking lakes and river ecosystems and higher morbidity rates in a number of regions.

The problem has become so pressing that it has been the subject of many world and regional conferences, including the World Summit on Sustainable Development held in September 2002 in Johannesburg.

Difficulties with water supply for drinking and economic needs are especially obvious in countries with water supply deficits. Kazakhstan is one such country, as the majority of its territory lies in a zone of low humidity. This publication has therefore come at the right time and draws the attention of the public, academia and decision-makers to this key determinant of the sustainable development of the country.

The publication discusses in detail all aspects of the rational use and protection of water resources. It provides a detailed description of the current status of water resources, environmental conditions and water generation. It assesses the water supply of different regions and the quality of water resources. Much consideration has been given to the supply of high-quality drinking water, institutional fundamentals of water management and greater public involvement in addressing water problems.

Building on this assessment, recommendations are given, including improving the water supply situation, the legal management of and economic mechanisms for water consumption, developing interstate water relations and enhancing regional cooperation. There are important conclusions about the need to develop national sustainable development strategies to emphasize the rational use and protection of water resources, partnerships between government authorities and the public and private sectors to ensure observance of nature management standards, enhancement of capacities and the information base of water resource authorities. Implementation of the publication's recommendations will enable the introduction of integrated water management principles and the achievement of sustainable development indicators.

This publication is integral and complete and contains objective data. It will help draw the attention of not just governmental authorities and the public of Kazakhstan but also the wider world, to Kazakhstan's water supply issues. This should eventually lead to more focused efforts being applied to resolve them.

Anatoliy Ryabtsev

Foreword By Fikret Akcura
UNDP Resident Representative

Kazakhstan is blessed with vast natural resources and, primarily based on the extraction of oil and gas, the country has made very impressive strides in the past several years. The recent GDP growth rates of 9.5 to 13.5% are impressive by any yardstick. However, another vital resource, water, is only available in scarce quantities. Moreover, the distribution of surface and ground water in this large country is quite uneven. Where water is present, it may not always be fit for human consumption.

Hence, water emerges as a resource that can impose a natural limitation on the development of Kazakhstan.

The water shortage problems are not so much a resource problem—though there are some regions that have limited water resources—they are mainly problems that result from poor management practices and inefficient use. Those lead to water shortages in most sectors and in many locations. Moreover, pollution of water resources pose serious challenges to achieving sustained economic growth and improved living standards.

This publication, "Water Resources of Kazakhstan in the New Millennium," aims to analyze the data and generate useful information to the general public on water issues of Kazakhstan: its condition, reserves, practice of utilization, water management practices, etc. We hope that the readers of this report will become better aware of the role and significance of fresh water as Kazakhstan's most important resource.

Consistent with the Millennium Development Goals, in particular Goal 7, the report offers an overview of the "integrated water resource management" concept, its application in Kazakhstan, as well as the progress and shortcomings in that regard.

The report also discusses the trans-boundary water issues since almost half of Kazakhstan's water flows in from neighboring countries. In recent years, attention has turned from a focus on the downstream problems in the immediate Aral Sea Basin to the need for a stable balance between upstream hydropower and downstream irrigation interests. The challenges of regional water management remain acute, and if the root causes of potential water-related conflict are not systematically dealt with now, water scarcity could eventually limit future development of Kazakhstan.

In keeping with the seventh goal of Millennium Development Goals, the donor community should be committed to assist the government and communities in the required investments and activities through funding, policy advice, and the sharing of knowledge. Further, the international community should work with all the nations of the region in order to prevent any water-related conflict from occurring. As UNDP, we promise to continue our utmost support to the Kazakhstan as well as to the Central Asia initiatives to make good quality water available for sustainable development.

Fikret Akcura

LIST OF ABBREVIATIONS

ASBP	Aral Sea Basin Programme
BVO	Basin Water Management Organization
CACO	Central Asian Cooperation Organisation
CEP	Caspian Environmental Programme
CRTC	Caspian Regional Thematic Centre
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
HEPS	Hydroelectric power station
HPP	Heating and power plant
ICAS	Interstate Council for the Aral Sea
ICSD	Interstate Committee on Sustainable Development
ICWC	Interstate Commission for Water Coordination
IFAS	International Fund for the Aral Sea
JSC	Joint Stock Company
MEP	Ministry of Environment Protection
MoA	Ministry of Agriculture
MoES	Ministry of Education and Science
NGO	Non-governmental organization
OJSC	Open Joint Stock Company
OSCE	Organization for Security and Cooperation in Europe
REC	Regional Environmental Centre
RK	Republic of Kazakhstan
RSE	Republican State Enterprise
SPECA	Special Programme for the Economies of Central Asia
UN	United Nations
UNDP	UN Development Programme
UNEP	UN Environmental Programme
WHO	World Health Organization
WRC	Water Resources Committee under the Ministry of Agriculture of the Republic of Kazakhstan

LIST OF UNIT MEASURES

bln	billion
ha	hectare
km	kilometre
km/km^2	kilometres per square kilometre
l/sec	litres per second
m^3	cubic metre
$m^3/24h$	cubic metres per 24 hours
m^3/sec	cubic metres per second
mln	million
mln ha	million hectares
mln km^2	million square kilometres
thousand ha	tousand hectares
thousand km^2	thousand square kilometres

The ‘old’ names of rivers and water bodies are used as the publication is intended for a general audience.

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CHAPTER 1. WATER AVAILABILITY IN KAZAKHSTAN

1.1. Natural Conditions and Specifics of Water Resources Formation

1.1.1. Physical and Geographical Conditions of Water Resources Formation

Geographical Location of the Country

The Republic of Kazakhstan is situated in Central Asia in the middle of the Eurasian continent. It occupies 2.72 million sq. km of land, ranking as the ninth largest country in the world. The western state border runs along the Caspian shore, with the Volga steppes ascending northward to the southern flanks of the Ural and further eastward along the southern edge of the Siberian Plain to the Altai Ridge. The eastern border runs along the Tarbagatai and Jungar ridges, and the southern border runs along the Tien Shan Ridge and the Turan Lowlands to the Caspian coast. The highest point in Kazakhstan is Khan-Tengri (6,995 m above sea level), and the lowest point is the Karagiye Depression (132 m below sea level).

Kazakhstan borders five countries. The total length of the state border is 12,187 km, including: 6,467 km with the Russian Federation; 2,300 km with the Republic of Uzbekistan; 1,460 km with the People's Republic of China; 980 km with the Kyrgyz Republic; 380 km with Turkmenistan. The land border amounts to 11,400 km. The Kazakhstani part of the Aral coastline comprises 1,015 km and of the Caspian coastline, 2,340 km. Kazakhstan borders Uzbekistan along the middle line of the Aral Sea.

A specific feature of the territory of Kazakhstan is that its greater part forms the internal-drainage basins of the Caspian Sea, the Aral Sea, Lake Balkash, Lake Tengiz, Lake Alakol, etc., none of which have an outflow into an ocean. As a result, a significant portion of pollutants accumulate in the lower reaches of the country's transboundary rivers such as the deltas of the Syrdarya River, Ili River, Ural River, etc. These pollutants are either carried by river flows, fall as atmospheric precipitation, occur as a result of the disposal of industrial waste and pollutant discharges or come from other sources. Thus the issue of water resource management and water quality in water facilities is becoming a critical issue in Kazakhstan.

Topography

The landscapes of Kazakhstan are extremely diverse. The southern part of Obschiy Syrt and Pre-Ural Plateau (354 m above sea level) occupy the northwest area of the Republic. The vast flat Pre-Caspian Lowlands are to the south. The Mangyshlak Peninsula (saline lowlands and deep internal-drainage depressions down to -132 m) is situated in the southwest of the Republic. The steep Ustyurt Plateau (up to 340 m above sea level) is located to the east. The pre-Caspian Lowlands are confined to the southern flanks of Ural and Mugodzhary (657 m above sea level). The Turgai Plateau (200-400 m above sea level) is situated northeast of Mugodzhary and in the south becomes the Turan Lowlands, occupied by the Kyzylkum Desert. Sand massifs Bolshiye and Maliye Barsuki and Pre-Ural Karakums are located north of the Aral Sea /78/.

The central part of the country is occupied by the Kazakh rolling hills. The most arid desert Betpak-Dala is located to the south; it borders the Moyinkum sands to the south and the Balkash Depression and sand massif Sary-Ishikotrau to the east. The Ili Depression is situated to the south of Balkash and the Sasykol-Alakol Depression is situated to the east.

Deserts and semi-deserts occupy 58% of the territory of the Republic. Approximately 10% of Kazakhstan's territory is occupied by mountains: the Altai Mountains in the northeast (Mount Belukha, 4,506 m above sea level) and the West. The North Tien Shan Mountains in the south, and in the southeast, including the Talas (4,488 m above sea level), Trans-Ili (4973 m above sea level), and the Jungar Alatau. New tectonic shifts and resulting earthquakes are observed in many mountainous regions of Kazakhstan.

Climate

The vastness of the territory, its openness in the north and southwest, remoteness from oceans and high radiation form a peculiar climate of Kazakhstan, which significantly differs from the climate of adjacent territories and from the climate of countries situated at approximately the same latitudes. At the same time, certain specific features of the country's climate can be observed in some remote parts of the world. For example, the number of sunny days that the southern regions of Kazakhstan experience, reminds one of Egypt and California; by annual evaporation they correspond to the central parts of South and North America; Kazakhstan's arid summers are similar to the inland areas of Iran, Arabia, Egypt and Sudan. Comparison of certain regions of the country to regions on the same latitudes on the Russian Plain shows that the climate of Kazakhstan differs in having lengthy and severe winters, short hot summers, and a greater number of clear days and by having higher aridity and more variable temperatures.

Winters are long and cold in the northern part of the country, mild in the central part and warm in the south. The average temperature in January varies from -18°Ñ in the north to -3°Ñ in the extreme south of the Kazakhstani plains. Summer is long and arid on the plains. It is warm in the north, very warm in the central part and hot in the south. The average temperature in July varies from 19°Ñ in the north to 28-30°Ñ in the south. In the mountains summer is short and moderate and winter is relatively warm.

Precipitation in the form of rain is insignificant, except for mountainous regions. In the zone of forest steppe precipitation is 300-400 mm per annum, decreasing to 250 mm in the steppe zone; in the territory of the Kazakh rolling hills annual precipitation increases to 300-400 mm and in semi-deserts and deserts decreases to 200-100 mm. The lowest precipitation (less than 100 mm/year) falls in Pre-Balkhash, on the southeast of Pre-Aral Kyzylkums and South Ustyurt. In the foothills and mountains precipitation varies from 400 mm to 1600 mm per annum. Maximum precipitation in central areas and in the north falls during summer months, and in the south during early spring.

In the north of Kazakhstan southwesterly winds prevail in winter, with northeast winds prevailing in the south; northerly winds prevail on the entire territory in summer. Strong winds are characteristic for the entire territory, while in a number of regions hurricanes (over 40 m/sec), and dry and frigid winds prevail. In summer dry periods can last 40-60 days, with air humidity decreasing to just 5-12%, causing evaporation of water bodies, burning of vegetation (surface drought) and extinction of wildlife. In winter alternation of severe frosts (down to -40-47°Ñ) and thaws, instability and blowing away of snow cover result in the freezing of trees, grass roots, formation of multilayer ice crust on the snow cover and complete freezing of water bodies causing constant lack of food, death of animals and mass deaths of fish in lakes.

Soils

Soils in Kazakhstan can be clearly classified by zones and altitudes. The chernozem zone is in the north: bleached chernozem of the forest steppe zone, common chernozem and southern chernozem of moderately arid steppe (10% of the total area). Chestnut soils are located to the south: dark-chestnut soils of the arid steppe zone, chestnut soils typical of the arid steppe, and light-chestnut soils of semi-deserts (33.2%). Further to the south brown and gray-brown desert soils expand, alternating with the massifs of desert sandy and *takyr*-like soils (45.0%). In the foothills of West and North Tien Shan gray and gray-chestnut soils of mountain plains and foothills prevail. The belt of mountainous brown soils is located higher; the belt of mountainous dark-chestnut, chestnut and chernozem is located in the mountains of the North Tien Shan, Saur, Tarbagatai, West Altai. The belt of mountainous bleached chernozems, forest gray and dark soils is located above the belt of chernozems, and in West Altai above chernozem-like and gray forest soils. The upper belt of all mountainous regions is one of mountainous meadow, sub-alpine and alpine soils. Soils of piedmont plains and mountains occupy 12.4% of the territory of the country.

Vegetation

Its landlocked location, uniform flat topography, vastness of the territory extending in latitudinal and longitudinal directions, plus various natural and climatic conditions, all determine the diversity of landscape and ecosystems of Kazakhstan.

The flora of Kazakhstan includes 68 species of trees, 266 species of bushes, 433 species of shrubs, semi-shrubs and semi-grasses, 2,598 species of perennial grasses and 849 annual grasses. According to the State Registration, the area of the forest reserve and specially protected territories - as of 1 January 2002 - comprised 26.08 million ha, including 11.47 million ha of forest.

Forests, including *saksaul* woods and bushes, cover 4.2% of the territory of Kazakhstan (without bushes, 1.2%). Forests are distributed unevenly across the country. In some regions the area of forests varies from 0.1% to 16%. The largest areas covered with forests (including *saksaul* trees and bushes) are in the south (69.3%), in the southeast (15.5%) and in the north (12.1%) of the country.

Forests of Kazakhstan include birch massifs (woods) in the northern regions and insular pine tree forests in the northwestern regions; pine tree forests on the Kazakh rolling hills; strip pine tree forests on the right bank of the Irtysh River, by piedmont forests in Altai and Saur, Trans-Ili Alatau and other Tien Shan ridges; desert *saksaul* woods and flood-plain forests which occupy insignificant areas along the rivers.

Flood-plain forests are located mostly along the Irtysh, Ishim and Tobol rivers in the north and along the Ural River in the west of the country. Willows, aspens, poplars, Russian elms, birches, bird-cherries and alders prevail; oaks prevail along the Ural River. These forests have exclusive water protection and water regulation significance.

It should be noted that the majority of natural systems have been disturbed during land development for agricultural, industrial and civil construction purposes. The beds of the main rivers have been altered; inter-mountain and steppe areas ploughed; piedmont and flood-plain forests cut; unique and relic biological communities have disappeared or are on the verge of extinction.

Wetlands as a Habitat

Wetlands mean natural or manmade, permanent or temporary, dead or running, fresh, or saline water bodies or their specific parts, where water is the principal life supporting factor for the majority of organisms living in the wetland. An abundance and unequal distribution of various types of wetlands: river mouths, lakes, rivers, bogs, ponds, reservoirs, irrigation canals and flooded fields, are quite typical for Kazakhstan.

Along with their notable social and economic importance, the role of wetlands is to preserve natural and anthropogenic hydro-ecosystems, maintain biodiversity, including endemic, rare and endangered species. In terms of social, economic and natural significance, wetlands can be divided into three groups: locally, nationally and globally important.

Locally important wetlands. This is the most extensive group. In all natural plains of Kazakhstan, there are small ponds inhabited by various plants and animals and used for irrigation, livestock watering and haymaking in coastal areas. There are around 47,000 locally important wetlands in the country.

Nationally important wetlands. Along with an important role in preserving biodiversity, the water bodies of this type are essential for the country's huge economic regions, primarily as potable water sources and a significant reserve of bio-resources: fish, waterfowl, industry, and in some cases for shipping. They are mainly located in the Ural-Caspian, Aral-Syrdarya, Nura-Sarysu and Irtysh basins. There are approximately 200 of these wetlands in Kazakhstan.

Globally important wetlands. The most important role of these areas is preservation of the biodiversity of species, mainly the endemic, rare and specially protected. There are migration routes of around 140 kinds of waterfowl - including 11 listed in the International Red Book - over Kazakhstan. These populations survival is dependent on 14 internationally important wetlands located in Kazakhstan, covering some 17,000 sq. km. They are mainly located in Central, Northern, South-Eastern and Eastern regions of Kazakhstan.

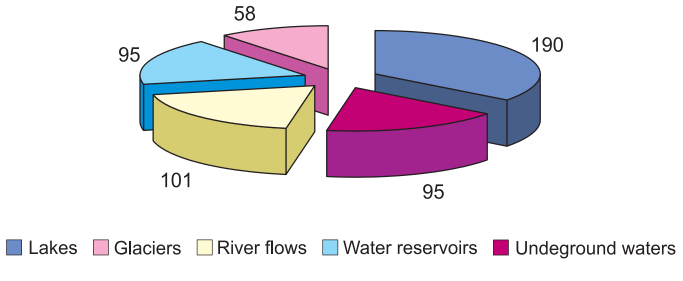
1.1.2. Water Fund and its Assessment

According to the Water Code of the Republic of Kazakhstan, the State Water Reserve of the Republic of Kazakhstan includes all water objects and water resources contained therein, within the territory of the Republic of Kazakhstan, registered or subject to registration in the State Water Cadastre /7, 15 and 35/.

Figure 1 shows average annual reserves of water resources of the Republic of Kazakhstan based on multi-year observations.

Data on major water objects/ facilities of the Republic of Kazakhstan is given below /60/.

Figure 1. Fresh Water Reserves in Kazakhstan, km^3



Source: Water Resources Committee of the Ministry of Agriculture of RK

Rivers

Some 39,000 rivers and streams flow on the territory of the Republic, 7,000 of which have a length of over 10 km. The river network is distributed unevenly. In the north it is within the limits of 0.03-0.05 km/km^2, in the regions of Altai, Jungar and Trans-Ili Alatau it comprises 0.4-1.8 km/km^2.

The majority of the rivers belong to the closed basins of the Caspian and Aral seas, Lakes Balkash and Tengiz. Six rivers in Kazakhstan have water discharge of 100 to 1,000 m^3/sec, seven rivers from 50 to 100 m^3/sec, and 40 rivers from 5 to 50 m^3/sec.

Lakes

Kazakhstan has numerous lakes - some 48,262 with a total surface area of 45,002 km^2. Small lakes (less than 1 km^2) comprise 94% of these, and 10% of the total lake area.

There are 3014 large lakes (over 1 km^2) with a total area of 40,769 km^2 (90%). There are 21 lakes with areas over 100 km^2, totaling 26,886 km^2.

The distribution of lakes within the territory of the Republic is not even: from hundreds of kilometers between separate lakes to the formation of lake districts with a high density of lakes. 45% of all lakes are located in North Kazakhstan, 36% are located in Central Kazakhstan and 19% are located in other regions.

The largest lakes in Kazakhstan are the Caspian and Aral seas; the Balkash Lake and Tengiz Lake in Central Kazakhstan; Alakol and Sasykol near Jungar Pass; Zaisan and Markakol in East Kazakhstan. A great number of lakes are located in the forest steppe and northern part of the steppe zones, of which the largest are Korgalzhyno, Chelkar-Tengiz, Bolshoye Chebachye, Schuchye, Selety-Tengiz.

The total volume of water contained in these natural reservoirs is 190 km^3.

Glaciers

The major mass of glaciers in Kazakhstan, which forms a huge ice belt, is located in the south and east of the Republic, where the ridges Tien Shan-Talas, Kyrgyz, Trans-Ili, Kungey and Terskey Alatau, as well as Jungar Alatau and Kazakhstani Altai rise at elevations over 4,000 meters.

At the end of the 1980's, 2,720 glaciers were registered in the territory of Kazakhstan, including 1,975 glaciers with an area of 0.6 km^2 or more. The total area of glaciations in the Republic of Kazakhstan comprised 2,033.3 km^2; the total volume of protected water resources contained therein is 80 billion m^3, which nearly equals the annual flow of all rivers in the country.

Almost half of the glaciations in the Republic of Kazakhstan are located in Jungar Alatau (1,000 km^2), followed by Trans-Ili and Kungey Alatau (660.7 km^2), and Terskey Alatau (144.9 km^2). Then follows Kazakhstani Altai with Saur (106.2 km^2) and the ridges of Kyrgyz and Talas Alatau (101.5 km^2).

Water Bodies/Reservoirs

Currently over 200 water reservoir, with a total capacity of 95.5 km^3 (excluding ponds and minor water reservoirs assigned for capturing spring flows) are located in Kazakhstan. Water reservoirs are classified based on their capacity as follows:

Table 1. Water Reservoirs in Kazakhstan

Volume, Million m^3	Quantity
1-5	116
5-10	30
10-50	33
50-100	15
100-500	12
500-1000	5
1000 and over	3

Source: *Water Resources Committee of the Republic of Kazakhstan*

Over 50 percent of water reservoirs have a volume of 1-5 million m^3 of water. The majority of water reservoirs are expected to regulate seasonal flows. Annual volumes of flows are affected by water reservoirs with multi-year regulation of flows, the number of which is about 20. The major reservoirs are: Bukhtarma Water Reservoir (on the Irtysh River) with a total volume of 49.0 km^3, Kapshagai Water Reservoir (on the Ili River) with a total volume of 14.0 km^3, Shardary Water Reservoir (on the Syrdarya River) with a total volume of 5.2 km^3, Upper Tobol Water Reservoir and Karatomar Water Reservoir (on the Tobol River) respectively 0.82 and 0.59 km^3, Vyacheslavskoye Water Reservoir and Sergeyevskoye Water Reservoir (on the Ishim River) with a total volume of 0.4 and 0.7 km^3 respectively.

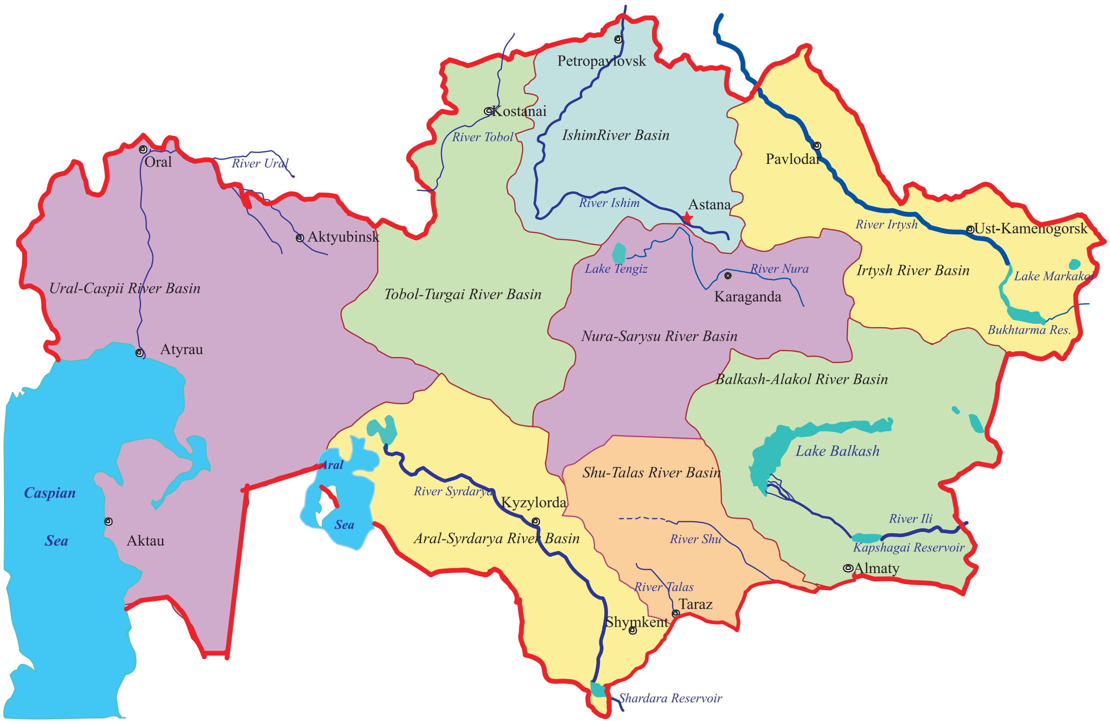
Ground Water

Based on the data of the state agencies for geology and subsoil protection and the National Academy of Sciences of the Republic of Kazakhstan, total probable and explored ground water reserves in Kazakhstan are estimated to be 45 km^3 per annum or 1,450 m^3/sec. As of 1st January 2002 proven reserves comprise 16.04 km^3 or 468 m^3/sec.

1.1.3. Main River Basins

The territory of Kazakhstan can be conditionally divided into 8 hydro-economic basins: Aral-Syrdarya basin, Balkhash-Alakol basin, Irtysh basin, Ural-Caspian basin, Ishim basin, Nura-Sarysu basin, Shy-Talas basin and Tobol-Turgai basin and (See Figure 2).

Figure 2. Map of Main River Basins in Kazakhstan



Source: *Water Resource Committee of the Republic of Kazakhstan*

Aral-Syrdarya Basin

The Aral-Syrdarya basin occupies an area of about 345,000 km^2 and includes two administrative regions: South Kazakhstan and Kyzylorda. The population of the basin is about 2.6 million people (17% of the total population of the Republic), including an urban population of 1.2 million people (46% of the total population of the basin) and a rural population of 1.4 million people (54%).

The main river of the basin is Syrdarya, which begins outside Kazakhstan in the Fergana Valley at the junction of the rivers Naryn and Karadarya. The total length from the junction is 2,212 km, and from the source of Naryn is 3,019 km. The length of the river within the territory of Kazakhstan from the Shardary Water Reservoir to the Aral Sea is 1,627 km, including 346 km in the territory of South Kazakhstan and 1,281 km in the territory of Kyzylorda Oblast.

The largest tributaries of Syrdarya within Kazakhstan are Keles, Arys, Badam, Boroldai, Bugun and smaller rivers, flowing from the southwestern slopes of the Karatau Ridge.

The area of the basin of the Syrdarya River from the source to the railway station Tyumen-Aryk, where the watershed line can be observed, is 21,900 km^2. In the source zone (the mountainous part of the basin) the principal source is seasonal snowmelt, with a less significant volume from glaciers and perennial snow, as well as rain.

Average water resources of the basin of the Syrdarya River equal 37.9 km^3. Some 70% of the water flow forms in the upper part of the basin prior to its exit from the Fergana Valley. The flow of the right bank tributaries above the Shardary Water Reservoir comprises 21-23% of the total water resources coming into Kazakhstan. The share of the flow of the Arys River, as well as other rivers flowing from the Karatau Ridge in Kazakhstan, is 7-9%.

Balkash-Alakol Basin

The Balkash-Alakol basin occupies a vast area of the southeast of Kazakhstan and a part of the adjacent territory of China. Its area is 413,000 km^2, including 353,000 km^2 of the territory of Kazakhstan. The Kazakhstani part of the Balkash-Alakol basin includes the territory of Almaty Oblast; the Moyinkum, Kordai and Shu Districts of Zhambyl Oblast; the Aktogai, Shet and Karkaraly Districts of Karaganda Oblast; the Urdzhar and Ayagoz Districts of East Kazakhstan Oblast; the Chinese territory includes the northwestern part of the Jingxian-Uighur Autonomous Region. The major megalopolis of Kazakhstan, Almaty, is also situated in this basin.

The population of the Kazakhstani part of the basin is about 3.3 million people. The majority - 1.6million people - resides in Almaty Oblast. The rural population comprises 1.5 million people.

The water reserve of this basin is significant, amounting to 149.4 km^3. However, the main volume of water (77%) is concentrated in the mountains, mainly in the Balkhash Lake, and cannot be used for irrigation of the lands of Almaty Oblast. The share of water in the rivers is 14%, and in water reservoirs just 5 per cent.

Irtysh Basin

The Irtysh River basin includes the Irtysh River and its tributaries. The Irtysh River is one of the largest rivers in Kazakhstan. Its length, including the Black Irtysh is 4,200 kilometers.

The average flow rate of the Irtysh River at its entry into the territory of Kazakhstan is about 300 m^3/sec (9 km^3/year and at the border with Russia, the village of Cherlak, is 840 m^3/sec (27 km^3/year).

There are three major water reservoirs on the Irtysh River within the territory of Kazakhstan: Bukhtarma, Ust-Kamenogorsk and Shulba water reservoirs, which have a regulating effect on the river's flow.

This basin is the most secure in respect to its water resources. The water reserve comprises 43.8 km^3. The principal water reserves are formed by the river flow – 26.04 km^3 (59%). The capacity of water reservoirs is the largest in Kazakhstan and comprises 7.7 km^3 (18% of the basin water reserve). About the same volume of water is contained in the lakes – 16%.

Ural-Caspian Basin

The Ural-Caspian river basin within the territory of Kazakhstan occupies an area of 415,000 km^2 and includes the catchment area of the Ural River (236,000 km^2), the Volga-Ural inter-fluvial area (107,000 km^2) and the Ural-Emba inter-fluvial area (72,000 km^2).

In general, the Ural River basin includes a part of the territory of the Russian Federation, and in the Republic of Kazakhstan it includes West Kazakhstan Oblast, Atyrau Oblast and a part of Aktobe Oblast. The population of the Ural-Caspian basin within the Republic of Kazakhstan is about 2.2 million people.

The water reserve comprises 28.0 km^3, including the Ural River basin – 11.4 km^3, the Volga River basin – 13.4 km^3 and by the basins of the rivers Uil, Sagiz and Emba – 15.2 km^3. The river waters comprise 94% of the total reserve, water reservoirs and ground water, 3% each.

A peculiar feature of this basin is that almost half of the surface drainage is located on the River Kigach, which is a branch of the Volga River estuary and is situated in the mouth, thus preventing use of the discharge of this river. Therefore, the principal water artery of the basin is the Ural River, which discharges 8.25 km^3 out of 11.6 km^3 and rises on the territory of Russia.

Ishim Basin

The Ishim River basin within the territory of the Republic of Kazakhstan occupies an area of 245,000 km^2 (215,000 km^2). Its population is 1.9 million people, including 1.09 million rural dwellers (57%).

This basin is the least secure in respect to water resources. The water reserve comprises 5.34 km^3. The majority of water reserves are contained in lakes – 55%, with river discharge comprising 34%. Only 7% of the water accumulates in water reservoirs. Ground water reserves here are the lowest in Kazakhstan at just 0.19 km^3 (30 times less than the reserves of the Balkhash-Alakol basin) and comprise only 4% in the water balance of the basin.

The principal water artery of the basin is the Ishim River, with a number of large tributaries, flowing down in the north from the Kokshetau upland, and from the flanks of Ulytau Mountains. The Ishim River begins from springs in Niaz Mountains in Karaganda Oblast (the northern margins of the Kazakh rolling hills). Its length is 2,450 km, including 1,717 km in the territory of Kazakhstan within Akmola and North Kazakhstan oblasts. The most significant tributaries in terms of water reserves and length are the rivers Koluton, Zhabai, Tersakkan, Akan-Burluk and Iman-Burluk.

A peculiar feature of the rivers of the basin is their uneven flow distribution by seasons and years. Water discharge in different years may differ by a hundred times, which complicates the economic use of the resources of these rivers.

Nura-Sarysu Basin

The territory of the Nura-Sarysu basin includes the basins of the rivers Nura and Sarysu, and the lakes Tengiz and Karasor. The population of the territory of the Nura-Sarysu basin is about 1 million people

The water reserve is smaller than that of the Ishim basin and comprises 4.59 km^3. In order to increase water resources of this basin the Irtysh-Karaganda Canal (currently the Satpaev Canal) was built; its share in the projected filling may comprise up to 18% of the total balance. Ground water comprises 25%, other water resources include surface sources: lakes – 20%; water reservoirs – 4% and riverbeds – 33%.

The largest river of the basin, the Nura, begins in the western flanks of Kyzyltas Mountains and flows into Tengiz. The length of the river is 978 km; the catchment area is 58,100 km^2. The main tributaries of the Nura River are the Sherubainura, Ulkenkundyzdy and Akbastau.

The Sarysu River begins from two branches of Zhaksysarysu and 761 km from their junction the Sarysu flows into the Telekol Lake, Kyzylorda Oblast, near the village of Atasu. The total catchment area of the Sarysu River is 81,600 km^2. The main tributaries are Karakengir and Kensaz.

The territory of the river basin is in regions with evidently insufficient humidity. The specific feature of the rivers of this basin is that the main annual water discharge (90% or more) is during the short spring flood. During low water in summer, autumn and winter, the discharge of the rivers significantly decreases, and in most rivers no discharge is observed.

There are about 2,000 lakes and 400 artificial reservoirs in the Nura-Sarysu river basin. The majority of lakes are in the basins of Nura and Karagalinka.

Shu-Talas Basin

The territory of the basin is formed by the rivers Shu, Talas and Asa. Its total area is 64,300 km^2, including part of the territory of the Kyrgyz Republic. The population of the Kazakhstani part of the basin (Zhambyl Oblast) is 980,000.

The water reserve comprises 6.11 km^3, which is 3.6 times less than in the Aral-Syrdarya basin. The ground water reserve comprises 1.65 km^3, which is larger than in the Aral-Syrdarya basin, and the share of these reserves in the total balance is 27%. The other water resources are concentrated in surface sources: lakes – 6%, water reservoirs – 8% and rivers – 59%.

The majority of the territory of the basin (73%) is located in the zone of deserts and semi-deserts; spurs of the Tien Shan mountainous systems occupy 14% of its territory. From an agricultural point of view, most interesting is the piedmont steppe, which occupies 13% of Zhambyl Oblast.

In addition to the major rivers, the Shu-Talas Oblast has 204 small rivers (in the Shu River basin – 140 rivers, in the Talas River basin – 20 rivers and in the Asa River basin – 64 rivers), as well as 35 lakes and 3 major water reservoirs.

In the Kyrgyz Republic on the Shu River is the Orto-Tokoi Water Reservoir with a projected capacity of 0.42 km^3 and on the Talas River the Kirovsk Water Reservoir has a capacity of 0.55 km^3. Thus, the flow of the main rivers of the basins of the rivers Shu, Talas and Asa is fully regulated. The main purpose of the water reservoirs of the basin is irrigation.

The flow of the rivers Shu, Talas and Kukureu-su (the main tributary of the Asa River) is formed completely on the territory of the Kyrgyz Republic.

Tobol-Turgai Basin

The total area of the river basin, including the basins of the rivers Tobol, Torgai and Irgiz, is 214,000 km^2. The territory of the basin extends in the meridian direction for 600 km, the extension from east to west being 300 km. The population of the basin is 1.05 million.

This is Kazakhstan's poorest basin in respect of water resources. The water reserve comprises 2.9 km^3. Ground water comprises 15% and the remaining water is concentrated in surface sources: lakes – 33%, water reservoirs – 17% and rivers – 35%.

The surface flow of the rivers of the basin is formed exclusively during snowmelt. The annual flow of the rivers of the Tobol-Torgai basin can fluctuate significantly and is characterized by alternating high-water and low-water years. The duration of high-water periods varies from 8 to 10 years, and the duration of low-water years varies from 6 to 20 years. During the high-water years the flow of the rivers exceeds the average multi-annual values by 3-5 times, and during low-water years it lowers to 0.6-0.15 of the average multi-annual values.

The Tobol River begins in the Ural Mountains. It is a typical steppe river, with little water within the territory of Kazakhstan. Over 90% of the flow forms in spring. The left-bank tributaries of the Tobol

River: Sytasty, Ayat, Ui also begin on the slopes of the Ural Mountains. The only right-bank river is the Ubagan River.

The natural regime of the Tobol River has been altered. Eight water reservoirs, including Upper Tobol and Karatomar reservoirs provide multi-year regulation of the flow.

Within the basin there are over 5,000 lakes, 80% of which have an area of less than 1 km^2 and the majority of lakes dry up in summer. The major lakes are Kushmurun, Sarykopa, Aksuat and Sarymoyin.

1.1.4. Ground Water Resources

Ground waters play a significant role in water provision of the Republic. Fresh ground waters have a number of advantages in comparison with surface waters: their quality, as a rule, is higher and they are better protected from pollution and infection and are less exposed to multi-annual and seasonal fluctuations.

In general the Republic of Kazakhstan is rich enough in ground waters, which can fully satisfy the population with domestic, potable, technical and other waters in accordance with the needs of the population, industry and agriculture.

Ground waters exist in practically all mountainous regions of the Republic; however their distribution is extremely uneven. In addition, the quality and reserves of ground water vary considerably.

The main ground water resources (about 50%) are concentrated in South Kazakhstan. Significantly fewer such resources (up to 20%) form in West Kazakhstan. About 30% of all ground water resources are in Central, North and East Kazakhstan.

There are 626 ground water deposits and sites explored on the territory of the Republic, with total reserves of 15.83 km^3 per year (43.38 million m^3/day), including: domestic-potable water – 6.14 (16.84), industrial water – 0.95 (2.6), irrigation water – 8.73 (23.91), balneological (mineral) water – 0.01 (0.03). Probable total ground water resources with salinity of less than 1 g/l comprise 33.85 km^3 per year (92.76 million m^3/day), salinity les than 10 g/l – 57.63 km^3 per year (157.9 million m^3/day).

The main explored ground water reserves are confined to the talus cone and artesian basins: only 25% of the reserves are held as surface flow.

The Republic of Kazakhstan is rich in mineral waters. Some 45 deposits have been explored, and are conditionally classified into five balneological groups according to their chemical composition, balneological and medicinal properties: iodine-bromide (5 deposits), silicon (4), and radon (7), ferric (2) and without specific components (27). In addition, 251 prospective occurrences of mineral waters have been identified, including: ferric – 7, radon – 27, silicon – 15, iodine-bromide – 68, radon-silicon – 1, hydrosulfuric – 1, arsenious – 1, without specific components and properties – 132.

Kazakhstan possesses significant hydrothermal resources distributed in deep-set depressions composed of sedimentary formations. These include artesian basins: Pre-Caspian, Mangyshlak-Ustyurt, Tobol, Irtysh, Torgai, Syrdarya, Shu-Sarysu, Trans-Ili, Ili and Balkhash-Alakol basins, whose ground waters have temperatures exceeding 30-40^{o}Ñ. The temperature of water in some depressions reaches 100^o and more. Natural reserves of hydrothermal resources in Kazakhstan are evaluated as follows: 10,275 km^3 – water resources, 679,820 million Gcal – heat resources and 97,115 million tons of conventional fuel resources. Currently the practical use of hydrothermal waters is insignificant, although their potential use in the economy is high.

Industrial waters with high content of alkaline metals and halogens occur in the Pre-Caspian, Mangyshlak-Ustyurt, Shu-Sarysu and South Torgai artesian basins. Insufficient hydro-geological data on the complexes prevent definitive conclusions as to the scale of these resources. Special research is required to study industrial water resources during the exploration of oil and gas fields.

Kazakhstan has a great number of lakes and *sors*, many of which contain medicinal mud. The probable commercial reserves of medicinal mud at 31 sites are evaluated at a total of 30,915,100 m^3. In addition, 18 prospective sites have been discovered, with their prospecting and exploration being recommended in view of positive results.

1.1.5. Return Water

Return water contained in reservoir-drainage, sewage and effluents caused by irrigation, industry and utilities is considered to be an additional water resource. In case of water consumption increase and due to the low technical level of production the total volume of these resources is likely to increase by 3-5% per year. Further ahead, in the course of modernizing hydro-economic systems and implementation of full-cycle water-saving technologies, the volume of such water should decrease.

Currently, the volume of recycled waters in Kazakhstan amounts to about 9.0 km^3. Their resource component – that which is returned to the sources - does not exceed 2.0 km^3, with the remaining flow being dispersed throughout the territory, lost, used to irrigate grazing lands or directed to support ecosystems. The majority of recycled water goes to the rivers of the basins of Syrdarya (47%) and Irtysh (34%), with the remaining volume feeding the rivers Ili (8%) and Nura (11%).

1.1.6. Water Supply and Hydro-Economic Balances of the Main River Basins

Water Provision in the Republic of Kazakhstan

The total average annual water resources of its rivers comprise 100.5 km^3, of which only 56.5 km^3 form in the territory of the Republic. The remaining 44.0 km^3 come from adjacent countries: the People's Republic of China – 18.9 km^3; the Republic of Uzbekistan – 14.6 km^3; the Kyrgyz Republic – 3.0 km^3; the Russian Federation – 7.5 km^3 /62/.

Recent evaluation of the resources of river flow into Kazakhstan differs significantly from previous estimates. In studies of the State Hydrogeological Institute conducted twenty years ago, the average multi-year river flow of the Republic was evaluated to be 126.0 km^3/year, of which 66.8 km^3/year was estimated to be local flow and 59.8 km^3/year to be cross-border flow. Thus, river flow resources have decreased by 25.3 km^3/year over the last 20 years, including: local flow by 10.3 km^3/year, cross-border flow by 15.2 km^3/year. The reasons for this unstable river flow are considered to be global and regional changes of climate, as well as economic activities in the catchment areas and river valleys, including the territories of adjacent countries.

Kazakhstan's river flow resources are characterized by significant year-on-year fluctuations. The observed maximum and minimum values of the annual flow are respectively 3 times and 2 times less than the norm. The river flow is also characterized by alternating low water (5-7 years) and high water (1-3 years) periods. Due to the climatic conditions of the Republic, up to 90% of the annual flow of the steppe rivers occurs during the spring season and up to 70% of the mountain river flows occur during the summer season.

In an averagely inundated year, Kazakhstan's volume of water resources is estimated to be 100.5 km^3. However, water resources available for economic use comprise only 46 km^3, as significant volumes of water are consumed for environmental, fishery, transportation and energy needs, sanitary discharge into the downstream of hydropower stations, as well as filtration and other losses. In particular, the total volume of obligatory discharges of water required for environmental and sanitary needs into the rivers Syrdarya, Ural, Ili, Tobol, Irtysh, Turgai and Shu is about 29 km^3 per year. Transportation and energy consumption of the flow in the Irtysh River, including the share of the Russian Federation, is 8.7 km^3, while losses caused by evaporation and filtration in water reservoirs and riverbeds are estimated to be 12 km^3 per year. The full spring flow of the plain rivers of Central Kazakhstan - which is dispersed due to the inability to control and use it - comprises about 4.8 km^3. During low-water years, the total volume of Kazakhstan's river flow decreases to 58 km^3, while the flow available for economic use drops to 26 km^3 per year.

The general indicators of water provision of the region are considered to be the specific annual flow volumes per square kilometre and per inhabitant. The specific water provision of the Republic of Kazakhstan is 37,000 km^3 per 1 km^2 and 6,000 m^3 per person per year. This is one of the lowest indicators among the CIS countries. The provision of water throughout the Republic varies significantly: there are well-provided regions, for example the basin of the Irtysh River (East Kazakhstan Oblast), and there are regions where water is lacking, for example Mangistau Oblast.

Comparison of water resources over the years with different water provision to the economy shows extreme water deficit in certain regions and in the Republic as a whole. The water resource deficit in Kazakhstan during averagely inundated years reaches 6.6 km^3 and can be observed in all basins. During arid years the level of water provision comprises only 60%, and in some regions (e.g. Central Kazakhstan) comprises only 5-10%, with the deficit due mainly to irrigated farming.

The reasons for water resource deficit are natural factors (e.g. uneven distribution of surface waters and significant temporal fluctuations of river flow by years and seasons) plus significant consumption of the flow of cross-border rivers of adjacent countries and extensive use and extremely unrecoverable consumption of water for irrigation, as well as water losses in the Republic (see Table 2) /60/.

River Water Resource Balances by Basins

Hydro-economic balances of river basins permit evaluation of the water income constituted of water supplied from adjacent territories and water formed in the territory of Kazakhstan, and water expense - losses caused by evaporation and filtration, sanitary and environmental discharges - as well as evaluation

Table 2. Water Supply by Basins of the Republic of Kazakhstan

#	Basins of rivers, lakes and seas	Water provision, %		
		50% norm	75% provision	95% provision
1	Aral-Syrdarya	90	82	77
2	Balkhash-Alakol	98	80	61
3	Irtysh	100	100	100
4	Ishim	90	40	10
5	Nura-Sarysu	53	20	5
6	Tobol-Turgai	89	33	6
7	Shu-Talas	90	73	56
8	Ural-Caspian	100	35	10
	Total for the Republic	**97**	**76**	**60**

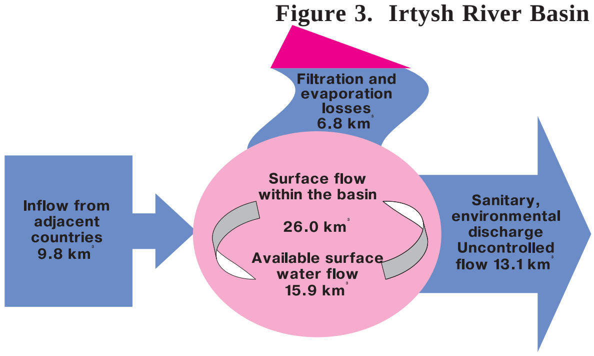
Source: *Water Resources Committee of RK, 2002*

of water resources of the basin available for economic needs. Hydro-economic balances form a basis for planning and substantiating any other activity in the basin, including environmental activities and reclamation of water objects and the entire basin.

Irtysh River Basin

The inflow of water from adjacent territories is 9.8 km^3, comprising 27.3% of the water balance of the rivers, while the remaining 72.7% (or 26 km^3) form on the territory of Kazakhstan. Losses caused by evaporation and filtration amount to 6.8 km^3, and necessary sanitary and environmental discharges, including uncontrolled flow, comprise 13.1 km^3. Water resources of the rivers available for economic needs are sufficient at 15.9 km^3.

Figure 3. Irtysh River Basin

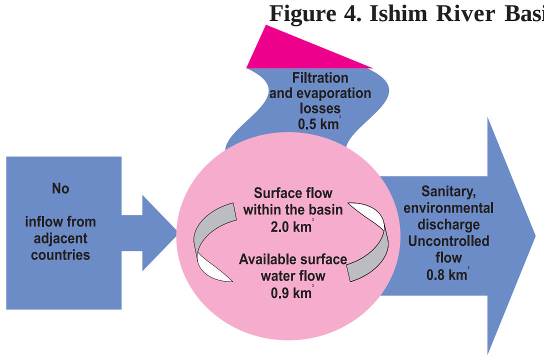


Source: *Water Resources Committee of RK, 2002*

Ishim River Basin

There is no water inflow from adjacent territories. 2.2 km^3 of water form within the basin, 0.5 km^3 of which are losses caused by filtration and evaporation, and 0.8 km^3 are sanitary and environmental discharge and uncontrolled flow. Thus, water resources of the rivers available for economic needs comprise only 0.9 km^3.

Figure 4. Ishim River Basin

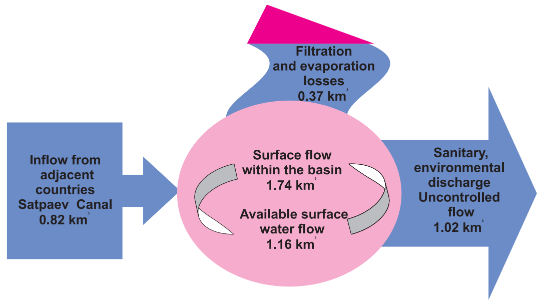


Source: *Water Resources Committee of RK, 2002*

Nura-Sarysu River Basin

The volume of the surface flow within the basin is 1.7 km^3. There is no water inflow from adjacent territories however, in addition to the waters forming in the basin, 0.82 km^3 of water can be supplied by the Satpaev Canal from the Irtysh basin. Taking into account sanitary and environmental discharges and losses caused by evaporation and filtration, the available surface water resources of the basin amount to 1.16 km^3, i.e. even in this case the basin remains the most water deficit basin in Kazakhstan.

Figure 5. Nura-Sarysu River Basin

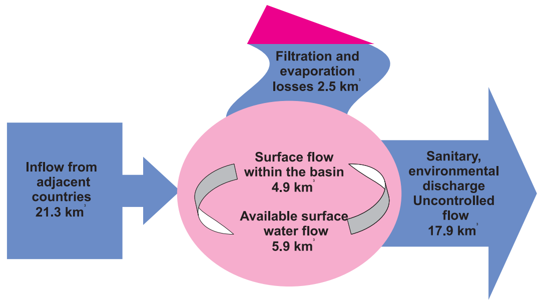


Source: *Water Resources Committee of RK, 2002*

Ural-Caspian Basin

Water flow from adjacent territories is 21.3 km^3 (76% of the basin water reserve). Only 4.9 km^3 forms within the basin. Taking into account necessary sanitary and environmental discharges and losses caused by evaporation and filtration, and uncontrolled flow, available surface water resources of the basin amount to 5.9 km^3.

Figure 6. Ural-Caspian Basin

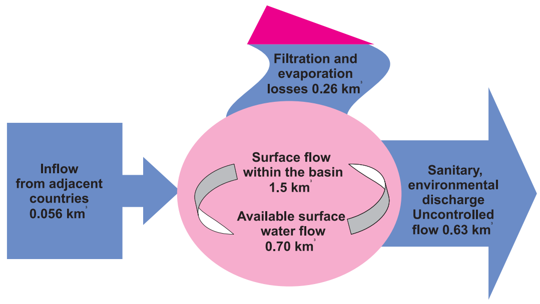


Source: *Water Resources Committee of RK, 2002*

Tobol-Turgai River Basin

The surface flow within the basin is 1.5 km^3. The Tobol River is transboundary: it flows from Russia and returns to Russia. 0.056 km^3 come from Russia. Taking into account sanitary and environmental discharges and losses caused by evaporation and filtration, the available surface water resources of the basin amount to 0.70 km^3. It is one of Kazakhstan's most water deficit basins.

Figure 7. Tobol-Torgai River Basin

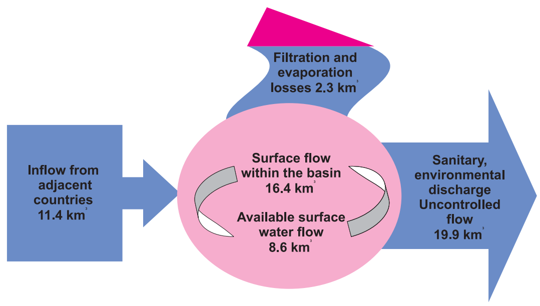


Source: *Water Resources Committee of RK, 2002*

Balkash-Alakol Basin

Surface flow from adjacent territories is 11.4 km^3, comprising 41% of the average multi-year balance of the rivers. The remaining water of 16.4 km^3 (59%), forms on the territory of Kazakhstan. The losses caused by evaporation and filtration amount to 2.3 km^3, and necessary sanitary and environmental discharges, taking into account the maintenance of equilibrium of Balkhash Lake, comprise 16.9 km^3. Therefore, water resources available for economic needs are relatively small, 8.6 km^3, which is two times more than the volume of water resources available in the Shu-Talas basin, but less than in the Aral-Syrdarya basin.

Figure 8. Balkhash-Alakol Basin

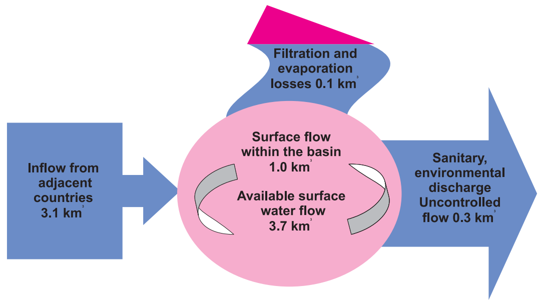


Source: *Water Resources Committee of RK, 2002*

Shu-Talas River Basin

Surface flow from adjacent territories is 3.1 km^3, or half of the total water reserves. Taking into account the balance of the rivers Shu, Talas, and Asa, 3/4 of their flow come to Kazakhstan from the Kyrgyz Republic and only 1/4 (1.0 km^3) forms in the territory of Kazakhstan. Losses caused by evaporation and filtration are at 0.1 km^3, only sanitary and environmental discharges comprise 0.3 km^3, which means that water is not used efficiently in the basin. This can be explained by the proximity of the irrigated lands of Zhambyl Oblast to the border of Kyrgyzstan. Water provision to the industries of the region depends on relations between the Republic of Kazakhstan and the Kyrgyz Republic.

Figure 9. Shu-Talas Basin

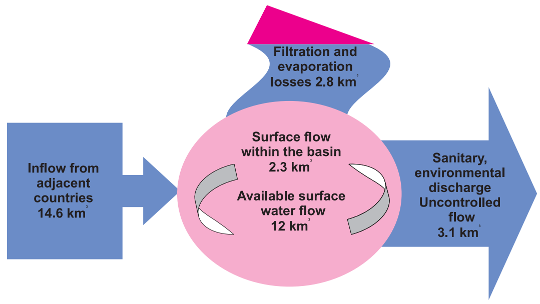


Source: *Water Resources Committee of RK, 2002*

Aral-Syrdarya Basin

The volume of water coming from the adjacent territories is 14.6 km^3, comprising 66.5% of the basin water reserve. 3.3 km^3 of water forms in the basin. Losses caused by evaporation and filtration amount to 3.8 km^3, and necessary sanitary and environmental discharges amount to 3.1 km^3. The available water resources are 12 km^3.

Figure 10. Aral-Syrdarya Basin



Source: *Water Resources Committee of RK, 2002*

1.1.7. Prospective Hydro-Economic Balances

To substantiate the concept of development and implementation of the national strategy of improvement of hydro-economic sector, and of the whole economy of the country, evaluation of prospective and probable hydro-economic balances is critical.

Recent and probable hydro-economic balances of the Republic of Kazakhstan are given in the tables /Appendix 6/ and provide a clear picture of water resource distribution and water deficit, which affect the economy and environmental conditions of the country.

Based on data of the national hydro-meteorological services of Central Asia Region (CAR), during recent decades there has been a tendency of ambient temperature increase in winter and summer periods, resulting in decreased snow reserves and degradation of glaciers. In particular, the glaciers of the Pamir and Altai ranges lost 19% of their ice reserves from 1957 to 1980, and this process is intensifying. During this period, the area of the glaciers of Trans-Ili Alatau and Jungar Alatau decreased threefold. This signifies that changing climatic conditions in the region may cause depletion of water resources. At the same time, all CAR countries demonstrate inefficient and uneconomic consumption of water, which exceeds the average parameters of water consumption in developed countries by several times. However, every state makes certain plans and forecasts for water consumption increase, primarily for agricultural development and utility and housing needs. Increase of water consumption in future without large-scale and efficient measures aimed at water conservation will result in the growth of water resources deficit, with significant potential economic repercussions for all CAR countries. Without adequate measures, a permanently growing water deficit will cause deterioration of the quality of water.

The evaluation of prospects of water consumption in Kazakhstan, Turkmenistan and Uzbekistan, which are in the lower part of the river basins, shows that in the nearest future implementation of water saving measures should become of high importance to satisfy a still growing demand for water.

The Kyrgyz Republic and the Republic of Tajikistan, located in the zone of formation of the main flow of the transbondary rivers - and therefore the most water-rich among the CAR countries - predict growing water consumption and therefore propose to initiate negotiations on the revision of the principles and mechanisms of distribution of water between Central Asia countries, making reference to the resolution of the Heads of the State of Central Asia of 1994.

Further, it should be taken into account that in future Afghanistan might increase its share of water for social and economic development of the northern part of the country. This may significantly change the flow of the Pyandzh River and the Amudarya River completely, causing water distribution problems across the region.

The threat of increased water intake by China from the rivers Ili and Irtysh is an additional risk factor in respect to the national security. The problem of Kazakhstan's and China's current consumption of water resources of their shared cross-border rivers might become one of the most critical issues in relations between these two countries and other Central Asia states.

Recent trends in terms of climate change, economic development and the demographic situation in Central Asia suggest that an acute water supply problem looms for Kazakhstan in the near future.

1.2. Water Use and Protection

1.2.1. Water Use Practices

Recently, average annual water consumption by industries of the Republic of Kazakhstan decreased from 35 to 20 km^3 due to unfavorable fluctuations of water availability and structural changes in the country. Some 85% of water is supplied from surface water sources, the remaining part is supplied from ground, marine and sewage waters. The main volume of water resources (about 78%) is consumed by agriculture.

Table 3. Average Water Use Indicators, %

Republic of Kazakhstan	Water consumption, %				
	Total	Utilities	Industry	Agriculture	Other
	100	5.0	16.0	78.0	1.0

Source: *Water Resources Committee of MoA RK, 2002*

Since 1990, consumption of water from natural sources has been decreasing, with a concurrent reduction of consumption of water for agricultural, industrial, domestic and utility needs. Due to the current economic situation and reductions in irrigated area, water intake for agricultural purposes has decreased by twofold. Currently, about 15 km^3 of water is used for irrigation (regular and estuary) based on the surface flow of the rivers Syrdarya, Ili, Shu, Talas and Irtysh.

Reduced water consumption volumes are characteristic of industrial sectors where water consumption in 2000 decreased to 2.2 km^3 compared to 4.8 km^3 in 1992. The bulk of the water is consumed by heat energy, non-ferrous metallurgy and petroleum operations.

Ground waters are used mainly for domestic and utility purposes and comprise an insignificant part of the total volume of water consumption (only 3-5% of the total volume).

Table 4. Ground Water Use Pattern, %

Domestic	-	66
Industrial	-	23
Regular irrigation	-	4
Inundation of pastures	-	7

Source: *Water Resources Committee of Ministry of Agriculture of Republic of Kazakhstan, 2002*

1.2.2. Water Use by Sectors of Economy

The major groups of water consumers in the Republic of Kazakhstan include: agriculture, industry and utility and housing facilities. The general tendency for all these is decreasing water consumption in comparison to the beginning of the 1990's, when total water intake in the Republic amounted to 30-35 km^3 per year. In recent years the volume of water used has averaged 20 km^3 per year, and this is likely to increase.

Data for 1997-2002 provided by the Committee for Water Resources of the Republic of Kazakhstan /60/ in respect to water resource consumption by the major groups of water consumers show the following:

The volume of water intake from natural water objects in 2002 comprised 20.07 km^3, which is more than in 2001 by 0.11 km^3. This increase is related to higher water intake for domestic and industrial purposes. In comparison to 2001 water intake decreased in Almaty, Pavlodar and South Kazakhstan oblasts by 296, 104 and 218 million m^3 respectively, due to decreased water consumption in irrigation and consumption of technical water at TETs-1 and TETs-2 in Pavlodar, and the Ekibastuz TETs.

The total water intake of 20.07 km^3 includes: fresh water from natural water objects – 19.3 km^3 (surface water 18.08 km^3 and ground water 1.18 km^3), seawater – 0.64 km^3. In addition, the figures include 0.15 km^3 of recycled sewage water and 0.03 km^3 of collected drainage water.

Water intake according to purpose comprises, in km^3:

- Production needs – 3.97;
- Domestic needs – 0.87;
- Agricultural needs – 14.67; and
- Fishery and other needs – 0.55.

Actual water consumption in the Republic as a whole is 15.1 km^3, including fresh water – 14.3 km^3, seawater – 0.63 km^3, treated sewage and collected drainage water – 0.18 km^3. Based on the previous year, consumption of fresh water increased by 0.35 km^3, i.e. by 3%, but compared to 1991 water consumption has decreased by 50%.

In comparison to 2001, water disposal increased by 0.90 km^3 and in 2002 comprised 5.61 km^3. In 2001, 3.45 km^3 of sewage, mine and collected drainage water were discharged into natural water bodies, while 0.76 km^3 was discharged into reservoirs and 1.4 million m^3 went underground.

In comparison with the year 2001, the volume of water in the recycled water supply increased by 0.32 km^3 and totaled 5.16 km^3 for the Republic as a whole.

Water Consumption for Domestic Purposes

Satisfaction of the population's water needs in potable and domestic supply is a water consumption priority, though potable water in the general water consumption structure is less than 5%.

In 2002 water consumption for domestic purposes of cities, workers' camps and industrial enterprises increased by 3% compared with 2001 and stood at 0.61 km^3. It is currently expected that average water consumption for domestic purposes will increase in the Republic by 4% per year. Together with the general increase in water consumption in the domestic sector, there is a tendency of increasing per capita water consumption in Kazakhstan.

Public utilities annually discharge about 0.14 km^3 of sewage water into natural water bodies, of which only 0.05 km^3 are treated to comply with minimum standards. This situation is aggravated by the fact that a significant volume of industrial waste water (in some cities up to 24%) is discharged into treatment facilities which are not designed to treat such waste water.

Water Consumption for Industrial Purposes

Kazakhstan's industrial water consumption averages about 5 km^3/year - the intake being 5.8-7.8 km^3/year. The enterprises of heat energy, non-ferrous metallurgy and the petroleum industry are the main industrial consumers. In recent years, overall industrial water consumption decreased by up to 4 km^3/year, due to decreases in production.

In 2002, water consumption for industrial purposes comprised 3.69 km^3 or 18% of total water consumption. In addition, intake from surface and other sources amounted to 3.97 km^3. In general, water consumption for industrial purposes in comparison to 2001, increased by 0.8%.

There are prospects for decreases in industrial water consumption per production unit due to the implementation of systems for recycling and repeated-consecutive water supply.

Water Consumption for Agricultural Purposes

Agriculture is the main water consumer in the Republic, with regular surface flow irrigation being the main user. Water consumption for irrigation purposes in the Republic decreased from 21.5 km^3/year in 1990 to 17.8 km^3/year in 1995, with irrigated areas decreasing from 2.3 and 1.9 million hectares over the same period. In 2002, total water consumption for agricultural purposes comprised 14.68 km^3, including 14.47 km^3 of non-recoverable use. This includes:

a) Water consumption for regular irrigation	9.90 km^3
b) Water consumption for estuary irrigation	0.50 km^3
c) Water consumption for watering hay fields in river flood lands	3.91 km^3
d) Water consumption for agricultural water supply	0.18 km^3
e) Water consumption for watering pasture lands	0.12 km^3
f) Maintaining aquifers	0.07 km^3

Thus, 14.31 km^3 or 97% of total water consumption is for irrigation (regular and estuary, including watering hay lands).

Low water consumption for agricultural purposes in 2002 is explained by high spring rainfall, reducing farms' demands for irrigation water. In addition, the actual area of irrigated agricultural land decreased from 2001-2002. The area of regular irrigated land fell by 52,000 ha - mainly in Almaty oblast (by 18,100 ha) and Zhambyl oblast (by 33,600 ha) and comprised 1.22 million ha overall; lands of engineering-liman irrigation and inundated hay lands reduced by 16,200 ha, and comprised 580,600 ha; the area of inundated grazing lands decreased by 10 million ha to stand at 94.8 million ha.

Use of Water for Hydropower

Unlike water consumers - irrigated farming, industrial-domestic and agricultural water supply - the hydro-electric power industry is a water consumer that uses the power of water by building reservoirs, dams or derivative hydraulic facilities. At the same time hydro-electric power stations (HEPS) use recoverable water resources of the rivers without polluting them with industrial wastes.

The hydraulic potential of the Republic of Kazakhstan is about 170 billion kWh per year, with the technological potential being 62 billion kWh per year; and economic potential being 27 billion kWh. At present, of the total potential, only 8 billion kWh per year are being consumed. Hydro-electric power resources are not evenly distributed in Kazakhstan. The majority of these resources are concentrated in three regions:

1. **Eastern Zone,** in the basin of the Irtysh River including its tributaries Bukhtarma, Uba, Ulba, Kurchum, Kaldzhir, Kenderlyk and Uidene.
2. **Southeast Zone,** in the basin of the Ili River including its tributaries flowing from the Trans-Ili Alatau Mountains (Kaskelen, Aksai, Turgen, Chilik, Charyn) and in the basin of the eastern Balkhash and the group of Alakol lakes fed by rivers flowing from the Jungar Alatau Mountains (Koksu, Karatal, Aksu, Lepsy and Tentek).
3. **Southern Zone,** in the basins of the rivers Syrdarya, Talas and Chu.

Table 5. Use of Hydro-electric resources in Kazakhstan

#	Regions	Potential hydropower resources, billion kWh	Including technically available for use	Power generated in 2000,billion kWh
1	Almaty region	30.5	11.3	1.2
2	Taldykorgan region	37.0	16.0	0.3
	Total: South-East	**67.5**	**27.3**	**1.5**
3	East Kazakhstan Oblast	50.0	20.0	5.2
4	Zhambyl Oblast	7.7	2.4	0.01
5	South Kazakhstan Oblast	10.7	2.8	0.5
6	Other oblasts	34.0	2.0	0.1
	TOTAL:	**170**	**54.5**	**7.31**

Source: Kazgidroproyekt, 2003

Despite Kazakhstan's significant hydro-electric potential, the share of HEPS in energy generation is only 15%. At present, Kazakhstan has five big HEPS with total installing capacity of 2,154 MW and generating output of 7,050 million kWh, as well as 68 small HEPS with total installed load of 78 MW and average annual power generation of 360 million kWh.

From the environmental point of view the construction of hydropower stations has both positive and negative impacts.

Positive impacts:

- A permanent recoverable source of power - the river flow;
- Use of resulting water reservoirs as fisheries;
- Use of the water reservoirs and their coastal zones for recreation and tourism;
- Water reservoirs create conditions for rest and nesting of migratory birds;
- No pollution
- Creation of water reservoirs can protect lowlands from the destructive impact of floods.

Negative impacts:

- Change of the regime of river flows on a multi-year and seasonal basis, i.e. change of natural regime of the river;
- Creation of artificial obstacles to the migration of fish by constructing water lifting and water reservoir dams;
- Downstream death and destruction of young fish and fish eggs during water level fluctuations in water reservoirs;
- Withdrawal of lands (agricultural, forest, etc.) to create water reservoirs;
- Inundation of lands, their swamping and change of flora in the coastal zone when creating water reservoirs;
- Relocation of people and removal of engineering lines from the flood zone and inundation of water reservoirs;
- Destruction of flora in the zone of water reservoir inundation
- Possible change of the microclimate in the coastal zone.

These negative impacts relate only to large hydro-electric power stations with water reservoirs. Small hydropower stations do not have these shortcomings and have insignificant impact upon the environment.

Currently attention should be paid to the condition of the HEPS facilities operating on the rivers. Inspection of existing HEPS on the rivers Irtysh, Ili, Syrdarya and other stations shows that these stations have serious faults and defects caused by improper operation (Shardary, Shulba and other hydropower stations), which might result in emergency situations. In particular, the Shulba Station was not commissioned into operation since construction was not completed (fitting out of the building of the hydropower station, the navigable lock; hydraulic equipment (6 units) are in temporary operation). At the same time proceeds from the sale of electrical power can be used to complete the construction and to build a counter regulator at the Shulba Hydropower Station.

The Shardary Hydropower Station was commissioned into operation in 1967 and has a state ownership. Its hydraulic facilities and equipment are in 'pre-emergency' condition:

- The equipment has worn out during its operation and needs to be replaced;
- The dam is exposed to intensive filtration (gryphons); and
- The throughput capacity of the Kyzylkum regulator has decreased from 200 m^3/sec to 90 m^3/sec-during excessive consumption vibration of the gates can be observed.

There should be efficient mechanisms of state control over the hydro-power industry's status, primarily over the condition and operation of the major hydropower stations which have been transferred into concession.

Issues of interstate cooperation between Kazakhstan, Kyrgyzstan and Uzbekistan in terms of use of water and power resources of transboundary rivers are still pending. Such lack of cooperation can result in crisis situations that can be environmentally and economically damaging to the countries concerned.

The economic development of Kazakhstan will cause inevitable urbanization and growth of peak loads, which may require further development of the hydro-electric power industry and construction of major hydropower stations. Development of agricultural production - due to increases in the number of farms and expansion of small processing businesses – will require independent power generating sources, which may be hydropower stations.

Pursuant to the strategy of industrial development and power consumption forecasts for the period until 2030, it is planned to build a major HEPS with a total capacity of 468 MW; the projected hydro potential of Kazakhstan's small rivers is about 2,400 MW. Almaty and South Kazakhstan oblasts offer the greatest potential in the development of small hydropower stations; however, they currently import electrical energy from other regions.

It is expected that strengthening of the position of small business and implementation of the program for development of rural areas will stimulate development of small hydropower stations.

1.2.3. Water Use Efficiency

In spite of the significant reduction of water consumption in the Republic of Kazakhstan, it should be acknowledged that the level of *efficiency* of water use is not sufficient in all water consuming industries and in irrigated farming in particular. The main unrecoverable losses of water occur within the irrigation network and in the fields; they exceed 40% of water supplied to Kazakhstan's farms.

Total water consumption for irrigation purposes in the basin of the Aral Sea, including the Republic of Kazakhstan, is about 12,000 m^3/ha. It should be noted that Israel - an international leader in irrigation technologies - in similar climatic conditions consumes less than half of this volume for irrigation purposes /63/.

Inefficiency of water consumption is observed in other groups of water consumers, including systems supplying water to populated areas. The system of water supply operating in the country does not meet requirements of reliable water supply and potable water quality. Water losses in the centralized water supply systems are also considerable - due to their poor condition - and account for some 20-30% of the total volume of water supplied.

The industrial sector suffers from degradation of the technical condition of its systems of recycled and repeated water supply, increased spillage from the trunk water pipeline and distributing network. The main reason is lack of financing for maintenance of water supply systems.

1.2.4. Surface Water Quality

Water quality in almost all Kazakhstan's water objects remains unsatisfactory, in spite of decreases in production and volumes of wastewater discharge. The principal pollutants occur in wastewater from chemical industries, petroleum processing, and machine building industries and non-ferrous metallurgy. The main damage to the environment, and in particular to water reservoirs, is caused by polluted wastewater discharged without prior treatment.

One of the hydrological features of Kazakhstan is that it has flow transit and dispersal zones, as well as delta zones of major river basins (Syrdarya, Ili, Ural and Irtysh rivers).

As the flow of practically all Kazakhstan's rivers is regulated, the regime of flow formation on river sections below water reservoirs is altered significantly. As a result of the impact of the rivers and the areas of catchment and intensive water consumption, there are changes to the hydrological regime and water quality in the transit and dispersal zones. This mutual impact is characterized by intensive water intake from the rivers for industrial and irrigation purposes and discharge back into the rivers of wastes containing salt, chemicals and other pollutants.

Described below are the characteristics of surface water quality in the main water objects of Kazakhstan, based on data provided by RSE KazGidroMet Environment Pollution Monitoring Center / 57,70,71/.

Aral-Syrdarya Basin

The level of nitrite pollution of the surface water of the basin remains high. In 2001 nitrites exceeded the maximum permissible concentration (MPC) by in 46% of tested samples, and the maximum level of pollution reached 27 MPCs.

The chemical composition of the Syrdarya River forms within the Republic of Uzbekistan. The water enters Kazakhstan (Kokbulak border post) with an average content of nitrite nitrogen of about 4 MPCs. Maximum concentration – 16 MPCs, the average content of copper reaches 4 MPCs, phenols – 3 MPCs, sulfates – 6.5 MPCs. The maximum level of pollution is observed in spring when the content of pollutants reaches: copper and nitrites 3 MPCs, sulfates – 7 MPCs, phenols – 6 MPCs, petroleum products – 4 MPCs. The water of the Shardary Water Reservoir is polluted mainly with sulfates, nitrites, phenol and copper.

The main tributaries of the Syrdarya River are also significantly polluted. The Keles River is characterized by a value of WPI (Water Pollution Index) corresponding to quality class 3, i.e. 'moderate pollution'. The principal pollutants are sulfates, copper, phenols, the content of which varies from 2 to 11 MPCs. The Arys River is polluted moderately (sulfates, copper, phenols and nitrites). The level of pollution of the Badam River is characterized by a WPI value of quality class 3, with the average concentration of sulfates, copper, phenols, nitrites and petroleum products exceeding MPC by 2-5 times.

Irtysh Basin

The level of heavy metal pollution of the surface water of the basin remains high. In 2001 levels of copper exceeded MPC in 99.6% of samples, zinc in 57% of samples, with the content of zinc and copper exceeded 10 MPCs. The water quality class is level 4, i.e. the water is 'highly polluted'.

Water Pollution Index in the area of the village of Buran is 1.02, quality class is 3 – "moderately polluted" water. Down river in the city of Ust-Kamenogorsk the level of pollution due to wastewater discharges from the East Kazakhstan industrial complex increases significantly. The gate "0.5 km below TMC" located below the junction of the Irtysh River and the Ulba River is the most polluted. In addition to the polluted Ulba River, the quality of surface water in this area is affected by wastewater from the treatment facilities of the right bank of the Irtysh.

The quality of the surface water of the Irtysh between the villages of Glubokoye and Predgornoye is affected by two right tributaries: the Glubochanka River and the Krasnoyarka River. These waters are polluted by discharges from the Belousovsk, Irtysh and Berezovsk mines and transit waters from the above-situated sources of pollution in Ust-Kamenogorsk. The average annual concentration of copper and zinc in these rivers amounts to 40-50 MPCs, with maximum concentrations often exceeding 100 MPCs.

In the end gate of the village of Borovskoye, the pollution index for the Irtysh River equals 1.14, corresponding to "moderate pollution".

Ural-Caspian Basin

The principal pollutants of the surface waters of the basin are boron and organic substances. The content of nitrites, phenols and copper is 80%, 49% and 22% respectively in the selected samples.

The water of the Ural River is polluted on the territory of the Russian Federation. Within Kazakhstan, wastewater discharges into the riverbed are not observed.

The Ilek River remains the most polluted water body in the basin. The content of boron and chromium in the river is caused by the tailing ponds of the former Alga chemical plant and AZKhS JSC, via ground water. In the gate of Alga "0.5 km below ground water discharge" the content of boron in the water varies from 35 to 129 MPCs. Within the city of Aktobe the content of boron equals 13.8 MPCs, phenols – 1 MPCs, nitrite nitrogen – 1.2 MPCs, chromium – 6.9 MPCs. The quality class of water in the Ilek River changes from 4 – "polluted water" to 6 – "very polluted water".

Balkhash-Alakol Basin

The principal pollutants of the surface water of the basin of the Ili River are petroleum products, the content of which in 83% of tested samples exceeded MPC (on the average 2.5 MPCs). According to the pollution index the basin is characterized as moderately polluted.

The chemical composition of the Ili River in Kazakhstan is created by pollutants from the People's Republic of China and the polluted surface flow and washout from agricultural lands adjacent to the basin. Within the area of the Dubun berth the concentration of copper reached 21.4 MPCs (maximum value – 181 MPCs), the content of phenols, zinc and petroleum products in the water was 1-3 MPCs. In this area the water of the river is estimated as 'dirty'. Down river the concentration of copper is a little lower. In the gate below the Kapshagai Hydropower Station the quality of water hardly changes and corresponds to class 4 on the WPI, i.e. "polluted water".

The principal pollutants of Balkhash Lake are heavy metals: copper and zinc, and petroleum products, phenols and fluorides. The content of copper exceeded MPC in all samples selected in Maly Sary-Shagan Bay and Bertys Bay.

Nura-Sarysu Basin

The area of the basin is characterized by a low level of water supply. Due to regulation of the lower part of the flow, it forms based on wastewater discharge from industrial enterprises.

The major polluted tributary of the Nura is the Sherubainura River. The rivers of this basin are characterized by nitrite pollution. The number of samples in which the content of nitrites exceeds MPC comprises 56%, nitrogen ammonia and copper – 50%, phenols and petroleum products – 67%, fluorides – 80%, zinc – 58%.

The quality of water in the basin is estimated to correspond to WPI class 4 – "polluted water"

Ishim and Tobol-Torgai Basin

In comparison with other basins, the level of pollution of the surface waters of the basins of the rivers Ishim and Tobol is significantly lower, and water quality class corresponds to "moderate pollution".

Data given in Table 6 shows that recently in the territory of Kazakhstan WPI of the surface waters within the areas impacted by cities and industrial centers has in general decreased. However, increased WPI for some rivers (Krasnoyarka River, Ishim River and others) is observed.

Based on monitoring of the surface waters of Kazakhstan conducted by the subdivisions of RSE KazGidroMet in the 1st quarter of 2003, the most polluted is the basin of the Irtysh River. The most polluted rivers of the East Kazakhstan Oblast are: Breksa, Tikhaya, Glubochanka and Krasnoyarka. The content of nitrogen ammonia exceeds MPC by 2.29 times, copper – 3.1-25.7 times, zinc – 17.5-40.1 MPC, petroleum products – up to 2.4 times and manganese – up to 8.6 MPC.

Table 6 /57/. Levels of Pollution of the Surface Water in Cities and Industrial Centers of Kazakhstan

Name of control station	WPI*		
	1997	2000	2001
Ural River, the city of Uralsk	2.96	1.28	1.76
Ilek River, the city of Aktobe	7.38	4.19	4.00
Ilek River, the city of Alga	4.86	5.81	4.98
Syrdarya River, the city of Kyzylorda		1.70	1.26
Badam River, the city of Shymkent	2.68	2.20	2.98
Shardary Water Reservoir	2.93	1.94	1.40
Talas River, the city of Taraz	1.38	0.88	1.24
Malaya Almatinka River, the city of Almaty	2.90	1.68	2.44
Bolshaya Almatinka River, the city of Almaty	1.95	0.81	1.78
Balkhash Lake, Tarangalyk Bay	2.38	3.70	3.96
Balkhash Lake, M. Sary-Shagan Bay	2.56	4.83	4.52
Samarkand Water Reservoir	3.35	2.64	2.65
Nura River, the city of Temirtau	4.38	4.12	2.90
Sherubainura River – Estuary	3.94	10.45	3.53
Kara-Kengir River, the city of Zhezkazgan	-	5.95	6.42
Kengir Water Reservoir	-	4.50	3.39
Irtysh River, the city of Ust-Kamenogorsk	1.43	1.57	1.54
Irtysh River, the city of Pavlodar	-	1.51	1.02
Irtysh River, the city of Aksu	-	1.17	1.14
Bukhtarma River, the city of Zyryanovsk	1.47	1.57	1.77
Ulba River, Tishinsky Mine	8.64	4.67	4.92
Ulba River, the city of Ust-Kamenogorsk	3.36	1.98	1.97
Tikhaya River, the city of Leninogorsk	9.46	5.80	5.00
Breksa River, the city of Leninogorsk	12.60	4.18	6.72
Krasnoyarka River, the village of Predgornoye	3.33	7.60	7.13
Ulba River, the city of Shemonaikha	1.49	1.36	1.36
Ishim River, the city of Astana	1.32	1.22	1.51
Ishim River, the city of Petropavlovsk	1.46	0.60	0.36
Tobol River, the city of Kostanai	0.49	2.17	0.79

**WPI – Water Pollution Index; Please see Technical Note*
Source: State Water Cadastre of the Republic of Kazakhstan. Annual data on surface water quality. 1999-2001. Almaty

1.2.5. Ground Water Quality

Based on data of the ground water monitoring service, about 700 potential sources of pollution have been discovered within the Republic /60/. These are industrial enterprises, solid and liquid wastes storages, stock breeding complexes, tailing ponds of industrial and agricultural facilities, irrigated farm lands, treated industrial wastes, urban agglomerations, oil fields and oil refineries, etc. Based on audit data, only 477 enterprises of the Republic had 762 industrial wastes collectors. However, not all enterprises with such collectors were covered by the audit. Unfortunately, more recently there has been no opportunity to make a comprehensive description of the amount of discharge and waste and the qualitative and quantitative composition of pollutants. Nevertheless it has been established that 241 enterprises in the Republic are polluters of surface waters, and at 158 sites pollution has been detected by regular observation, and on 83 sites by single samples.

The principal sources of pollution in the Republic are industrial and agricultural facilities, and to a lesser extent, utilities.

The highest number of polluted sites and areas were revealed in Almaty Oblast (40), Karaganda Oblast (33), and East Kazakhstan Oblast (22). Of the areas with polluted ground water, the majority (over 200), are characterized by higher salinity, water hardness, plus concentration of sulfates and chlorides exceeding MPC. Some 75 sites are characterized by the presence of nitrogen compounds in the ground water, 59 with heavy metals, 41 with phenols and 28 with organic compounds.

According to the degree of hazard caused by pollutants, ground water pollution at 127 sites can be described as dangerous and at 63 sites as moderately dangerous. There are 48 sites with highly dangerous groundwater pollution levels, while these levels are described as 'extremely' dangerous at three sites.

Throughout the country there are 272 water intakes in zones of ground water pollution, 92 of which are part of the regular observation network. Ground water pollution at other water intake sites was established by random observation. In most cases ground water pollution at water intake sites is connected with economic activities, and at 44 intakes it is determined by natural factors. 143 water intakes are characterized by high salinity of ground water, hardness, content of chlorides and sulfates. In a number of intakes ground waters are polluted by heavy metals (Aktobe Oblast – 12 water intakes, East Kazakhstan – 15 water intakes, Kostanai Oblast – 17 water intakes). The maximum number of water intakes in zones of ground water pollution is in Karaganda Oblast – 77, East Kazakhstan Oblast – 28, North Kazakhstan Oblast – 25. At 180 water intakes where single observations revealed ground water pollution a regular observation network was required.

1.2.6. Water Resources Monitoring and Control in Kazakhstan

State management of hydro-meteorological and environmental monitoring in the Republic of Kazakhstan is conducted by RSE KazGidroMet.

A network of hydrologic observation stations is designed to collect data on the condition of water bodies and water resources of the Republic of Kazakhstan. The placement of hydrologic observation stations is based on the principle of obtaining accurate parameters of the regime – level and annual flow. The number and density of observation stations are determined by natural-climatic conditions and needs of the economy.

Regular hydrological observations on the surface water facilities of the republic of Kazakhstan are conducted at 3 hydro-meteorological stations, 180 level stations, 23 lake stations and 3 marine stations. Rivers longer than 100 km are sufficiently covered by observation. Recently there has been a decline in the number of stations on rivers of lengths from 10 to 100 km. Operating hydro-meteorological stations are located mainly at the elevations up to 2,000 m, with some located higher.

Water quality observations are made based on hydro-chemical and hydro-biological parameters in 53 water bodies, 101 surface water control stations and 142 gates.

Water sample analyses are conducted in the network laboratories of the Environment Pollution Monitoring Center of KazGidroMet in accordance with approved methods.

The significant reduction in observation stations on water bodies requires the optimization of the surface water resources monitoring network. The priority task is restoration and organization of the network of hydrological observations on cross-border water bodies.

Groundwater monitoring in the Republic of Kazakhstan is conducted by the Committee for Geology and Subsoil Protection of the Ministry of Energy and Mineral Resources. The main concern is ground and low-pressure ground waters in the zone of active water exchange and waters of feasible aquifers.

On the territory of Kazakhstan there are 6,838 observation stations of State Ground Water Monitoring, including 3,152 observation stations related to the regional network, 3,621 related to the local network and 65 wells relating to the proprietary network. The existing observation stations, their location and equipment can not fully monitor and account for the current hydro-ecological situation in Kazakhstan and the extent of manmade impacts. The observation network is unevenly dispersed and in many cases is concentrated in more developed areas, while the major oil and gas provinces and regions of ecological disaster remain unstudied.

One key specific feature of Kazakhstan's groundwater regime is the decreasing average multi-year value of pre-spring and spring maximum water levels. In most ground water reservoirs, after stabilization of the water level, resulted from decreased water intake, there has been a decrease in water levels caused by low water years. Changes in the salinity and chemical composition of ground waters are not reported.

CHAPTER 2. KAZAKHSTAN'S CONTEMPORARY WATER PROBLEMS

2.1. Water Supply Issues

2.1.1. Decrease in the River Basins Capacity

Complicated water management situations have arisen throughout Kazakhstan. This has been caused by a lack of water resources and the pollution of water sources, which worsened during the latter Soviet-era period of extensive industrial development. Population growth and the inadequate capacity of aquatic ecosystems to regenerate have resulted in environmental deterioration in all of the country's main river basins /54, 60, 63, 75/.

The Aral-Syrdarya basin is characterized by a complex water-management situation, especially in the lower reach of the Syrdarya River. The principal issue is removal of water from the main course of the river in connection with an expansion of land under irrigation. Reduction of natural river drainage and an increase in pollution of river water has led to a sharp deterioration in the state of the natural environment and living conditions for the population of the Aral region. The river delta has lost its water regulating capability and other ecosystem services both for the deltaic region and for the Aral Sea as a whole. Desertification has encroached over 2 million hectares. The overflow of manifold drainage waters, domestic, industrial and agricultural sewage into the Syrdarya has led to chemical and bacterial pollution of the water and a growth in illness among the population. The complexity of resolving the water problems of the region is due to the fact that water usage is being monopolized by the agriculture sector and therefore surface water resources throughout the basin are being completely directed towards non-domestic use.

The Ural-Caspian basin can be described as a severely water-deficient basin. The deployment and development of industry in the region is due to the location of raw materials and other regional and national economic demands without due consideration to the water factor. As a result, water demand significantly exceeds supply capabilities, especially in dry years. This deficit of fresh water is intensified by constant and growing demand from the rapidly developing oil-extraction industry and also by the intensive pollution of the waters of the Ural basin. Resolution of these problems is essential. One proposed approach could be joint consideration, with the Russian Federation, of the possibility of transferring part of the drainage from the Volga River to the Ural.

The Ishim, Nura-Sarysu and Tobol-Torgai basins are characterized by comparatively small volume of river flows and its concentration during the year: 90% of drainage occurs during 1-2 months in the spring.

The associated acute water resource deficit for most of the year is an obstacle to development of the mining industry in these locations, which is of great significance for the country. In total, 76% of the country's electricity is produced here, as is 98% of coal, 99% of iron ore and a large share of copper. Besides coal, copper and iron ore, the region also possesses large reserves of manganese and lead-zinc ore, wolfram, molybdenum, bauxite and asbestos raw materials for the development of the chemical industry and others. The potential to develop the raw materials sector determines the interest to attract water resources into the area from neighboring river basins as a solution to the local deficit. The Irtysh River has been proposed as such a source for this region, and the Irtysh-Karaganda Canal (currently the Satpaev Canal) was built to feed water from the river to Central Kazakhstan. However, in recent years, as a result of its poor initial construction and currently weak maintenance as well as the instability of economic relations with water consumers and the energy industry, the canal's flow capacity has decreased to only 30% of previous levels. In future, the provision of water from this region should be possible by increasing the flow capacity of this canal.

The Irtysh basin, despite its high levels of water, the Irtysh River is also suffering from a seasonal lack of water, and therefore its water management balance is very strained. In addition, the Irtysh river basin is afflicted by heavy industrial pollution. Moreover, the Irtysh is an international river-shared by the People's Republic of China, the Republic of Kazakhstan and the Russian Federation–each of whom have their own interests for using the waters of this basin. When examining the various potential solutions for resolving Kazakhstan's water problems in the Irtysh basin, it is worth noting the need for signing bilateral and then trilateral long-term inter-state agreements with the aforementioned neighboring countries on joint usage of waters across state borders. These agreements should reflect various solutions for resolving and preventing pollution, plus measures to maintain the quality of transferred drainage from the river at state borders as well as maximum volumes of water that may be extracted without causing harm to downstream neighbors.

The Balkhash-Alakol basin. The Lake Balkhash basin, with an area of 500,000 km^2, may become-like the Aral Sea–yet another environmental catastrophe in the region in the near future. This is mainly linked to the swallowing of the lake's waters by ustream uses, leading to its desiccation and consequent negative changes in both the environment and the living conditions for the local population. Like the Irtush, the basin is international: waters are shared between the Republic of Kazakhstan and the People's Republic of China The reasons for these changes are a reduction in the flow of water into the lake caused by the building of the Kapshagai Hydroelectric Station on the River Ili and uncontrolled use of water resources coming into it from other rivers: Karatal, Aksu, Lepsy and others. The Ayagoz River, for example, fed the lake with water until the 1950s–now it practically does not reach the lake at all. As a result, the shore reed area has become exposed, and the variety of fauna inhabiting it has decreased sharply. Wildlife has suffered losses, having been deprived of the lower Ili River's water and as a result of the encroachment of sand from arable and pasture land. Water pollution from industrial waste and the ill-conceived 1950s policy of acclimatization of alien species of fish and uncontrolled fishing has led to depletion of the lake's fish reserves. The envisaged measures to reduce these negative consequences–construction downstream of a hydro-plant to control the flow of water into Lake Balkhash and to be a receiver for fish–over the course of a number of years have not been completed /82, 83/. Resolving the problems of maintaining Lake Balkhash, and the ecosystems of the basin as a whole, depends on the implementation of measures to save water, and to prevent the discharge of untreated industrial and agricultural sewage into the river. The water balance in the basin will mainly be determined by the control of water relations along the Ili River from the Chinese side.

2.1.2. Water and Environmental Problems of the Caspian and Aral Seas and of Lake Balkhash

The Caspian Sea

The Caspian Sea is the world's largest inland reservoir, unparalleled in the diversity of its flora and fauna, and it is undergoing a major period in its natural and economic history. The role of the Caspian Sea region in developing Kazakhstan's economy is priceless, due to the growth in global demand for the natural resources located here. At the present time and in the near future, the Caspian region is of particular strategic importance for Kazakhstan as the country's oil and gas industry expands. Meanwhile, the initiation of economic activity in this region–and the prospecting and assimilation of oil and gas field reserves–is accompanied by growth in water pollution of the Caspian itself and of the rivers flowing into it. This is resulting in a reduction in the quality of bio-resources and the destruction of natural ecosystems.

The unfavorable economic situation is aggravated by the submersion of a number of coastal territories, caused by the rising sea level. The period from the 1900s until 1978 was marked by a falling Caspian sea level, but this has unexpectedly changed since then and given way to a sharp rise–including a 2.5 m increase in the last 7 years alone. Forecasts indicate that the rise in the level of the Caspian will continue, although in recent years relative stability has been noted. In the opinion of the majority of experts, a rise of this kind is mainly connected with changes in the global climate.

A consequence of the rising sea level is the intensification of erosive phenomena: waves with a height of 3 meters and more spread along the coastline , destroying the coastline at a rate of 10 m/year. Submersion of coastal land also is occurring at a rate of 1-2 km/year. The total annual harm done by the rising sea level to the economies of the Caspian region countries is around 15 million US dollars. According to some estimates, by 2007 this damage for all Caspian states could grow to as much as 200 million US dollars.

In connection with the rise in the level of the Caspian Sea, coastal territories are under threat of submersion and are heavily polluted by oil products. Oil pollution in this area is not only an important national environmental priority for Kazakhstan, but is also the largest international problem in the Caspian region as a whole. The effects of water pollution in the Caspian will lead to enormous economic and environmental losses in addition to those associated with changes in the sea level.

The international Caspian Environmental Program (CEP) was developed in 1997 with the objective of encouraging co-operation in protecting the environment in the Caspian Sea region. In 1998, the Global Environment Facility (GEF) project *Addressing Transboundary Environmental Issues in the Caspian Environment Programme*, was put together under CEP framework. The governments of the Caspian Sea countries, taking upon themselves the tangible obligations to ensure its implementation, approved the project. The GEF project has put in place organizational structures to develop a coordinated mechanism for managing the Caspian Sea region environment. The CEP is being implemented at regional and national levels. The Chairman of the CEP Regional Committee annually elects a national CEP coordinator–an Environment Minister from one of the Caspian region countries, on a rotational basis. Two Caspian Regional Thematic Centers (CRTC) have been set up: for the fluctuation of sea level (in Almaty); and for the protection of biodiversity (in Atyrau).

As a result of work carried out under the first phase of CEP with financial support from international partners, a set of results has been gathered, and scientific research has been conducted to determine the background pollution of the Caspian and seabed deposits. A series of projects has been prepared, including:

- Project of framework conventions on protecting the marine environment of the Caspian Sea;
- National plan to prevent oil spills and react to them in the sea and internal reservoirs of Kazakhstan (approved by Governmental Decree of the Republic of Kazakhstan No. 676 dated May 6, 2000);
- Project for regional cross-border conclusive analysis of existing and new environmental problems;
- Project for a Strategic Action Program (SAP); and
- Project for a Caspian National Action Plan (CNAP).

The second phase of the CEP is now underway. It envisages completion of the priority actions of the regional SAP and CNAP of the Caspian countries. However, as a result of lack of finances and coordination of actions of the CEP structures, problems of protecting the ecosystems of the Caspian have, up until now, not been addressed effectively enough. The absence of an inter-state agreement between all five countries of the Caspian Sea region on the status and division of areas of water and the seabed is seriously hindering the efficient use of natural resources in the Caspian and the avoidance of degradation of the ecosystem. Negotiations are continuing and tangible, and positive results have been achieved. On May 12-14, 2003, a meeting of special working groups to develop a Convention on the Status of the Caspian was held in Almaty. The signing of a trilateral agreement between Azerbaijan, Russia and Kazakhstan on the meeting point of the contiguous sections of the Caspian Sea bed was a significant event at the meeting. A Framework Convention for the Protection of the Marine Environment of the Caspian Sea also was signed in Tehran on November 4, 2003 at a meeting of ministers from Azerbaijan, Iran, Kazakhstan and Russia. Turkmenistan signed the convention four days later. The document obliges all sides to "undertake all necessary measures to prevent, reduce and control pollution of the Caspian Sea".

The Aral Sea

The environmental crisis of the Aral basin is a major disaster that has affected the territories of all five riparian Central Asian states, with a total population of over 40 million people. The intensive extraction of water for irrigation from the Amudarya and Syrdarya Rivers over the last 40 years has caused a fall in the level of the Aral Sea by 17-19 meters and reduced the volume of its water resources by 75%. The mineral (saline) concentration of the seawater has increased from 10% to 60% as a result. By the end of the 1980s, the Aral Sea effectively no longer reached its former borders, resulting in such negative consequences as: desertification of the delta; development of erosion processes on the dried out sections of the seabed; localized climate change; and a sharp deterioration in the health of the population as a result in the drop in the quality of the sea water and transfer of salt dust, etc. Other consequences of this deterioration, which are no less dangerous, include:

- Drop in the quality of waters in rivers and underground waters;
- Collapse of the fishery industry based on the Sea's resources;
- Salinization and waterlogging of irrigated soils;
- Desertification of the area and surrounding irrigated land;
- Instability of water and salt balance of water bodies, caused mainly by reverse water drainage; and
- A drop in bio-productivity and biodiversity and variety of aquatic ecosystems.

The following fact indicates the scale of the Aral problem. Approximately 2 billion US dollars (about 5% of the GDP of the Central Asian countries) is being lost through salinization alone in the region annually. These losses will increase if the process of salinization is not stopped /63/.

Analysis of the causes of the Aral crisis shows that–in addition to intensive development of irrigation in the Aral basin–the effects of irrigational factors on the environment were misunderstood. To be more precise, the environmental and social aspects of large-scale development of water and land resources were not taken into account. The collective impact of these and other negative factors of ill-considered irrigation caused severe social and environmental impacts in the region and reduced the water balance of such large areas as the Republic of Karakalpakstan, Kyzylorda Oblast as well as some areas of Turkmenistan adjoining the lower reach of the Amudarya that now do not have access to quality river water /108/.

In response, the heads of Central Asian states interested in resolving the problems of the Aral Sea approved the *Aral Sea Basin Program (ASBP)*. The first stage of the program (ASBP-1) included, among others, completion of the following measures aimed at protecting the environment of the Aral Sea basin:

- Development and implementation of a regional system to monitor water resources and control their use in the Aral Sea region for the clarification of environmental conditions, including creation of a database, and specially-equipped meteorological stations, particularly in the flow forming zone;
- Development of principles to improve water quality, and limiting of all forms of pollution;
- Development and implementation of the inter-state programs *Clean Water* and *Health*;
- Conducting essential water management and environmental research, and implementation of measures to improve the environment in the flow forming zone;
- Equipping the water management organizations *Syrdarya* and *Amudarya* with technical equipment.

In October 2002 in Dushanbe, the heads of the Central Asian states took a decision to develop a *Program of Concrete Action to Improve the Environmental and Economic Environment of the Aral Sea Basin for 2003-2010 (ASBP-2)*. Based on the results and experience of the first phase of the period, the presidents of the Central Asian republics determined and approved the following main directions of the second phase of ASBP-2:

1. Development of agreed mechanisms for integrated management of water resources in the Aral Sea basin;
2. Restoration of water management sites and improvement of water and land resource use;
3. Completion of a monitoring system;
4. Development and implementation of a program to combat natural disasters;
5. Development of a series of co-operative projects to resolve the region's social problems;
6. Strengthening of the material-technical and legal bases of inter-state organizations;
7. Development and implementation of a regional and national program of environmental measures in the drainage formation zone;
8. Development and implementation of regional and national programs for rational water consumption in sectors of the economy in Central Asian countries;
9. Development and implementation of a regional and international program for sanitary and environmental improvement of health in populated areas and natural ecosystems;
10. Development of an international program to restore environmental stability and biological productivity;
11. Development of a conceptual idea for sustainable development of the Aral Sea basin;
12. Co-operation in carrying out a regional action program to counter desertification;
13. Development of introductory swamp lands in the downstream Amudarya and Syrdarya rivers; and
14. Rationale use of mineral drainage waters.

The exhaustion of water resources in the Aral region is a direct result of their excessive use, mainly for irrigation needs. Therefore, it is completely natural that any form of environmental rehabilitation will strongly depend on the increase of volumes and quality of water flowing each year into the Amudarya and Syrdarya Rivers. The following measures are required for successful fulfillment of these plans:

- Approval of agreements on water sharing between all countries of the basin with the aim of rationalizing management of water resources in the Aral Sea basin. Agreed and authentic models of water resource management based on principles of mass balance and with a realistic time scale, to provide the necessary means, as well as an approved database;

- Open exchange of existing and new data on rivers, lakes, reservoirs and the basin's water-conducting network;
- Standardization of existing rules for water consumption for irrigation and hydro-electric power, and also a decrease in the rate of water loss; and
- Measures to provide effective use of scarce water resources.

At present, management of water resources of transboundary rivers of the Aral Sea basin is being carried out by the following interstate organizations: the International Fund for Saving the Aral Sea (IFAS); and its subsidiaries the Interstate Commission for Water Coordination (ICWC), the ICWC Scientific Information Center (SIC-ICWC), and the Amudarya and Syrdarya Basin Water Management Organizations (BVO Amudarya and BVO Syrdarya).

IFAS carries out the functions of international coordinator for financing inter-regional programs for the Aral Sea and for managing investment from donor countries, the World Bank, UNDP and other international organizations.

ICWC is the main organization for managing transboundary water resources from the basin of the Aral Sea. The committee determines a single water management policy and sets the limits for water extraction and the operating schedule of reservoir flow into the rivers Amudarya and Syrdarya. It also implements environmental programs and coordinates major water management work. Membership of the ICWC is comprised of ministers from the five Central Asian countries or individuals authorized by the governments of these countries.

The ICWC's Scientific Information Center is tasked with working out water management problems, managing water resources, and planning for the future use of transboundary water resources in the Aral Sea basin.

BVO Amudarya and BVO Syrdarya are executive interstate and interdepartmental bodies of the ICWC. They supervise the rate of flow from reservoirs, the use of limits of water extraction with consideration of quality of water resources and the supply of environmentally-sound and sanitary technical flows into the Aral Sea, approved by the ICWC.

As far as practical activities of the regional organizations for planning and implementing the ASBP, it is worth noting that the potential of such bodies as the ICWC, IFAS and the BVOs is still far from being realized.

Regional measures include steps to coordinate, stimulate and support national action plans. Each state has its own environmental strategy and its own organizations. All national strategies prioritize safeguarding water resources and providing the population with clean drinking water. However, there are currently major disagreements between states regarding the progress and selection of priorities. It may be said that the states have not yet fully estimated the economic and environmental potential of joint cooperation in the sphere of water economy in the region.

Lake Balkhash

Lake Balkhash is one of the largest closed inland lakes in Central Asia, with an area exceeding 18,000 km^2. It is fed from the waters of the Ili, Karatal, Aksu and Lepsy Rivers. The most significant feeding source is the Ili–with its basin taking up 80% of the lake's water catchment area. Surface and ground waters flowing from the riversides and precipitation falling on the surface of the lake also are major water sources. Balkhash's peculiarity is the fact that a narrow channel of Uzun-Aral divides it into two separate parts, i.e., the western part, which is larger in area (over 10,000 km^2) but shallower than the eastern one, which is as large as 7,000 km^2 and up to 26 m deep.

Another specific aspect of the lake is that nearly all inflowing water evaporates, while in the situation of difficult water exchange between the lake's western and eastern parts through the Uzun Agach channel, the two parts have differing salt economies and levels of water salinity. The salinity of the eastern part of the lake is over 4 g/l, while the western part is strongly desalinated due to great inflows of the relatively desalinated waters of the Ili River. The salinity level of the western section is only up to 0.5-1.5 g/l. Annually, significant volumes of water flow from western to eastern Balkhash through the Uzun-Aral channel. This does not mean that the Uzun-Aral channel supports the current that flows from west to east. However, the balance of these differently directed currents is that the west-east water volumes are larger than east-west volumes. The mean annual water disparity is 1.15 km^3. The dynamics of water exchange depends on inflows and mostly affects the salinity level of the western waters.

Balkhash's water resources are very important for Kazakhstan's economy. The western part of the lake is a vital source of water for industrial projects and the people of the Balkhash region. In addition, Lake Balkhash is one of the most prominent fishing centres in the country.

A problem regarding the Ili-Balkhash region emerged several decades ago due to the establishment of the Ili-based Kapshagai Reservoir. According to the Institute of Geography, up until 1970 the water balance of the lake was maintained by annual inflows of 23.8 km^3 from mountain rivers, of which 17.4 km^3/year were inflows from the Ili–with a further 6.4 km^3/year flowing from such eastern rivers as the Karatal, Aksu, Lepsy and Ayaguz. However, 14.9 km^3/year were actually reaching Balkhash, with the remaining 8.9 km^3/year of inflowing water lost in the natural drainage network, i.e., to wetlands of the Ili's unique delta, streamside tugai bushes, meadows and irrigated areas within the basin. With the Kapshagai Reservoir filled with water and irretrievable water loss for irrigation, surface water input dropped to 12.2 km^3/year and currently Balkhash's water intake is only 7 km^3 per year.

It took 39 km^3 of Ili runoff to complete the filling of the Kapshagai reservoir, which started in 1970. The water level of the lake started to decline at around 15.6 cm/year, which was much more than during the previous naturally regressive phase from 1908-1946 (9.2 cm/year). As a result, by November 1986 the level of the lake had fallen to its lowest point of 340.46 metres above sea level, causing higher water salinity. The complexity of the problem is that the salinity of western Balkhash alone is at the lowest acceptable point to be used as a water source. Therefore, a decision was taken to restrict refilling of the Kapshagai reservoir and maintain it at just 16-18 km^3 of its originally planned capacity of 28 km^3.

In 1999, Priosyorsk, a town in Karaganda oblast, hosted an international symposium on the "Balkhash Ecosystem: Problems and Solutions", which carried a resolution to adopt a special law on Lake Balkhash's conservation and a national Balkhash regional rehabilitation programme. In November 2000, a government decision instigated the international environmental forum "Balkhash-2000", held in Almaty.

Summarising the causes of the Ili-Balkhash problem, it can be concluded that this unique lake has become a victim of a conflict of interests between greater consumption of river water for irrigation and hydroelectricity and the need to maintain a stable economy and water balance of the lake. Preventing pollution of the basin and ensuring sufficient inflows from China, primarily through the Ili, are essential to maintaining the sustainable environmental status of Balkhash.

2.1.3. Use of Ground Water for Water Supply

In most regions of Kazakhstan, underground water is the main source of water supply for economic and drinking purposes. Annual water extraction of groundwater for drinking and economic water supply is about 0.70 km^3 per year (2 million m^3/day). Around 1 km^3 is extracted from non-prospected reserves. On average, the rate of usage of prospected reserves is 14%–the highest being 23.7% in Mangistau Oblast, and the lowest 0.4% in Atyrau Oblast. For industrial purposes, in recent years an average of 0.95 million m^3/day has been extracted, as opposed to 1.5 million m^3/day during 1990-1993.

Drinking Water. Groundwater used for drinking does not always meet the quality requirements of the State Standard (GOST). The cleanliness of underground water varies widely and depends on a multitude of factors: depth of the underground water deposit; its distance from pollution source(s); the capacity and make up of water-supporting geological structures. Deterioration in the quality of groundwater is evident in the water extracting installations of most towns and villages. Their total capacity equals 16.4% of total groundwater extraction. To a large extent, underground waters in Aktobe, Kostanai, Akmola and South Kazakhstan Oblasts are under threat of pollution–from 31% to 45% of the total volume of water demand. Practically clean groundwater is available and used in Pavlodar Oblast. To provide the country's more than 8,500 villages, around 600 million m^3 of water are used annually, including 470 million m^3 of underground waters.

The water supply system in urban areas is, in most cases, in poor condition. Wear and tear of water collecting installations and distribution networks has reduced their efficiency to around 50 percent. The mains networks were built predominantly in areas of scarce or no fresh groundwater supply and are mainly geared towards collecting water from surface sources. Currently, 18 such systems take more than half the volume of water transferred to all the communal drinking water supply pipelines in the country. Localized pipelines in populated areas rely 97% on underground water. These are mainly major villages, regional centers and central farms of agricultural enterprises, in which around 60-65% of the rural population live.

Up to 4% of established reserves of fresh groundwater is used for the needs of agricultural water supply. In villages without a centralized supply, water is extracted from tube wells and individually dug wells; surface water sources are also used. The water extraction and channeling apparatus, controls and measuring instruments and locking devices, chlorination or bactericide plants of many water supply systems also are in a poor state of repair.

Underground water, with an increased mineral composition in the decentralized water supply systems, amounts to 10% to 50%, depending on the region. An increase in accordance with normal levels of mineral composition of underground water has also been noted, as well as in some centralized water systems. For example more then 70% of the centralized water supply from Kyzylorda Oblast is based on underground water with a mineral composition of 1.2 to 4 g/l.

For underground water used for agricultural water supply a deviation from recognized optimum concentrations of fluorine and iron has been noted in a number of cases. The presence in this water of manmade organic pollution and its potential carcinogenic effect is particularly dangerous.

The pollution of underground sources of drinking water supply and the lack of appropriate water treatment, and the poor technical condition of water supply networks will entail deterioration in the quality of drinking water supplied to consumers and poses a serious threat to the health of the country's population.

2.1.4. Transboundary Water Supply Issues

Current Challenges of Transboundary Water Problems for Kazakhstan

Due to the fact that almost half of Kazakhstan's water resources flows from neighboring countries, joint use and protection of water resources from cross-border hydro plants is of pressing and urgent importance for the Republic. The question of sharing water in the region is far from being fully resolved, and in recent years the situation has become more acute. In particular, the republics of Kyrgyzstan and Tajikistan, who have the largest water resources among the Central Asian countries, consider it necessary to review as soon as possible existing criteria and principles for interstate use of transboundary waters in those areas where water resources are shared and managed for the rational use and protection of these waters. The People's Republic of China is unilaterally beginning to implement plans to expand usage of water resources from the Irtysh and Ili rivers within its borders. These conflicting situations must be resolved on the basis of international agreements, discussions and consultations.

Water Relations between Kazakhstan and Its Riparian Neighbors

The flow of the rivers Chui, Talas, Assa and Syrdarya to the region serving Zhambyl, South Kazakhstan and Kyzylorda Oblasts in Kazakhstan, is formed in Kyrgyzstan and Tajikistan. The economic and environmental sustainability of this region, which in Kazakhstan has 1.02 million hectares of irrigated land—or almost half of its total area in the country as a whole—to a large extent depends on the water factor. At the current time the environmental and natural resources management situation here is unsustainable.

A single river network and water resources system link the Central Asian states located on the territory of the Syrdarya water basin to each other from natural flow as well as hydro-technical facilities, which include dams, canals and reservoirs. The current amount and seasonal variation of water is restricting the capacity to meet water demand in some countries and to produce hydro-electricity in others. Fluctuations in interstate relations concerning cross-border water usage may lead to economic, social and political tensions in the region.

The main problems affecting the joint usage of water resources in the region are:

- Distribution of water for electricity and irrigation purposes;
- Agreement on provision of water only on an annual basis;
- A currently complex compensation system for the accumulation and storage of water;
- Principles for distributing water to consumers; and
- Water quality.

Rational use of water, especially from transboundary rivers, is complicated by a range of factors such as the lack of a clear agreement between riparian states regarding water allocation and a lack of mechanisms to implement previous agreements between the countries on these issues. The differing interests of basin water consumers also contribute to the problem.

The most acute disagreement relates to the operation of the Toktogul Reservoir (in Kyrgyzstan), which is the largest in the Syrdarya basin and in Central Asia. There is essentially a clash of interests between three Central Asian states – Kyrgyzstan, Uzbekistan and Kazakhstan. The two downstream countries of the Syrdarya Basin are interested in maintaining storage for summertime irrigation from the Toktogul Reservoir, whereas wintertime energy generation from the reservoir is beneficial to Kyrgyzstan. A similar set of issues may be seen between Tajikistan and Uzbekistan regarding management of Karikkum Reserv

Changes in the operations of the Toktogul Reservoir have led to the following negative developments in Kazakhstan:

- Worsened conditions and decreased development figures for agriculture in the region: insufficient water for irrigation, a fall in the area under crop and a drop in yield from the most strategically important agricultural crops;
- Deteriorating social, economic and living conditions of the population;
- Non-productive water loss for the Aral Sea when its winter surpluses - due to insufficient carrying capacity of the lower flow of the river - overfill the Chardara Reservoir (South Kazakhstan region) and has to be released into the Arnasai Depression in Uzbekistan;
- Flooding of populated areas and agricultural land in Uzbekistan, Tajikistan and Kazakhstan;
- The environmental and sanitary situation in the basin has become more acute, particularly in dry years; and
- Decreased capacity of Toktogul Reservoir to regulate multi-year flows into the Syrdarya due to unavoidable releases for electricity generation.

Each of these problems is affecting the national interests of Central Asian states. Taking their demographic situation into account, shortage of water in the region is likely to grow in the future /63/. The solution of the problems listed above requires the establishment of an interstate legal basis for mutually advantageous cooperation on use of shared basin water resources.

Water Relations between Kazakhstan and China

The leadership of the People’s Republic of China has declared its intent to accelerate full-scale development of Western China, which is one of the most underdeveloped regions of the country. This plan includes the building of a water canal Cherniy Irtysh-Karamai in the Jingxian-Uighur Autonomous Region. Part of the water from the upstream Irtysh River will be transferred along the canal to the oilfield region near Karamai. To compensate within Western China, an increase in the extraction of water from the Ili River’s upstream waters is envisaged to meet agricultural needs.

The transfer of part of the water from the Irtysh and Ili Rivers aims to provide water resources to the rapidly developing economic region where growing industry–especially oil–and newly developed and urbanizing areas are experiencing an acute water shortage. In addition, an increase in demand for water is linked to a planned significant increase in irrigated agricultural areas for grain and cotton crops in Jingxian Province.

The Chinese are intending to carry out an annual extraction of water from the River Irtysh to a volume of 0.50-1.0 km^3 when the Karamai oilfield comes into production. In future, water extraction may increase up to 2-4 km^3. To put this in context, the average annual drainage from the Cherniy Irtysh River in the Buran range is only around 9 km^3.

The planned extraction of water from the river by China may have serious consequences for the economy and the environment, not only in Kazakhstan but also Russia. Water extraction from the Cherniy Irtysh River, with existing sources of pollution, will likewise result in a deterioration of water quality and the condition of the Irtysh aquatic ecosystems, which are already regarded as being poor /111/.

There are 2.5 million people living in the Irtysh River basin within Kazakhstan’s borders. Major industrial centers are based here–Ust-Kamenogorsk, Semipalatinsk, Pavlodar, not to mention numerous smaller towns and villages. Water is supplied along the Irtysh-Karaganda Canal from the Irtysh River to Central Kazakhstan, and includes the Republic’s capital, Astana. In the event of an increased use of the Irtysh’s waters by China, the environmental equilibrium of a large region of Central Asia and among neighboring states will be destroyed.

Similar consequences will be seen if water is extracted from another cross-border river–the Ili–which provides 80% of the water flow into Lake Balkhash. As mentioned, the reduced inflows and salinization of Lake Balkhash could become an environmental tragedy comparable to the Aral Sea disaster. Lake Balkhash has a key function in the climate balance of all the southeastern and central parts of Kazakhstan.

It should be noted that China is currently pushing ahead with the following projects on the upper Ili at a rapid rate:

- Installation of new and reconstruction of existing hydro-electric and hydro-chemical stations and their advance to state borders;

- Provision of laboratories in cross-border regions for hydro-chemical analysis of the quality of the transit flow; and
- Conducting scientific and research work to determine the condition of water resources and their quality according to retrospective and current statistics, to prepare grounds for evidence to prove the ‘insignificance’ of environmental and economic consequences of implementing their plans for extracting water from the cross-border rivers.

From the Kazakhstan side of the boder with China, as a result of insufficient financing, little is being done to better understand the issues and make plans for the integrated management of shared water resources. Only one cross-border station–Dubun on the Ili River–has been opened, but this is far from adequate. A range of measures must be carried out to strengthen border water control, not only on the Irtysh and Ili Rivers, but also for a number of other cross-border rivers (there is information that the Chinese authorities are examining possibilities to extract water from several other cross-border rivers), among which priorities should include:

- Refitting of the Buran Station on the Cherniy Irtysh River;
- Renovation of the Tekes River Hydro Station; and
- Opening of new stations on the Khorgos River.

Over the past two years there have been five rounds of negotiations between Kazakhstan and China on cross-border rivers and two meetings of working groups of experts, during which a definite rapprochement for both sides occurred on these issues. A mutual inspection of hydro-technical installations was conducted, including the Irtysh-Karamai Canal. As a result, an agreement between the governments of Kazakhstan and the People’s Republic of China on co-operation regarding the use and protection of cross-border rivers was signed in Astana in September 2001. This agreement, however, only envisages such major obligations for the Chinese as considering Kazakhstan’s interest in the use of cross-border water resources.

Water Relations with the Russian Federation

Several cross-border rivers link Kazakhstan and the Russian Federation to each other. The main rivers include the Ural, Irtysh, Ishim and the Tobol. Considering the circumstances, an interstate agreement between Kazakhstan and the Russian Federation on the joint use and safeguarding of cross-border water facilities was signed on August 27, 1992 in Orenburg. A Kazakhstan-Russia committee was set up on the basis of this agreement which meets twice a year at set times to approve the work schedule of reservoirs designated for joint use, to set the limits for water extraction and to develop measures for repairing and operating water facilities designated for joint use. In 1997 the validity of the agreement was extended until 2002, and its validity was further extended for another 5 years to 2006.

2.1.5. Managing Risks Associated with Hydrological Disasters

Flood Protection

Flooding is one of the most frequent and harmful natural disasters, and it causes both direct and indirect damage. Primarily it results in the destruction of buildings and the landscape and harm to people, domestic animals and agricultural crops. Secondly, as a result of consequences arising from these disasters, there is a halt in economic production, destruction of transport and communications facilities, pollution of the environment, including water, and development of possible epidemics and other problems.

About 100,000 people have died in floods in the world over the last 10 years alone with over 1.5 million people affected; total damage resulting from floods during this period amounts to some 300 billion US dollars. The causes of flooding are: heavy and persistent rainfall; intensive melting of snow and glaciers; breach of lakes and reservoirs; wind driving water in large reservoirs; obstruction and ice on rivers; tidal waves; and other factors.

Despite the aridity of the climate, floods are quite frequent in Kazakhstan. There are about 800 rivers with a length exceeding 50 km on which flooding can occur. Those territories most susceptible to flooding include the north-west, the north, the east, the south-east and central regions of the Republic. Most damage is caused through the flooding of the Ural, Tobol, Ishim, Nura, Emba, Torgai, Sarysu, Bukhtarma Rivers and their numerous tributaries. Flooding can also be caused by accidental overflow of water from reservoirs, breaching of regulation ponds and other manmade reservoir facilities.

Over 300 floods caused by different phenomena have been recorded in Kazakhstan over the last

10 years–where 70% of these were floods caused by spring thaw, 30% were caused by rainfall and 10% by other factors. Floods in Kazakhstan occur each year, but their distribution and scale varies quite substantially from year to year. Approximately once in every 50-100 years a catastrophic flood occurs in the rivers of Kazakhstan. An example of this was in the spring of 1993 when catastrophic rain- and snow-induced flooding occurred in practically all the river plains of the Republic–covering 16 of its regions–as a result of heavy rainfall, surplus snowfall, combined with a sharp and significant rise in temperature. According to official statistics, 669 populated areas were affected by this flood, 6 people died, and 12,700 were evacuated. A further 7,000 homes, with a total area of 635,000 m^2, were flooded and destroyed. The flood likewise affected 50,000 hectares of land under cultivation and 2,300 farms. Some 66,000 livestock perished, and 875 km of roads, 718 km of electricity power lines, 275 km of communications lines and 513 hydro-technical facilities were rendered unusable. Direct damage from this flood alone reached 500-600 million US dollars. Direct annual damage from floods in other recent years has totaled from several hundred thousand to several tens of millions of US dollars, and in the period since 1995 the total figure is about 100 million US dollars.

Sewage ponds in major populated areas and industrial centers (the towns of Almaty, Aktobe, Zhambyl and others) present a particularly troublesome danger. As a result of a lack of financial resources, there is a threat of a breach of these ponds caused by catastrophic floods with serious consequences for the downstream population, the economy and associated water facilities. An example of this problem may be seen in the torrent-like flood that occurred on January 28-29, 1988 following a breach of the Zhamankum sewage-settling tank in the town of Almaty. Maximum output of the breach flood was evaluated at 2-4 m^3/sec, and its volume totaled 70 million m^3. During this disaster several buildings and facilities, road and railway bridges were destroyed, and 19 people died. The only reason this event was not more catastrophic was the area's sparse population.

Wind-driven flooding in coastal areas represents another important concern. A significant threat–especially when taken against the backdrop of a rise in the level of the Caspian Sea–is posed by wind-driven water encroaching on the sea's northern shore, where the height of waves can reach up to 2.5 meters.

The general threat from floods in Kazakhstan, including wind-propelled ones, with the exception of those caused by reservoir breaches, are predicted accurately and usually reliably. It is because of this that not more than 20 people have died in floods in the past 10 years in the country while about 14,000 people have been affected. Certainly these figures are modest in comparison with similar phenomena in other areas of the world.

The problem of flooding, and above all the issue of full-scale protection against its destructive impact, has not yet been resolved in Kazakhstan. Ideas and long-term programs to protect against flooding, and likewise a corresponding risk assessment and new standards for safe construction in areas susceptible to flooding, are currently being developed at a national level. The resolution of such problems must be based on information from satellite monitoring of actual flooding processes and modeling of potential scenarios using GIS technology. This methodical approach will enable major damage resulting from catastrophic floods to be avoided in future. For example, in the Republic's new capital, construction work is in progress on the left bank of the flood plains of the River Ishim. According to preliminary hydrological calculations already carried out, infrequent floods can reach extremely high water levels in this area. Therefore it is necessary to carry out its development on the basis of a thoroughly developed assessment of such risks.

Mudslides

The mountainous regions in the southeast of the Republic are the most vulnerable to mudslides. Their area encompasses about 360,000 km^2, or 13% of the country's territory. The main causes of mudslides in Kazakhstan are extremely heavy downpours, breaches of glacier lakes and seismic landslides. There are over 300 mountain basins where approximately 800 cases of mudslides have occurred over the last 150 years. Mudslides that occur most frequently are those caused by heavy downpours, while the share caused by glacial (glacier, snow-glacier) mudslides is up to 15%, and the proportion of those caused by other factors, including seismic mudslides, is about 5%.

The results of mudslides can be catastrophic. Seismic mudslides are the most powerful in Kazakhstan. At the time of the Verny earthquake (June 9, 1887), with a value of 9-10 on the open-ended Richter scale in separate basins of the Trans-Ili Alatau range (near Almaty), a landslip torrent was formed with a volume of up to 10-30 million m^3. The largest downpour torrent was that on the M. Almatinka River on July 8-9, 1921. The town of Verny (Almaty) was almost completely destroyed by this torrent over the course of 5 hours and more than 500 people died. The torrent's volume was 7-10 million m^3 and the outpour rate was 1,000 to 5,000 m^3/sec. The strongest glacial mudslides, which were equal to the torrent of 1921, were breach torrents on the Issyk River in 1963, on the M. Almatinka River in 1973 and on the B. Almatinka River in 1977.

The main government body responsible for mudslide protection, the Chief Administration for the Construction and Operation of Facilities against Mudflows (KazSeleZashchita), was set up by the government following the catastrophic torrent on the M. Almatinka River. This administration was given the task of developing and implementing current and future plans for the construction and operation of facilities against torrents and downpours and to carry out precautionary measures to reduce the risk of torrents and downpours, and likewise to organize work to eliminate the consequences of mountain and snow torrents.

By the beginning of 1990, a sufficiently reliable system to protect against torrents had been established in the Republic of Kazakhstan and this has received global recognition. The main achievement of this system is without doubt the engineering of an anti-torrent protection system for the country's major populated areas, above all for the former capital and largest city, Almaty.

Since 1991, due to lack of financing, the anti-torrent protection system that was set up gradually has been deteriorating. Project exploratory work has been stopped, and planned work on completing an approved complex scheme to protect the area against torrents has been frozen. The volume of work on the operational content of engineering facilities is being restricted, and scientific, analytical and forecasting measures have been put back. A reduction in funding has led to deterioration in the technical capabilities of KazSeleZashchita itself, while the technical equipment and instrumentation of the observation service and early warning system and communications has worn out. Many structures of KazSeleZashchita have been destroyed, and the number of its employees has been reduced, with most of its qualified staff leaving its employ.

Without doubt, this is having a negative effect on the general quality of anti-torrent protection in the country. The situation has been made more complicated by the recent increase of seismic activity in the mountain territories of Kazakhstan and likewise the predicted growth in the risk of torrents in connection with the processes of global warming.

In recent years Kazakhstan's government has planned a substantial increase in finance for KazSeleZashchita and a growth in its technical capacity. Coordination of activities between KazSeleZashchita and the agency for emergencies set up in the Republic–the Central Asian Emergencies Monitoring Center–has become an urgent necessity and will become extremely important. The groundwork for setting up this Center was recently prepared by the government's completed project in conjunction with the UNDP. Future research into torrents and completion of anti-torrent protection measures has been proposed, in close cooperation with specialists from countries such as Germany, Japan, Italy, the USA, Austria and others.

2.2. Quality of Drinking Water and Health of the Population

2.2.1. Access to Safe Drinking Water

The share of population with access to safe water supply, though still high, has been diminishing both in urban and rural areas.

According to established norms, the volume of drinking water demand in Kazakhstan stands at approximately 1.7 km^3 a year in order to satisfy the needs of the population. However, by 1995 the actual volume of water demand had decreased to 1.3 km^3 a year, and for the last 5 years has remained at around this level.

More than 2,000 water pipelines have been built in different towns to provide water to the population of villages, towns, district and regional centers. The majority of these first came into operation 20-25 years ago. At the current time the service period of a number of pipelines and their separate branches has expired, and for the remaining pipelines the wearing out of pipes and installations has reached over 70%. This is causing numerous localized disasters as well as secondary pollution of drinking water, lengthy interruption to supply, significant leakage in the network which in individual cases can be up to as much as 30% of the volume of water transferred.

The provision of pipeline coverage in different regions varies from 35% to 85%. On average across the Republic 70-75% of the municipal population is supplied with water by pipeline, 15-18% by water from decentralized water sources, and the remainder (more than 500,000 people) use imported water and water from open reservoirs.

In a number of cities that have a water supply system, because of its long period of usage, the aging water purification technology does not supply water that meets regulatory standards. Nationally, some 28.5% of operational water pipelines do not meet sanitary requirements. In Zhambyl Oblast, this figure reaches 89.7%, in Pavlodar Oblast 57.1%, in East Kazakhstan – up to 55.8%, in West Kazakhstan – up to 46%, and in Karaganda Oblast up to 36%. The situation is no better in the cities of Astana and Almaty, where 50% and 31.2% respectively of water pipelines do not meet sanitary requirements. As a result of these shortcomings in the water supply system, 50% of the population is forced to drink water that falls far below minimum standards of salinity and hardness. Indeed, 5 per cent of the population has to use water that does not meet bacteriological standards.[1]

A serious problem exists in the provision of drinking water to rural populations. The total length of constructed networks of water pipelines at the beginning of the 1990s was 17,100 km, serving 1,276 rural settlements. All major pipelines in the village are supported by state subsidies. Some 2,600 populated rural areas have been provided with local water pipelines. The total length of internal village networks amounts to 29,000 km. Around 60 % (approximately 3.5 million people) of Kazakhstan's rural population are provided with water by pipeline. The rest use water from tubular and shaft wells, as well as open reservoirs and imported water. In rural areas only 9% of the population use facilities of centralized pipelines – the remainder rely on other sources. The technical and sanitary reliability of this type of water provision is extremely low.

Due to the expiry of service period of a number of water pipelines, accidents have become more frequent and this has led to lengthy interruptions in water supply. A high accident rate leads to unproductive water losses, which in turn lead to over-expenditure of electricity and finally to an increase in the unit cost of water.

The cost of 1 m^3 of water supplied to the population in remote regions has, for various reasons, reached in excess of 60-80 tenge. On average, the cost fluctuates from 18-25 up to 40-60 according to district and water supply system. The unit cost of water supplied to networks in North Kazakhstan in 1999-2000 rose to 102 tenge, in comparison with the previous rate of 52.05 tenge.

As a result, a large number of rural communities have stopped using water pipeline networks. Many areas have been disconnected from water supply networks due to continuous non-payment. Populations in many remote areas experience severe water shortages or use water of low quality.

The drinking and economic water supply requirement of a single urban citizen in Kazakhstan is on average 167 liters per day. The exact figure varies from 206 liters per day in Almaty Oblast to 120 liters per day in Kyzylorda and Atyrau Oblasts. Specific water consumption for a single inhabitant of a rural area is 68 liters per day: from 70-75 liters per day in Kostanai, North Kazakhstan, Almaty and East Kazakhstan oblasts, to 25 liters per day in Mangistau Oblast. The lowest consumption of water in Kazakhstan is in rural areas of West Kazakhstan, North Kazakhstan and Zhambyl oblasts – only 10-16 liters per person per day.[2]

Average water provision in Kazakhstan is (in % of the 'norm') for towns – 85% (the maximum value is 92% in Almaty Oblast, minimum 62%); for rural areas 71% (from 84% in Almaty Oblast to 42% in Mangistau Oblast).

The following factors are causing deterioration in the quality and accessibility of Kazakhstan's drinking water:

- Overall manmade pollution of water sources, particularly service water, discharge from industrial, agricultural and domestic flow;
- Aging of water pipelines and sewage networks and installations, not providing the required water treatment and cleaning of discharged water;
- Secondary pollution of drinking water by bacterial activity caused by deterioration of the anti-corrosion coating of pipe surfaces;
- Incomplete pricing policy mechanisms, payment tariffs for drinking water, lack of operations in the communal-domestic sector and management of the agricultural water supply;
- Population's inability to pay and low level of access to quality drinking water;

[1] Millennium Development Goals in Kazakhstan, UNDP, 2002.
[2] Millennium Development Goals in Kazakhstan, UNDP, 2002.

- Lack of government investment in construction of new water supply systems and inadequate repair and renovation works on existing systems;
- Inadequate use of specially projected underground water fields for the purpose of economic water supply;
- Irrelevant use of fresh underground waters;
- Lack of fresh sources of drinking water supply in remote regions of the country.

Lack and/or inadequacy of measures to prevent reduction in water quality and to increase access to drinking water has had the following consequences:

- Deterioration of the health of the population in remote regions of the country;
- Irregular migration of the population due to deterioration of sanitation and ecology in remote areas;
- Aging of industrial resources of enterprises in the communal-domestic sector;
- Reduction in the quality and interruption to the supply of communal-domestic services, including increased operational delays to businesses in this sector;
- Loss of the drinking value of underground water fields and open reservoirs;
- Increased expenditure on purifying and treating water.

2.2.2. Regional Aspects of Drinking Water Supply

In connection with the critical condition of the country’s drinking water supply system and also with the objective of implementing the Presidential Decree of May 18, 1998, No. 3956 *On Foremost Measures to Improve the Quality of Health of Citizens of the Republic of Kazakhstan* /31/, in January 2002, the government of Kazakhstan passed a related program named *Drinking Water* for 2002-2010 (hereinafter referred to as the Program) as well as a plan for measures to implement it.

The main aim of the Program is the sustainable provision to the population of Kazakhstan with drinking water of required quantity and guaranteed quality. The program is scheduled to run for 9 years. The total volume of investment in its implementation has been set at about 115 million tenge, financing of which will come from local and national budgets, through external grants and loans from other sources. Implementation of the measures will be achieved in two phases:

Phase I (2002-2005):

- Continuation of construction of vital facilities to supply the population with drinking water.
- Creation of an inventory system of water supply facilities, fields and underground water extraction points.
- Renovation and decentralization of major group water pipelines.
- Reconstruction of water pipeline networks in Astana, Almaty, Atyrau and other cities. Creation of a sector base for new technological production of equipment, instruments and accessories for water supply.
- Introduction of measures to intensify the use of underground water.

Phase II (2006-2010):

- Continuation of work to introduce state-of-the-art technologies in the construction of the drinking water supply and treatment system.
- Construction and refurbishment of systems and facilities necessary for the complete supply of quality drinking water to the country’s population.

The problems of water supply in the main regions of Kazakhstan and measures undertaken by the Program are underlined below:

Kyzylorda Oblast, in the zone of the Aral Sea environmental catastrophe, can be regarded as a priority region. In fulfilling a governmental decree *On Measures for the Fundamental Improvement of the Economic and Sanitary Environment in the Aral Sea Region*, a number of installations for agricultural water supply have been built, and building continues on the Aral-Sarybulak group water pipeline to supply water to the rural and urban populations of the Aral and Kazaly Districts. Construction of the Pravoberezhny and Zhidely group water pipelines has begun, and the installation and renovation of other facilities is scheduled.

One of the most acute problems in Kyzylorda Oblast is supplying quality drinking water. More than 600,000 people live in the oblast, with 235,000 of these in rural areas. There are four major cities – Kyzylorda (regional center), Baykonyr, Aralsk and Kazaly, as well as six district center towns - Novokazalinsk, Zhosaly, Zhalagash, Terenozek, Shieli, Zhanakorgan - and 378 village settlements.

Reserves of drinking water in the oblast are distributed very unevenly. Areas in the immediate vicinity of the Aral Sea face an acute shortage of fresh water due to the high mineral content of the underground waters.

Three quarters (74.1%) of the population is supplied with pipeline water. There are 86 water supply facilities in the oblast, of which 15 do not work and 16 do not meet sanitary requirements. Centralized water supply serves 130 populated areas and the inhabitants of 118 villages use water from local water sources of a non-guaranteed quality. From 10-23% of the population uses imported water.

As a result, each year 20,000 cases of viral hepatitis and parasitic infections are registered in the region and 80% of these are children. The number of cases of sickness, peritonitis and typhoid has increased 5-6 times. The number of new forms of malignant illnesses continues to increase, particularly of the throat and kidney. The epidemic situation concerning Crimean hemorrhagic fever remains acute /74/.

High levels of sicknesses uncharacteristic for children of 6-7 years are registered in the Aral region (atrophic gastritis, gall stones, chronic deformed bronchitis). The total level of sickness of the population has doubled and the number of birth defects increased 3.2 times.

A scheme to develop the agricultural water supply in Kyzylorda Oblast for the period up to 2005 has been developed. The aim is to resolve the problem of supplying the population with quality drinking water, and to switch water supply for populated areas to underground sources.

The scheme envisages the construction of 9 group water pipelines (Aral-Sarybulak, Kyzylorda Left Bank, Kyzylorda Right Bank, Oktyabrsky, Zhideli, Syrdarya, Talap, Aidarly, Akkoshkar), which should supply 148 populated areas with quality drinking water. Water supply for the remaining populated areas will be achieved by using local sources and water pipelines.

Some 717 km of water pipeline have been brought into operation since the start of construction of group water pipeline networks and connecting branches.

Funds of around 500 million tenge are needed to complete construction of the Aral-Sarybulak mains group water pipeline and connecting branches: in 2001, 30 million tenge were assigned for this purpose. This enabled 13.5 km of mains water pipeline to come into operation in the populated areas of Akkulak-Zhankurlys. Construction of a pump station in Akkulak will be completed and drinking water will be supplied to Zhanakurlys, with a population of 2,500.

A further 57 populated areas will be connected to the Aral-Sarybulak group water pipeline after its construction: 31 populated areas in the Aral District and 26 in the Kazaly District; 2 towns (Aralsk and Kazalinsk) and the district center, Novokazalinsk.

Besides, from 2001 to 2004, water supply projects will be undertaken in the towns of Aralsk (funded by the Kuwait Fund for Arabic Economic Development and costing USD 16.42 million), Kazalinsk and Novokazalinsk, with funds from KFW Bank (Germany) with a value of USD 5.5 million.

The working project Kyzylorda Right Bank Water Pipeline KRWP (construction sequence I-II) was developed by the project institute KazGiproVodKhoz, to supply quality drinking water to rural areas on the right bank of the River Syrdarya, in the Syrdarya, Zhalagash and Karmakchi Districts. The Ainakol field of underground water will act as the water source at 16.5 m^3 a day. The total length of the mains water pipeline is 148 km, and length of inter-settlement distribution networks is 88.5 km. Twelve populated areas and 3 district centers - the villages of Zhalagash, Zhusaly and Terenozek - were connected to the mains water pipeline when construction was completed.

In its first phase construction of KRWP brought 2,300 m^3 of water extraction into productivity, a pump station on the water extraction site and 4 settlements pump stations, as well as a mains water channel with a length of 47 km and a distribution water pipeline network with a length of 25.8 km.

Construction sequence I of KRWP began in 1989 and the facility came into full-scale operation in 1990.

The second phase of construction of the Right Bank group water pipeline includes the construction of 101 km of mains group water pipelines and 14 km of distribution water pipeline networks. The project envisages connection to the water pipeline of 4 populated areas in Zhalagash District and 2 populated areas in Karmakchi District, the district centers Zhalagash and Zhusaly. Construction commenced in 1990. During the period 1990 to 2000, 20 km of mains networks came into operation, and the district center Zhalagash and the settlement of Aksu were connected to the group water pipeline.

The Oktyabrsky group of water pipelines project was developed to supply drinking water to rural areas in the Karmakchi District. The length of mains water pipelines is 116.3 km, and that of inter-village distribution networks is 106.8 km. It has been proposed to connect 8 rural settlements to the group water pipeline. The area affiliated to the territory of the settlement ‘3rd International’ has been chosen for the construction of a water extraction installation, capable of extracting 4,500 m^3 per day. The mineral content of the water can reach 1.4 g/l. Almost all populated areas connected to the Oktyabrsky water pipeline have local systems of water supply, with a mineral composition of 2-3 g/l and more: water treatment facilities do not work and installations are in poor condition.

Construction of branches connected to the Zhideli group water pipeline network started in 1990. During construction, 44.2 km of mains water pipeline branches and 84.6 km of distribution inter-village water pipeline networks came into operation. Water from the Zhideli water pipeline was transferred to 14 populated areas in the Shieli and Zhanakorgan Districts. Some 20 million tenge was assigned from the national budget in 2001 for construction of the Snidely group water pipeline network and connecting branches, as a result of which 7.2 km of water pipeline to connect the settlement Shieli came into operation, and construction of the III-lift pump station began. Around 120 million tenge were earmarked in 2002 for completion of the pump station.

The International Fund for Saving the Aral Sea financed construction of a fresh water installation in the settlement of Urkendeu, and in the mountain village of Sarybulak a deep-water bore-hole was drilled, while in the village of Karataren a water pipeline 5.4 km in length came into operation to extract water from the Syrdarya River. During 2000-2001, 17 motorized water-carriers were delivered to the region to provide transported drinking water to outlying villages.

In total, 3,116.7 million tenge needs to be assigned from the national budget for the period 2002-2005 to resolve the problems of water supply in this region.

In accordance with the *Drinking Water* program, construction of the Aral-Sarybulak Right Bank group water pipelines and branches connecting to the Zhideli pipeline will continue. Construction of the Talap and Syrdarya group water pipelines is proposed. The construction of local water pipelines is envisaged for 60 villages to whom it was previously impossible to supply water. In regions with an advantageous distribution of mineral underground water the construction of water treatment facilities is envisaged. A range of repair and renovation work on existing water supply systems is planned in Kyzylorda, as well as other towns and rural areas

In **Mangistau Oblast**, 69.2% of the population is supplied with water via pipeline. In rural areas the figures are: 36.3% in Mangistau District, 26.6% in Tupkaragan District and 23.6% in Beineu District. 22 populated areas in rural districts have a centralized water supply. Water channels extend over a large distance and are badly worn out. Of 17 installations 3 do not work and 5 fail to meet sanitary requirements. Up to 23% of the population use imported water of dubious quality. Microbiological research in the region shows that 10.8% of water samples do not meet regulations, and this reaches 19% in Mangistau District. Chemical figures show that up to 27% of water samples taken at various intervals in Beineu and Karakiyan Districts do not meet required quality standards. An adverse epidemic situation still exists in the region as far as infectious diseases are concerned. Viral hepatitis is 1.5 times more frequent and is 3 times higher than the national average. The deterioration in domestic living conditions, including a lack of drinking water, is one of the main factors causing an increase in disease, including the highest levels of scabies and mange.

Measures to address the problem of supplying water to the population of the oblast include reconstruction of the Astrakhan-Mangyshlak water pipeline and building the Fetisovo-Zhanaozen water pipeline with a transfer volume of 50,000 m^3/day. Installation of the water treatment station at Zhanaozen will create an alternative source of drinking water to supply 18,800 people in the town. In addition, small-scale reconstruction of existing water pipelines and construction of new networks to link villages with the mains pipelines are envisaged. The requirements of Beineu District - one of the most depressed regions - have been fully considered in the project.

East Kazakhstan Oblast is relatively promising in terms of its level of water provision to the population. 67% of the population is supplied with water via pipeline. 54 of the 290 water supply facilities in the region do not work, and 120 do not meet sanitary requirements. 204 of the 884 populated areas receive water from the central water supply, and of these 191 have local water pipelines. Some 662 villages use local water sources, and 18 use imported water. In 10 villages in Tarbagatai District reconstruction and renovation of the water pipeline network is essential. The lowest supply of water via pipeline occurs in Urdzhar (27.1%), Beskaragai (28.3%) and Abai (34%) districts. This figure reaches 50-60% in remaining districts and in the Shemonaikha District is 92%.

20-25% of water samples do not meet sanitary requirements in their microbiological composition in the Ayagoz, Glubokov, Zharmy and Shemonaikha districts. The quality of water in Zyryanovsk, Ayagoz, Abai and Shemonaikha districts does not meet chemical norms. Cases of acute intestinal infections are frequently recorded in these districts.

Almaty Oblast is the leader among Kazakhstan's regions in terms of provision of water resources, which partly pre-determines the level of water provision to its cities and villages from centralized systems of water supply.

The supply of water to the population of Almaty oblast via water pipeline is 72.3%. Of 826 rural populated areas, 384 receive water from the central water supply, 415 receive water from local sources and the inhabitants of 27 remote villages use imported water. The lowest rates of water supply via pipeline are in Panfilov (66%), Sarkand (52%), Uighur (42.3%) and Aksu (41.8%) districts. Water quality in Koksu (22.5%), Balkhash (18.1%) and Eskeldy (12.9%) districts does not meet minimum microbiological standards. In half of the oblast's rural areas illnesses of the digestive and urino-genital systems occur at 2.5 times the national average.

The technical condition of most of the water pipelines requires urgent measures to maintain operational capacity. Of Almaty city's 2,200 km water pipeline network, the service life of 1380 km of steel and pig iron pipes has already expired. Remote sections of 130 km of pipe are in a dangerous state of repair.

Repair and renovation work on municipal and village networks is planned under the *Drinking Water* program. Construction and reconstruction of local water pipelines is due in 360 villages, including in Aksu and Rayimbek districts which have stagnant economies.

In **South Kazakhstan Oblast** 67.4% of the population receive water via pipeline. This figure varies greatly according to district: from 92% in Makhtaaral district to 12% in Saryagash, 24% in Kazygurt, 27.6% in Sozak and 33% in Shardary.

Poor quality of drinking water in terms of bacterial pollution has been recorded in the Tyulkubas (sample gave 13.4%), Kazygurt (22.2%), and Sairam (27.3%) districts. In Tyulkubas, Ordabasy, and Shardary districts, over 20% of water samples do not meet minimum levels for chemical composition. Cases of viral hepatitis continue to increase in most areas of this oblast. This figure has increased 1.9 times in Tyulkubas, 1.7 times in Baidibek, and 1.1 times in Tole-Bi District.

To improve the supply of drinking water to the urban population of South Kazakhstan, reconstruction of the water pipeline network in the towns of Shymkent and Shardary is envisaged. There are plans to build a water extraction plant, over 60 km of water pipeline and water treatment facilities in the towns of Saryagash and Turkestan. Construction is proposed of the Shaulder and Arys group water pipeline to provide rural areas with water. The reconstruction of existing group water pipelines is also proposed.

The population of Saryagash and Kazygurt districts are experiencing an acute shortage in water suitable for drinking. The *Drinking Water* program envisages building the Ugam group water pipeline to supply water for drinking only, with local underground sources to meet economic and domestic needs.

An increase in the provision of water to the country's capital, Astana, is the most urgent problem regarding water supply in **Akmola Oblast**. The construction of facilities and water pipelines to transfer water from the Irtysh-Karaganda Canal to the River Ishim has already been completed. The building of a third run of water pipelines to supply the town with water from the Vyacheslavskoye Reservoir is also finished and the expansion and new construction of water treatment facilities is expected. It is proposed to replace 94 km of internal municipal networks.

The supply of water to the oblast's population via water pipeline is 70.6%. Of 727 populated areas, 311 receive water from the central water supply, 361 use local sources, and 55 rely on imported water. Over the last few years the proportion of the population using water from open reservoirs has doubled. A significant section of the population in Enbekshilder (11.8%), Zhaksy (57%), Zharkain (46%) and Zerenda (48%) districts use imported water and water from local sources.

30.9% of water samples in the oblast do not meet minimum standards for chemical composition. In the majority of rural areas acute intestinal infections, illnesses of the digestive organs, urino-genital system, and oncological illnesses are widespread.

The water supply situation in the town of Kokshetau is considered critical according to criteria of health and epidemic safety. The *Drinking Water* program includes continued construction of the Kokshetau industrial water pipeline to provide complete supply of quality drinking water to the population of Kokshetau and the Borovoye treatment zone.

The Seleti and Nura water group pipelines have been in use for more than 20 years and require emergency repair. The sector program envisages expenditure to keep existing local water supply systems operational as well as construction of new systems in rural areas, including Zharkain and Korgalzhy districts, which are depressed and poorly supplied with water.

North Kazakhstan Oblast has always been ahead in terms of the range and level of drinking water supply from centralized systems due to the laying work of a branching network of group water pipelines with an overall length of over 5,000 km. However, as a result of the length of operation (separate branches have operated for 25-30 years) and the influence of negative factors (aggressiveness of water and soil-basis, lack of electrochemical protection etc.) some parts of the water pipeline are now in complete disrepair. The pumping and electro-technical equipment of the head and intermediary pumping stations has passed its service life and is in dire need of replacement. The centralization of water supply from interconnected systems has become inefficient under market economy conditions due to increased operating losses, lengthy emergency disconnection and as a consequence, large losses of water.

74.7% of the population is provided with water via pipeline, but in rural areas this is significantly lower: 36% in Aktogai, 34% in Maysky, 31% in Irtysh and 19% in Pavlodar districts. Of 779 populated areas, 493 are connected to the group water pipeline, of which only 164 use water: 154 settlements have been disconnected due to accidents, 175 have begun using local water sources and the inhabitants of 46 villages use imported water.

10.7% of water samples do not meet regulations on microbiological content. A high level of bacterial water pollution has been noted in Akzhar (42%), Akkayin (22.2%), Ayirtau (20,2%), Ualikhanov and M. Zhumabaev (18.9%) districts. In a number of populated areas up to 34.2% of water samples do not satisfy statutory requirements for chemical content. The death rate from digestive illnesses has grown by 29.9%, and from infectious and parasitic illnesses by 8.6%.

The Sector Program envisages the following measures to reorganize the water supply system with the aim of guaranteeing drinking water supply to the oblast’s population:

- Maintenance of the existing work scheme of sections of the group water pipelines by means of segmentation (removal) from the overall system. Replacement of 244 km of pipeline;
- Connection of the Bulaevsk and Belovodsk group water pipeline to new sources in the form of prospected reserves of underground water;
- Establishment of local water supply for 220 populated areas by using local resources of underground water;
- Transportation of pipeline water of drinking quality to large settlements.

In **Pavlodar Oblast** the unequal distribution of water resources and the poor quality of water has resulted in a low level of water supply to its population in remote regions.

Almost a third of the rural population uses drinking water that has a high mineral content. 105 populated areas are served by centralized water supply, while the inhabitants of 345 villages use local sources, and the inhabitants of more than 50 villages only have access to imported water. Of all water supply facilities 18% do not work, and 60% do not meet sanitary requirements. Some 221 rural communities (43%) use water that does not satisfy statutory requirements. The main consumers of poor-quality drinking water are in Aktogai, Bayanaul, Irtysh and Kachir districts.

The highest levels of microbiological water pollution are to be found in Maysky (16%), Zhelezinsk (16.6%), Pavlodar (20.9%), Sherbakty (35.7%), and Irtysh (77.7%) districts. Up to 30% of water samples do not meet minimum requirements for chemical composition in Maysky, Aktogai, Uspensk and Pavlodar districts. Rates of kidney infection among the rural population are 2.5 times above the national level.

As a primary step the *Drinking Water* program envisages the installation of water treatment stations on existing water supply systems and the construction of new block systems with water treatment facilities in 115 villages. In Maysky District the reconstruction of the Maysky group water pipeline is planned. The water supply situation in Aktogai District, where more than 70% of populated areas use water of a non-guaranteed quality, is one of the most complex. Renewal of part of the Belovodsk section of the group pipeline to supply water to villages lacking any alternative source of water is essential.

The sector Program envisages supplying more than 265,000 people in rural areas with water.

Necessary funds will be directed towards improving water supply in Pavlodar by using underground water and also by renovating the existing water supply in other towns.

Kostanai Oblast occupies second place in the Republic (after North Kazakhstan Oblast) in terms of the number of people supplied by centralized systems of water supply and length of water pipeline systems.

59% of the total population is supplied with water by pipeline. In rural areas from 8 to 40% of the population is served. Of the 104 water supply facilities in the oblast, 7% do not work and 43.8% of water pipelines in operation are in poor technical condition. In 227 rural areas water supply is centralized, while the inhabitants of 520 villages use local sources and more than 70 villages use imported water.

The situation regarding microbiological pollution is unsatisfactory in Zhetygary (28% of samples showed non-standard results), Amangeldy (26.4%) and Uzunkol Districts. 37.4% of samples of water from non-centralized sources in the oblast do not meet regulatory requirements. A serious situation has arisen in Denisov (88% of samples), Sarykol (78.7%), Amangeldy (50%) and Kostanai districts. The deterioration in drinking water quality has contributed to a high level of viral hepatitis – 31.1% /75/.

In coming years it is essential that repair work be carried out on group systems where there is no real alternative source of water supply, with gradual connection of villages without water supply. Provision of quality drinking water - which was previously done de-centrally through the use of surface and underground sources of non-guaranteed quality - is planned through the construction and reconstruction of local systems in 275 villages in the oblast, including the economically depressed Amangeldy and Dzhangildy districts. Completion of the Likhachevsk group water pipeline is scheduled for the near future, which will provide 10,000 rural inhabitants with access to reliable drinking water.

Another potential source for a number of villages is surface water, with corresponding treatment and preparation. The necessary means for construction and reconstruction of water pipeline networks to improve the condition of water supply to the population of towns and rural settlements are being considered.

Water supply for the population of **Aktobe Oblast** is based almost entirely on underground water. 73.6% of the population is supplied with water via pipeline. Of 471 populated areas 114 are serviced by centralized water supply. In 334 populated areas the populations make use of local sources. 423 villages and settlements experience a shortage of quality drinking water. The highest level of water supply is in Mugalzhar District (83%) and the lowest is in Baigany District (19%).

9.8% of water samples in the region do not meet minimum standards for microbiological content. The worst results were obtained in Mugalzhar (23.0%), Khromtau (26.5%) and Irgiz districts.

Pollution of water from decentralized zones with chemical substances appeared in 15.5% of samples – in Aiteke-Bi District this was 25%. The poor standard of drinking water has caused a high level of somatic illness among the population. Sickness of the digestive and urino-genital systems is prevalent in the region – 3,229 and 3,460 per 100,000 of the population, which is significantly higher than the national average. The highest levels of cases of these illnesses have been registered in Aiteke-Bi, Kargaly, Uil, Kobdy and Khromtau districts. In 2001 there was an increase in acute intestinal infections of 13.3%.

The program of measures to improve the condition of drinking water in Aktobe Oblast includes:

- Increase in water supply to the population of towns and rural areas by means of expanding water extraction – drilling of additional bore-holes and construction of pump stations;
- Improvement in the quality of water demand by means of search and discovery of alternative sources or treatment of existing mineral underground water;
- Construction of local water pipelines in major settlements;
- Transportation of drinking quality water to small villages.

Several reserves have been discovered for water supply in Aktobe although 70% of its total water resources are polluted. It is essential to increase water extraction from the Sarybulak group of reserves, which possess good quality underground water. Reconstruction of the Irgiz and Nura group water pipelines is expected to improve water supply to the villages of Irgiz District.

The problems of water supply in **Atyrau Oblast** are complex. Today, over 20% of its population uses untreated and undisinfected water from open sources for domestic drinking requirements. The population of Atyrau is experiencing a shortage of drinking water, and to a large extent so do the population of towns and villages who receive water from municipal water-treatment installations along the Atyrau-Makat-Sagiz Canal.

62.7% of the oblast's population is provided with water via pipeline. Of 27 installations, 3.7% of water pipelines do not work, and 15.4% do not meet sanitary requirements. Only 32 populated areas are covered by a centralized system of water supply while 155 populated areas use local sources and 16 areas use imported water of uncertain quality.

Water does not meet microbiological requirements in Zhylyoi and Kurmangazy districts. In these districts acute intestinal illnesses and viral hepatitis remain. In the Kyzylkogi, Inder, Makat, Zhylyoi and Isatai districts illness of the digestive and urino-genital system exceeds the national average by 2.5 times.

At present in two districts of Atyrau oblast - with a combined population of more than 30,000 people - reconstruction of the water pipeline and channel networks is taking place. Construction of the remainder of the city network is scheduled for the future. The sector program envisages a range of measures to stabilize the situation of water supply for the population. The reconstruction of the water pipeline Astrakhan-Mangyshlak, which was built to supply water to the oil fields of Atyrau and Mangistau oblasts and treatment for its drinking needs, is desperately needed. Water treatment installations in the village of Inder need capital repair, and the inter-village network in the village of Kulsary needs replacing. Construction of local water pipelines with facilities to treat surface water is planned for 37 rural settlements.

It is necessary to continue with the construction of the 2nd phase of the Koyandy group water pipeline and to carry out reconstruction of the Inder-Miyaly water pipeline. All the aforementioned measures will enable an improvement in the supply of drinking water to more than 300,000 people in the region.

The supply of drinking water to the population of **West Kazakhstan Oblast** is insufficient. The main sources of centralized drinking water supply are surface reservoirs. Only 58.2% of the population in the region is supplied with water via pipeline. In rural areas barely 35% are supplied with pipeline water. This problem is most acute in the districts of Akzhaik (supply rate of 1.7%), Zhanybek (5.5%), Dzhangaly (8.9%) and Chingirlau (14%) and Zelenovsk (22%). 204 populated areas (39%) receive water from the centralized water supply, and 305 populated areas use local sources.

There are 101 water supply facilities in the region: 38 of these are out of use, and 29 do not meet sanitary requirements. A number of villages in southern parts of the oblast use imported water. The specific gravity of water samples does not meet minimum levels for chemical content, reaching 22.1% in some rural areas. In 2001 this figure was highest in Chingirlau District at 35.2%. The extent of poor quality water extracted from water pipelines and samples from de-centralized sources, according to regulatory chemical content, remained highest in Zhanybek (8.5% and 50% respectively), Taskaly (18% and 31.2%), Syrym (3.6% and 26.6%) and Burli (19.8% and 16.6%) districts.

The overall rate of illness in most rural areas of the oblast is 1.5 times above the national average. The highest rate of infectious and parasitic problems has been recorded in the Akzhaik, Karatobi, Terekty and Chingirlau districts, while new strains have been seen in the Burli, Zelenovsk, Taskaly, Kaztal, Terekty and Chingirlau districts.

130 rural populated areas are supplied with water from 6 group water pipelines with a total length of over 2,000 km. In the last 3-5 years the Furmanov and Taipak water pipelines have ceased to operate after exceeding their operational service life. The sector program plans to build local water pipelines which will be served by underground and surface water in order to supply purified water to 55 villages connected to the network. The reconstruction of other functioning group water pipelines is also planned, along with replacement of pipes in remote areas and repair of water pipeline facilities in villages. Moreover, the reconstruction of existing local water pipelines is envisaged by the planned replacement of pipes over a section of 64.7 km, modernization of technological processes for treating drinking water, and replacement of technical equipment in pumping stations. From 2005 onwards, the completion of the Iskrovsk group water pipeline and reconstruction of the Urdy water pipeline is planned to supply drinking water to the villages of Urdy District, which do not have an alternative source of water supply. These measures will improve the supply of water for almost 220,000 people living in rural areas, and will provide a guaranteed supply of water to the urban population throughout the oblast as a whole.

In **Zhambyl Oblast** 57.7% of the population is supplied with water via water pipeline. Of 186 water supply installations, 79 do not work, and 96 do not meet sanitary requirements. Boreholes in the water pipeline network are worn out and this is affecting the quality of drinking water. The service life of 47% of the boreholes and water pipeline networks has expired, but they are still being used. In particular 37% of these have been operating for 21 to 30 years, 14% for a period of 31 to 40 years and 2% for over 50 years. The inhabitants of many populated areas use water from surface sources (springs etc.), or untreated, stagnant water drawn from wells. Over 10 villages in Kordai District do not have water pipeline systems. In T. Ryskulov District 10 artesian boreholes have been taken out of service, and in 3 villages water extraction systems from mountain-rivers are no longer in use. The majority of water pipelines are ownerless, particularly in rural areas. In 2001, operational reserves of fresh underground water at 38 sites, with a volume of 4.52 m^3, were sourced and ratified in Zhambyl Oblast.

The number of cases of tuberculosis in the oblast is increasing in rural areas: the figure is almost double the national average in the Shu District, where 290.8 per 100,000 are affected and viral hepatitis is also increasing. The number of people infected in 2001 reached 352.3 and 250.0 per 100,000 respectively - considerably higher than the national average. A decline in sexual health figures has been caused by the spread of iron-deficient anemia and kidney disease.

The quality of surface waters in the region does not meet drinking water standards. The major rivers – the Shu, Talas and Asa – are heavily polluted with phenols, heavy metal salts, oil products, fertilizers, pesticides and herbicides. Concentration of these substances is 3-5 times greater than the maximum allowed limit.

The construction of new and the reconstruction of existing local water pipelines to villages using underground waters that are undrinkable according to toxicity and micro-bacterial figures is envisaged by the Sector Program as a series of immediate measures. An increase in the quality and quantity of the water supply is planned for 250 villages with a combined population of approximately 400,000. The program also outlines the resources needed to maintain normal operating conditions for urban water supply systems.

According the national Medical Epidemiological Center, in 2002 water supply by pipeline had increased and now stands at 75.5%, as opposed to 74.2% in 2001. At the end of 2002, the provision to water treatment facilities of drinking water disinfection and cleaning reagents was 98.5%. 128 water extraction facilities have been restored in populated areas, and in 52 populated areas artesian boreholes have been drilled. Fifteen populated areas have been connected to the water pipeline network so that repair and restoration work can be carried out on the water pipelines built by 'Brigade 1361'.

In addition, the centralized transportation of drinking water to 90 of the 359 populated areas where the population takes its drinking water from open reservoirs has been organized. As a result, the proportion of water pipelines which do not meet sanitary requirements has fallen from 23.4% in 2001 to 17.3% at the end of 2002, while the specific gravity of drinking waters not meeting requirements for bacterial content has fallen from 3.9% to 3.8%, and for chemical composition from 8.5% to 7.1%.

2.3. Decrease in Environmental Capacity of Water Bodies

2.3.1. Deterioration of Living Conditions in Environmental Blackspots

Environmental degradation in the country has resulted from a sharp water deficit, exhaustion and deterioration of water resources, soil erosion, accumulation of harmful toxic industrial and domestic wastes, radiation, deforestation, irreversible damage to bio-diversity and destruction of the genetic fund of wild life, regional manmade desertification, atmospheric pollution, appearance of life-threatening natural phenomena and industrial catastrophes.

The scale and severity of the ecological problems affecting the social condition and health of the population give rise to serious concerns. In this regard, the key problem is the deficit of water resources hindering the country's stable development. Natural reservoirs are being polluted intensely by household discharge and industrial sewage against a background of littering of water-storage zones with domestic, agricultural and industrial waste products. Each year the level of pollution in water from de-centralized water sources increases. This is the main reason for the large-scale deterioration in the population's health.

Approximately 50 localized outbreaks of infectious illness due to poor water quality have been registered in the last 10 years. Of these 48% were due to the sanitary and technical condition of the pipeline; 24% due to the unsatisfactory condition of the pipeline network; 20% due to the use of surface water and 8% due to the pollution of water-storage zones. The following illnesses have been primarily transferred by polluted water – dysentery, peritonitic typhoid, and viral hepatitis A. In February 2001, two outbreaks of intestinal infections were registered, one in Arkalyk, Kostanai Oblast, and the other in Temirtau, Karaganda Oblast, with a total number of 448 victims.

It has been established that the main reason for the deterioration in the population's health is the complex effect of inhabitation and the industrial environment, social sphere and the environmental condition of the territory. 60% of cases of irregular physical development and decreasing average life expectancy by 5-7 years, can be attributed to these factors.

The exhaustion of water resources in some regions has caused an increase in unemployment, depriving many families of their main source of income and pushing them to the edge of survival. In the Aral region 13 fishing enterprises once operated; there used to be a shipyard in Aralsk and a ship-repair workshop in the port of Uch-Sai. With the retreat of the Aral Sea more than 10,000 people lost their jobs, i.e. if the average family is 5 persons, then 50,000 of the region's population were deprived of their main source of income. There were 16,000 people out of work in Kyzylorda Oblast in 1995 – of these, over 12,000 were inhabitants of rural areas and 11,300 people were on forced leave due to the halting or partial cessation of operations. Every 5th family - over 100,000 people - was affected by unemployment.[3]

Research conducted by the Asian Bank for Reconstruction and Development technical assistance project in the Republic of Kazakhstan *Access to Sources of Water Supply as a Factor in Evaluating Poverty* involved testing in more than 800 villages in South Kazakhstan, North Kazakhstan, Karaganda and Akmola oblasts. The research indicated that lack of water leads to non-adherence to hygiene and sanitation standards among the population, which in turn leads to increased sickness levels. The level of per capita income in water-deficient areas across all oblasts is almost two times lower than the official minimum living requirement.

Across Kazakhstan lack of water, its uneven distribution and deterioration in quality is causing migration of the population. This is threatening the labor resources of some of the country's major regions, primarily central and northern areas. In turn, these negative factors are a serious threat to the country's economic development and security.

2.3.2. Factors Impeding Environmentally Safe Water Use

The growing role of water resources both in the economy and other public areas requires heightened attention to questions of water usage, based primarily on risk analysis for health, life and the well-being of the population as well as evaluation of the effect on the environment in the regions, and in the country as a whole. The specific environmental and social significance of water resources, which greatly increase their economic value, has been emphasized in decisions taken at global forums such as the 2002 Summit on Sustainable Development in Johannesburg and the Water Forum in Kyoto in 2003.

The resource-management approach to the use of natural resources, water resources in particular, is the major contributor to environmental and social problems in Central Asia, including desiccation of the Aral Sea and resulted consequences. Based on this approach, water resources (available reserves, volume of extraction, water-sharing between the countries) are regarded only from the viewpoint of provision of water supply to consumers. environmental function of water is the need of the natural landscape and ecosystems for water to maintain stability, and the possible consequences of destruction in this case have yet to be considered. Unfortunately, such an approach to the consumption of water resources remains unchanged even now. Using the Aral Sea as an example, it is clear that any short-term economic gains from additional rice and cotton as a result of usage of the Aral's water resources do not match the huge negative environmental and social consequences of the sea's disappearance, the destruction of infrastructure in the Aral region, as well as the massive deterioration in the health of the population.

Such situations constantly demand the development of reliable new management structures, built on the basis of balancing the economic interests of the population and the aims of preserving a sustainable natural ecosystem. Environmental forecasting in this light must form an integral part of water-management in general. This must precede the design of projects for water resource consumption and must be based on data obtained through regular, systematic and reliable adherence to elements in the ecosystem and the use of forecast modeling. It is essential to develop new methods to evaluate the environmental economics of water resources, the value of water ecosystems in profit-loss accounts and the economic efficiency of water usage.

National water (and associated) legislation for the Central Asian republics must reflect water's function as a resource for supporting natural ecosystems. The principle of having to maintain living conditions for water ecosystems must be included in the basic requirements of any such legislation.

General plans for water-management in the region must assess the efficiency of the main ideas

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[3] National Program to Combat Desertification, 1997

behind the environmental approach to water-management. Coastal countries should include ecosystem conditions both in water-management plans for appropriate sections of basins and cross-border reservoirs and in bi- and-unilateral action plans encompassing all the basins from these reservoirs.

This is because the aims of water resource planning and management of rivers must be regarded as a single complex ecosystem, in that it is pictured as the sequential link for interconnected local eco-systems from the source to the estuary. This approach requires more active and agreed inter-governmental co-operation at all levels and the development of effective new management methods and instruments. The development of models for the environmentally safe drainage of river water, which can be used to determine the maximum volumes of water-management, is extremely important.

The ecosystem approach to management provides a different method for evaluating the role and significance of the water resources of Central Asia, above all formation of the water drainage belt for Kyrgyzstan and Tajikistan, and major water resources of the region, such as the Aral Sea, Lake Balkhash, Lake Issyk-Kul, River Irtysh and others. Above all, the preservation of glaciers in Kyrgyzstan and Tajikistan, combined with rational use of the region's water resources, will provide security and the sustainable development of Central Asia and related territories.

It is well established that a large part of the territory of Kazakhstan is in an arid zone. Farming in such conditions is extremely risky, and some 75% of pasture yield is of the desert or semi-desert type. The country's location in the center of the Eurasian continent, with its related climate, means that Kazakhstan has a vulnerable ecosystem and this will determine the specifics of development of the agrarian sector.

The 'manmade' nature-destroying model of developing the agro-industrial sector was adopted in the country, with its exhaustive and unsustainable use of natural resources such as water, soil and forests. The main symptom of this crisis was the degradation and loss of agro-industrial yield due to erosion, salination, creation of swamps, loss of natural flora and fauna, increase in harmful substance content in soil – all of which contributed to a general reduction in agricultural productivity.

Currently in Kazakhstan, more than half the water set aside for irrigation does not reach the fields as a result of natural evaporation during filtration. For the Aral region this loss of water is 30-40 km^3 per year. In order to use these water reserves, a thorough restructuring of the existing system of natural water resource use is essential.

CHAPTER 3. NATIONAL WATER RESOURCES MANAGEMENT POLICIES

3.1. Institutional Framework for Water Resources Management

State management of water resources in Kazakhstan is done by the Government, an authorized state body managing water use and conservation, local representative and executive bodies (maslikhats, akims of oblasts, cities, districts, auls/villages), and other state bodies, within their competencies /Figure 11/.

Underground water management is carried out by the authorized body in coordination with the state body for geology and conservation of mineral resources. Other special authorized state bodies in the area of water use and conservation include bodies dealing with environmental protection, mineral resources, fishery, flora, fauna, and state sanitary and veterinary supervision. Within its competencies, government interacts with the other state bodies listed below.

The relationships between state management bodies concerning rational use and conservation of water, is regulated by the Republic of Kazakhstan’s legislation.

3.1.1. Water Resources Management

At the national level, state water resource management and conservation is implemented by the *Water Resources Committee* of the Ministry of Agriculture, and its basin water management units.

The Committee’s mandate includes:

- Participation in development and implementation of State water use and conservation policy;
- Development of water sector programs;
- Development of schemes of comprehensive use and conservation of water resources;
- Coordination of water consumption norms in economic sectors;
- Licensing special water use and approving new rules of common water use;
- Distribution of water resources between territories and sectors;
- State control over water use and conservation;
- Approving norms and standards regarding water use, use of water bodies, and maintenance rules for water facilities;
- Organization of use of water bodies and water facilities under national administration;
- Participation in working out priorities in intergovernmental cooperation, attracting and using investment in the water industry;
- Cooperation with neighboring countries about water etc.

Local representative (*maslikhats*) and executive (*akimats*) bodies manage water relations at the regional (oblast) level, within their authorities. For example:

Maslikhats:

- Set the rules of common water use, based on regulations approved by the authorized body;
- Approve regional programs of rational use and conservation of water bodies, and control their implementation;
- Regulate lease of water facilities under communal administration.

Akimats:

- Set up water organizations to manage and maintain water facilities under communal administration;
- Define water conservation areas and sanitary zones to protect potable water supply sources, in coordination with basin water bodies and territorial bodies of geology and sanitary controls;
- Transfer water bodies into separate or joint use, in coordination with the authorized body;
- Work out and implement regional programs of rational use and conservation of water bodies;
- Coordinate location and use of enterprises and structures affecting water, as well as conditions of work on ponds and in water conservation areas; impose restrictions on the use of water bodies;

- Inform the population about the condition of water bodies.

Basin water management units (BVOs) are territorial subdivisions of the Water Resources Committee and provide integrated management of water resources and coordination between water use subjects in the basin. They are charged with:

- Comprehensive management of the basin's water resources;
- Coordination of the work of water-related subjects within the basin;
- State control over water use and conservation, and observance of water legislation;
- State accounting, monitoring, and upkeep of the state water cadastre, jointly with environmental protection bodies, geological, mineral resource, and hydrometeorology bodies;
- Licensing special water use;
- Coordinating plans of rational water use and conservation of water bodies; coordinating suggestions and documents on construction and rehabilitation of facilities affecting water;
- Identifying water use limits in the basin, participation in approving ground water deposits and working out water balances in the basin;
- Approval and control over reservoirs;
- Working out plans for diversion flow and apportioning of water;
- Coordinating structures of comprehensive water use and conservation in the basin, as well as maintenance rules. Suggestions to use water bodies and structures;
- Informing the population about water conservation, rational use of water etc.

State water management is based on the principles of recognizing the national and social importance of water resources, sustainable water use, separating the functions of state control and management, and basin management.

Based on these principles, in 1998 the government began a structural reorganization of the water system, aimed at clear assignment of responsibilities at national and local levels. According to government resolution No. 1359 of December 30, 1998, oblast committees for water resources have been reorganized into *republican state enterprises for water*, charged with technical maintenance of hydrosystems, water headworks, mains systems, pumping stations, group water pipelines, i.e. the facilities which provide consumers with water. The next stage of reform was the 2001-2002 transition of water facilities (excluding facilities of national importance) from the national to communal ownership, as well as assigning the local level with the authority to manage them. Delineation of water resource management functions and improving the mechanisms of regulating water use allows consideration of the interests of water users both within the whole basin and in a certain area. It also allows effective measures to be taken to protect basin waters from exhaustion. In market conditions, the management system should ensure conservation and reproduction of water resources, proper terms for water use, and preserve environmental stability within a specific catchment basin and area.

The reforms have resulted in a *multi-level system of water management* represented by intergovernmental, state, basin and territorial levels of management. These levels are interconnected and perform the following tasks:

At the intergovernmental level of water resource management, cooperation is provided for joint use and conservation of water resources. At this level, the following issues are considered, based on international practices: water resource management, reducing or preventing negative impacts; preventing water loss headstream and in basin sites by reducing surface evaporation loss; and cooperation in protecting water quality.

At the state (national) and basin levels, water projects of national or regional importance are implemented. Examples of activities at this level include: construction of causeways, reservoirs, dams, centralized ground water inlets and pumping works; regulation of river flows and the work of major reservoirs; finding alternative sources of freshwater; reducing losses during water supply and distribution.

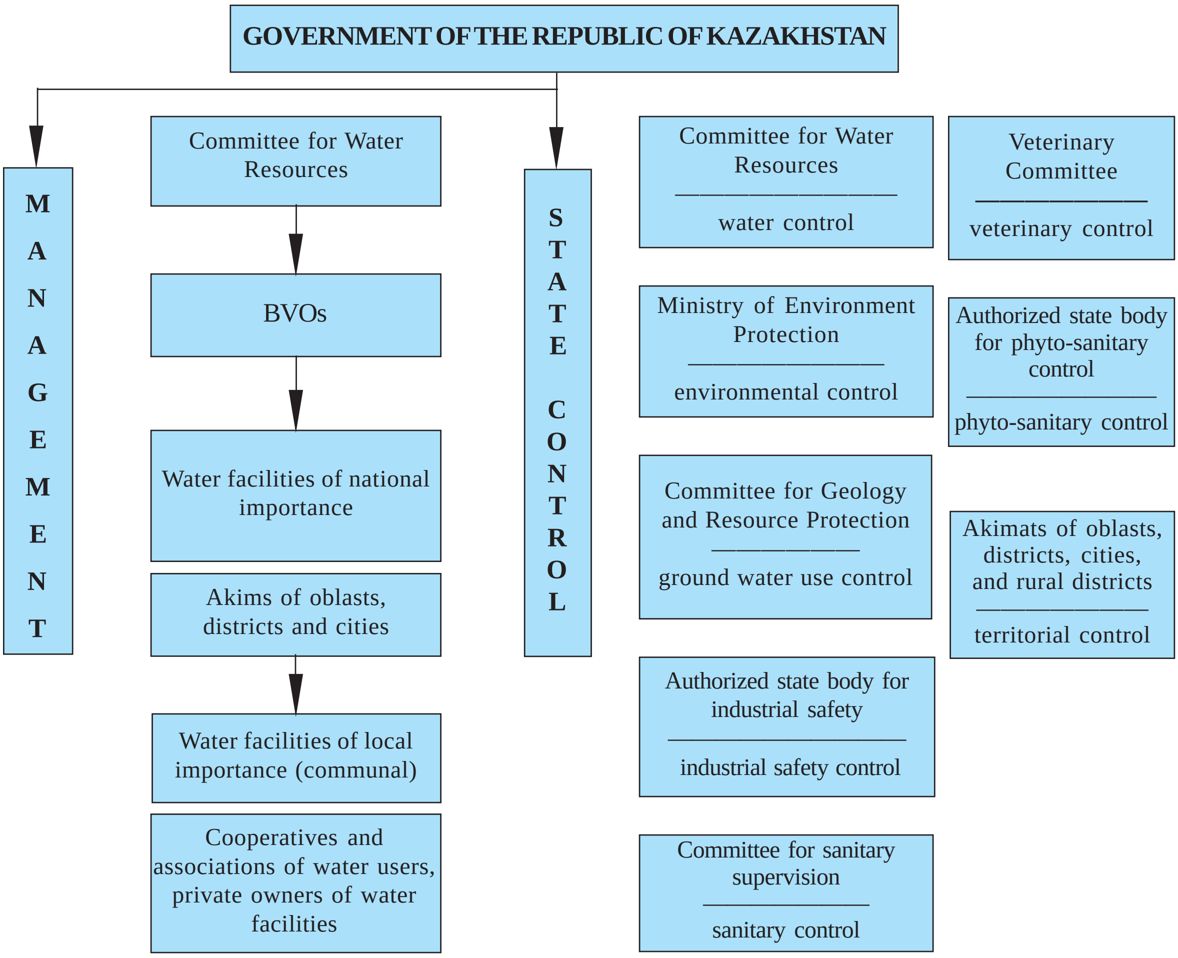
Management plans at these levels should be mostly based on realistic needs and consider current social and economic conditions in catchment basins. Management at the lower levels should correspond to general management plans and water policy should be oriented towards all levels of management. A compromise is needed (technical, economic and social) between the distance of transporting water to the consumer and bringing consumers closer to water sources.

At the territorial level, maintenance of all state-run water facilities is carried out. Work at this level usually aims to reduce water loss during transportation and distribution, deliver high-quality water in sufficient amounts and on time to different points, and to establish effective links between central and local organizations dealing with water resources in various areas.

Work is done to improve the effectiveness of water use, set up cooperatives and associations of water users and develop interaction between water users and territorial bodies in charge of water resource allocation. This ensures fairer allocation of water and minimizes loss.

Also at this level, cooperation and control over water facilities is ensured, where water facilities belong to cooperatives and associations of water users or individuals, to ensure the safety and effectiveness of these facilities. An important goal here is establishing an effective non-governmental maintenance network and private companies to maintain and repair water facilities.

Figure 11. National Water Resources Management



The Water Resources Committee manages eight basin water management units: Balkhash-Alakol, Ural-Caspian, Shu-Talas, Aral-Syrdarya, Nura-Sarysu, Tobol-Turgai, Irtysh, and Ishim /Section 1.1.3/, which cover Kazakhstan's drainage basins. The water system of the catchment basin is made up of a complex of interconnected water facilities and hydraulic structures. These are intended to ensure rational use of water resources and conservation and removal of wastewater within the catchment basin, managed by a uniform water policy in the basin.

According to the basin management principle, general rules of water resource uses in a specific basin-irrespective of the location of water facilities, water consumers and water users—determine operation of the majority of the hydrological facilities including those that regulate the river flow and territory-based reallocation of water resources. It mostly relates to reservoirs, internal and inter-basin diversions of run-off that help regulate flow in the catchment basin. Each reservoir and hydraulic scheme in the basin assigned for regulating the river flow works in accordance with schedules designed to meet the objectives in the whole basin.

Water systems of any catchment basins are relatively autonomous in their inter-basin policy. However, all are subsystems of the higher-tier water system.

Water systems of large catchment basins are the main technological link, as they form a basis for establishment of basin water management bodies. Water systems of smaller catchment basins are, as a rule, included in the basin water management of larger rivers.

The Committee for Water Resources manages the use of water resources within water basins in the interests of all economic sectors, taking into consideration environmental requirements.

Basin Water Management Units (BVOs) set up in each main catchment basin, regulate the use and conservation of water resource within a catchment basin. BVOs are funded solely from the national budget.

Maintenance of hydraulic structures and water facilities is funded through water users' fees. Facilities of national and oblast importance, which are in state property, are partly funded from the national budget.

It is worth mentioning that water reforms are quite a complex undertaking and depend on many factors. Due to natural and environmental conditions, the water industry is a 'natural' monopoly, so competition in this area cannot take place.

Despite structural reorganization, water resource management is still administered by numerous departments. Often, water resource management ignores specific peculiarities of these resources: mutual influence, no local boundaries, and seasonal flow changes. This means that upstream users often infringe on the interests of downstream users in all catchment basins. The latter receive water in limited quantities and, as a rule, of lower quality. Structural improvement of the water management system should aim at a well-defined assignment of responsibilities at national and local levels.

At the basin level, it is critical to consider public interests and to involve population in implementing on-going projects and programs on sanitary improvement, preserving natural water flows and ponds, and establishing reliable water supply systems.

Due to the lack of national funds to address water issues, deterioration of facilities and structures, there is a need to involve the private sector in the water sector – mostly in water supply and rehabilitation and maintenance of water systems. In forming this water 'market', the basin water management bodies will play an important role in setting clear goals for privatization in the water industry and elaborating its rules and legal base.

Creation of a reliable licensing system for water activities and the issuing water use permits are the key functions of water resources management. In Kazakhstan this work is to be done by basin water management bodies.

Rational use of water resources should be based on establishing cooperatives and associations of water users in different economic sectors - first of all in land irrigation. Such cooperatives and associations should be initiated by water users and established at relatively small farms. In practice, however, the effective work of irrigation channels and the rational use of irrigation water means that a cooperative or association should include farms of the whole irrigated area – up to 10,000 or 15,000 hectares, or more. Establishment of effective cooperatives (associations) of water users will ensure efficient use of irrigation water, will allow to maintain farmers' hydraulic facilities, and repair them on a timely basis.

Further expansion of the non-governmental sector in the water industry can take different forms – such as a management contract, lease, concession, a fully private company – and be based on programs designed to develop water activities in the basin and territories included in that basin. All these, as well as water saving projects, require coordination and control by the basin water management bodies.

Management problems

During the last years, the Water Resources Committee has been reorganized several times. These structural changes have had a negative impact on human resources, materials and equipment. The Committee's full-time staff was reduced many times, and now stands at 33 employees. Meanwhile, BVOs' full-time personnel have been halved, which makes it impossible for them to meet their set objectives. Meanwhile, the number of problems and complexity of water management objectives have increased significantly in recent years.

There has also been a loss of key personnel with scientific, technical and project expertise, while it takes 15-20 years to train and qualify a skilled designer engineer.

Scientific research in the water and sewerage systems has become almost non-existent. Today in Kazakhstan, there is not a single research institute in this area. The priorities for scientific research to solve key problems have not been set and there is no research into the rational use of water resources.

3.1.2. Civil Society Participation in Water Resources Management

Public Participation in Solving Water-related Issues

There are currently about 300 active environmental organizations in Kazakhstan, and at least half of them work on solving water-related issues. This work includes designing strategies to address water-related problems, participation in local and international workshops and conferences, environmental river tours, cleaning of riverbeds, environmental education and publications in the mass media /81,84/.

In 2000, the EcoForum of Kazakhstan's environmental non-governmental organizations (NGOs) initiated a 'Water Campaign' which unites the efforts of NGOs dealing with water problems in Kazakhstan. The Campaign covers the whole country according to each catchment basin. NGOs have been implementing water projects in Kazakhstan for about ten years. EcoForum's advantage is that it coordinates activities and initiates a variety of partnership-based water projects and actions. The EcoForum's Water Campaign establishes a database of organizations and specialists dealing with water-related issues and projects. Work is also carried out with government bodies, parliament, the business sector and international communities to exchange experience and support the Water Campaign. The Water Campaign's forthcoming plans include setting up a web site and initiation of an all-Kazakhstan action to clean river banks and springs.

Public organizations hold workshops and conferences at local, oblast, national, and international levels, which aim to develop practical techniques to preserve waterways and to exchange experience. The Balkhash 2000 International Forum became the largest conference. It was organized by the Tabigat Environmental Union and supported by the Government of the Republic of Kazakhstan, Ministry of Environment Protection, and Almaty Oblast Akimat.

The Forum's participants included environmental scientists from different countries, representatives of various international foundations and missions, plus industrial enterprises located in the Balkhash basin, oblast and city akims, ministers and representatives of public and governmental organizations. The Forum adopted a Resolution and Address to the President, parliament, government, and international organizations entitled *On New Mechanisms of Basin Management*. The principle of a comprehensive basin management of the Ili-Balkhash ecosystem proposed in this document has the potential to enhance co-financing (direct private investments) in addition to government and inter-government funds assigned for this region.

NGOs' Participation in Actions to Protect Waterways and Ponds

Cleaning ponds and environmental tours ("eco-tours") are the most popular water 'actions' in Kazakhstan.

The eco-tours' goals include informing local populations about the condition of rivers and ways to improve the local environment, involving local residents in the actions to improve living conditions and preserve clean waterways. During the eco-tours in riverbank settlements meetings with local residents and government representatives are held and polls are conducted in order to reveal the region's problems. Roundtables yield good results, to which representatives of local authorities and state supervising bodies of different levels are invited. Press conferences, exhibitions of children's environmental posters and photos also produce positive results. Village schools are provided with environmental information packs.

During the eco-tours, independent environmental research of rivers is also conducted and water samples are taken. Results of this research are sent to akimat officials and local residents. Below are some examples of eco-tours held in Kazakhstan over the last three years:

In 2000, a youth campaigning expedition, *SOS Balkhash*, was held to prevent environmental disasters on Lake Balkhash. The youth organizations' initiative was supported by government bodies and funded by business companies. The action began by installing a billboard on the border between Kazakhstan and China to symbolize the universal problem of saving the lake.

In June 2000, a Pavlodar public association, ECOM, held a boat campaign. Participants included representatives of NGOs from Pavlodar, political parties, students and teachers of Pavlodar State University. Participants rafted down the Irtysh River from Pavlodar to Omsk, Russia, and visited all major villages and towns en route. This action was part of the *Clean Irtysh* information campaign. In Omsk, public hearings were held at which representatives of its oblast's government environmental bodies took part. The hearings stimulated the idea of establishing a "Clean Water Parliament" and were a first step in uniting Russian and Kazakhstani public environmental bodies.

Members of the 'EcoMuseum' NGO from Karaganda had an environmental information tour with an international team. The tour, which used rafts made of plastic bottles, navigated its way down the Irtysh and Nura rivers. In 2001 a tour rafted 650 km from Temirtau to Korgaldzhino, and in 2002 negotiated some 1,200 km from Ridder to Pavlodar. The Clean River project and EcoForum's Water Campaign held an action in the spring of 2003 to clean small rivers in Karaganda Oblast. Some 2,000 people from 22 Karaganda schools and residents of 12 villages took part in the event. Over 18,000 people from 117 organizations and companies went to clean the rivers.

At the beginning of 2001, the Tabigat Environmental Union initiated a *Live Balkhash* annual international regatta. Active participants included teams using rafts, catamarans, kayaks, rowboats, dinghies and canoes. The regatta includes extensive cultural events: performances by singer-songwriters from Almaty and groups from Almaty Oblast.

In 2002, with the support from GEF/SGP, the Belovodye Association held a "sanitary raid" to protect the Irtysh River. The river bank from Ust-Kamenogorsk to Semipalatinsk was cleaned. In general, cleaning ponds of rubbish is an annual action, and public organizations involve high school and university students, civil servants, and city authorities. The ultimate goal of such activity is to assign certain spots near the rivers to specific organizations and to draw local government attention to the condition of the waterways.

Implementation of Projects to Preserve Water and Riverside Ecosystems

In all oblasts public organizations are actively implementing water projects, both at their own cost and with donor support. The most successful projects implemented by NGOs include:

(1) Project *Preserving the Bio-diversity of Lakes* is being implemented by Aral Tenizi NGO (Aralsk). It uses a comprehensive approach to the problem based on two components: environmental, preserving the fragile ecosystems of the delta lakes near the Aral Sea; social, forming infrastructure for plaice fishery. The environmental component of the project is supported by GEF/SGP. The social element, *From Kattegat to the Aral Sea*, is funded by the Government of Denmark, Danish fishing organizations, and private foundations. As a result of joint efforts, in October 1996 - after an induced break which stopped fishing on the Aral Sea for 18 years - experimental plaice fishing took place. Now, three fishing centers work at three spots on the Aral Sea. The centers have refrigerators, generators, offices, and fish storage facilities. Fishermen are independent in terms of accepting fish and registration of the catch, whereas in the past only people from administrations of fishing units were permitted to do so. The final phase of the project covers the period from 2000 till 2004. By the end of the period a complete fishing infrastructure should be built – from catching fish to selling;

(2) Project "Preserving the Bio-diversity of the Natural Lakes of the Semi-deserts of Southern Kazakhstan" is implemented by the Shymkent Society of Hunters and Fishermen. It aims to preserve and improve habitats of migrating waterbirds. The Society held activities on sustainable management of wetlands of the Shoshka-Kul lake system: a study of specific names and numbers of rare birds was conducted, legal protection of the biodiversity was improved, the water regime of the lakes was ensured, and environmental tourism was organized;

(3) Germany's Union of Nature Conservation (NABU) and various public organizations of Akmola Oblast have worked in the Korgalzhyno Natural Reserve for several years to address the issues of nature conservation, environmental tourism and efficient environmental management. As part of their efforts, they also aim to include the Tengiz-Korgalzhyno lake system in the UNESCO's list of World Heritage sites.

Drinking Water and Civil Society

All activities related to potable water supply should be transparent at all levels and be carried out with close support of the society. The potable water tariff system should contribute to saving water and ensuring financial stability of enterprises which maintain group pipelines. Municipal water supply enterprises should make their financial and economic activities transparent and inform people through the media about how the money received for water delivery is spent. The sectoral program on *Drinking Water* should receive wide coverage. People and public organizations should be more involved in discussions and decision making about improvements to the water supply and water companies.

NGOs' Actions to Improve the Quality of Drinking Water

Practical activities of public organizations concerning the quality of potable water concern the following:

- providing the population with potable water;
- monitoring water quality;
- specific measures to improve water quality (installing water filters and desalters);
- public information campaigns;
- lobbying authorities to take measures to improve the quality of potable water.

One of the most simple and effective solutions in providing residents of Aral Sea villages with high quality potable water was the installation of solar water-heaters and desalters. This project was implemented by Kosaral NGO in the villages of Karateren and Tastak, with funding from GEF\PMG and Yerkin K JSC. Water-heaters and desalters have had a significant impact on the life of these villagers. Apart from reducing residents' costs for coal, the cutting down of *saksaul* and tamarisk trees also decreased, while rates of infectious disease have also fallen. The villagers now have secure supplies of clean potable and hot water during spring, summer and fall.

The UNDP program *Building Water Users' Potential for Sustainable Development of the Aral Sea Basin – Potential 21* has been of great assistance for the Aral region. This program, with funding from different donors, established three Project Support Centers in Arkalyk, Kazalinsk and Kyzylorda, which designed and implemented a variety of projects, including providing the population with clean potable water. Rural water users' NGOs were established in over fifteen remote villages of Aralsk and Kazalinsk districts and the practical implementation of water saving principles was demonstrated in the villages.

Three more centers for NGOs were recently set up at the Project Support Centers: the Initiative Support Center, the Aral Resource Center, and the Executive Group for Sustainable Development Initiatives. The main goal of the resource centers is building the capacity of existing NGOs and public organizations and supporting project design and implementation. Currently, there are some fifty NGOs in Kyzylorda Oblast specializing in issues of women, children, family, youth, disabled and retired people, culture and education, the environment and social development. These are also associations of water users.

Other donor-funded projects, such as UNDP Small Grants Program, the Global Environment Facility (GEF/SGP) and CIDA also involve local NGOs in identifying, designing and implementing projects according to their own objectives.

In many oblasts, public organizations examine the quality of potable water and the condition of potable water supply and treatment systems. For example, the Kostanai-based public organization, Youth for Ecology and Sustainable Development, conducts studies of potable water micro-flora. Water samples are taken for examination from apartments on different floors, and from water-pumps in detached houses. The samples are then tested to identify physical, chemical and bacteriological characteristics and the biochemical composition of water mains is identified. The research has shown that the water did not meet the state's standard minimum requirements in one neighborhood, where the drinking water had a high content of ferrous oxides, nitrogen compounds, sulfur, etc. The research data were sent to the organization responsible for water quality. As a result, the city authorities decided to replace water mains in the city. Later, 'expeditions' for high school and university students were organized all over the oblast to collect scientific material for students' papers and theses, including selection of water samples for further laboratory analysis.

NGOs publish much information in the media about water-related issues, as well as booklets and brochures. Among the most active NGOs in this respect are 'Greenwomen' Ecological Information Agency; Eco Press Center public organization, and Baspana public organization.

In the summer of 2000, while preparing for a consultative meeting of ministers of economy, finance and environmental protection *NNS Water Industry and Investment in NNS Water Sector: Overcoming Political and Institutional Challenges* (October 2002), the Greenwomen public organization of Almaty, and US Peace Corps volunteers sent a request to Vodokanal (water-supply) company and other sanitary and environmental supervisory services about the current state and measures taken to improve potable water supply and sewage system in the city. Vodokanal responded by holding a roundtable with representatives of public environmental organizations, and visiting the city's treatment facilities. On the whole, the participants' questions about potable water quality, water consumption, Vodokanal's plans regarding the drainage area, and procedures for dealing with water users' complaints, were answered.

To a large extent, the success of NGOs' work depends on donor support because the national government does not finance them at all. For instance, donor support was decisive in mobilizing public initiatives and building NGOs and public organizations in Aralsk and Kazalinsk districts, Kyzylorda Oblast.

3.1.3. Community-Based Water Resources Management: Opportunities and Challenges

Rural water supply systems are important for all Central Asian countries since their economies are based on agriculture. Formerly, in the Soviet Union, such centralized systems were very well developed. For example, in 1990 in Kyrgyzstan 75% of the rural population used such systems. However, centralized sewage systems were underdeveloped, and only 8% of rural population used them.

Rural water supply systems brought water not only to villages but also to agricultural enterprises which consumed water for cattle breeding and processing of agricultural produce. Restructuring of the agricultural sector resulted in significant changes in the rural water supply system. The state stopped providing technical and financial support to collective farms, while village councils, with few financial resources, have neither the technical nor financial means to manage and maintain these systems. This has had a negative impact on people’s living conditions and health. Most rural populations are sick, with different diseases caused by poor water quality, such as diarrhea, typhus and dysentery. In areas where the water supply system does not function, the population has no access to safe water. Most villages lack individual wells or water pumps, and where these are available they are usually too shallow or muddy. In many villages water is extracted by electrical pumps; however, frequent power failures result in pump breakages, so people may go without water for several days at a time.

Water supply in Kazakhstan’s rural areas remains extremely poor. Irregular water supply from the headworks of group water mains in northern oblasts forces many villages to do without potable water for long periods. Hence, rural communities tend to use various other water sources, even snow melt. Many water mains are either disassembled or inactive. The number of water mains in this poor condition is increasing each year. In Kostanai Oblast, for example, there are now 18 fewer water mains than in 1998, and in Kyzylorda Oblast 32 fewer.

Water supply problems in rural areas are also caused by the fact that the water complex is managed by many departments, so there is lack of clear assignment of responsibilities between ministries and local authorities. Village authorities cannot independently solve water problems, as it is often beyond their competency and capacity.

New civil institutions, such as NGOs and public associations can play an important role in solving water supply and water use issues, social issues, reducing the unemployment rate, etc. These institutions are still in their early stages, and are mostly concentrated in bigger cities, where it is easier to access donor support. In addition, many public organizations lack the experience, skills and funds to mobilize communities to address local problems.

Of the various NGOs in Central Asia, women’s organizations have a special place. They can provide a serious alternative to government-run social services and actively assist in solving issues regarding water, health and hygiene. Women’s success in this area is connected with their traditional role as home keeper. Most often, it is women who are water users, suppliers and managers at home, who also ensure a clean home environment. Women tend to have a more acute understanding of the water crisis and are willing to assist in changing the situation.

To enhance NGOs’ influence on the civil mobilization process, their knowledge and skills need to be improved. Information sharing systems have to be developed between public organizations, government bodies, and external donor organizations in Central Asia, concerning conceptual issues of water use and community-based water management.

In this respect, a good example is implementation of a project by the International Secretariat for Water Problems – *Water Management at the Community Level in the Fergana Valley in Kyrgyzstan and Uzbekistan: Enhancing the Role of Women*. This project set up committees to address water problems at the town level in order to improve water supply, people’s health and public hygiene. Loans for production and processing of foodstuffs were provided in five towns. One of these was the village of Mangyt, Aravan District, Osh Oblast, Kyrgyzstan, with 380 families and a total population of 1,600. During Soviet times the village had a 7 km long water main. With the break-up of the Soviet Union, the water mains fell into disrepair, resulting in a sharp increase of viral hepatitis and typhoid fever in the village.

Currently, the project has established associations of water users and installed water-pumps. Women do 95% of the work in these associations and the local high school also takes an active part.

Payment for water depends on how many children the family has and how far away the water pump is. Water pumps are repaired using funds generated by the water tariffs. At the project's costs, association members attended a special course to study the mechanics and maintenance of the water pumps. Association members include a volunteer on sanitary hygiene. The local sanitary station regularly tests water quality. A study tour to Jordan and France was organized for students of the Mangyt school.

The successful and effective work of such NGOs depends on a sound economic and legal base for the work of rural water committees. The practice of project implementation in the Fergana Valley shows that when organizing community-based water management, special attention should be paid to the following:

1. Institutional aspects: How to decentralize water resource management to the level of the community:

- effective assignment of responsibilities and tasks between ministries in charge of water resources, technical agencies, local executive bodies, and communities organized into water committees;
- setting up water committees in villages with specific goals, activities, bylaws, and legal registration; building up their technical capacity;
- working out a mechanism of preventing conflicts in the region, at basin and village levels; use of traditional and new conflict resolution forms, such as roundtables in villages, councils of elders.

2. Social aspects: How to strengthen community-based organizations (CBOs) at village level:

- setting up NGOs CBOs to address current problems and utilize community potential;
- strengthening the role of women in managing water resources; the importance of understanding this role;
- acknowledging the importance of social support in expanding the family network.

3. Economic aspects: How to make users pay for water:

- a fair price for water: review of the current situation and establishing a new water payment structure; the need for water users' participation in decision-making; determining water users' contribution to investment costs, alongside costs connected with the ongoing work and maintenance;
- the need to enhance the work which brings revenues to the water resource management sphere;
- a diverse right of ownership for water supply systems;
- liberalization of the banking system.

4. The role of external donor organizations: What kind of assistance is needed?

- support for CBOs and projects on water resource management at the village level;
- human resource development in project development and management; maintenance and development of water systems and gradual involvement of the community in this process, including confidence building;
- continuation of the process of careful monitoring of local partners who implement projects.

5. A regional network of practitioners - needs assessment and evaluation of participants' interests:

- sharing of experience and information on different aspects of water resource management at the community level;
- regular meetings and trips to sites (once or twice a year);
- interest in developing discussions to work out policy concerning water resource management at the community level.

3.2. Legal Regulation of Water Use

3.2.1. Review of Current Water Legislation

The effectiveness of water resource protection and rational use is largely contingent on legal regulation of water relations.

During Soviet times the Law of the USSR of December 10, 1970 “Basics of Water legislation of the USSR and Union Republics” and the Water Code of the Kazakh SSR of December 27, 1972 served as a legal framework for water relations.

After declaring sovereignty on March 31, 1993 the Supreme Soviet of the Republic of Kazakhstan adopted the Water Code of the Republic of Kazakhstan. Over the past period many provisions of the prior Water Code of the Republic of Kazakhstan (1993) became obsolete and restrained market reforms in the water sector.

On July 9, 2003 Kazakhstan adopted a new Water Code /2/, which includes 11 chapters, 32 sections and 146 articles. The development of the Water Code was necessitated by, first of all, the development of market relations in the water sector and agriculture. Specifically, the new Water Code provides for transfer of waterworks facilities to water users for rent, trust management or free-of-charge use.

The document was founded on international principles of fair and equal access of water users to water. The priority was given to the drinking water supply. The new Water Code designated the Water Resources Committee under the Ministry of Agriculture of the Republic of Kazakhstan to issue all approvals related to surface and ground waters. Prior to this, the Committee of Geology and Conservation of Earth Resources under the Ministry of Power Engineering and Mineral Resources had been in charge of issues pertaining to the use and protection of ground water.

An important innovation of the Water Code was the strengthening of the basin principle of water management. For example, the role and goals of Basin Water Departments, previously defined by the Water Resources Committee, are now included in the Water Code. In order to define and coordinate the activities of various governmental and non-governmental entities of water relations, such as associations of water users, non-governmental water organisations etc., the Water Code provides for them to enter into basin agreements on the rehabilitation and protection of water sources and basin councils. A basin council is an advisory body set up at the basin level to jointly resolve issues of water fund use and protection and implement signed basin agreements. In addition, the Code focused more attention on transboundary waters and included a special section on international cooperation in this area.

According to the new Code, special water use can only be exercised if a special approval or license has been obtained. Kazakhstan has instituted licensing requirements for the first time for the following types of special water use:

- Withdrawal and use of over fifty cubic metres per 24 hours of water from surface water sources for agricultural, industrial, power engineering, fishing or transport needs;
- Withdrawal and supply of water from surface water sources to secondary water users.

A number of provisions and norms pertaining to regulation of water relations were included in the recently adopted Land Code and Wood Code. Specifically, the Land Code has a special chapter on lands of the water fund, which include lands in water sources, hydrotechnical and other waterworks facilities, as well as water protection areas and protected zones of drinking water intake facilities. The bulk of the water fund lands are water lots. The water fund lands are to be used for water use and protection. Therefore, there are certain special provisions that deal with the legal regime of such lands. Thus, provision of the Land Code of the Republic of Kazakhstan regulates specific issues pertaining to ownership of such lands, procedures for land allotment and use, restricted seizure of land, etc. Many specifics of the legal regime for water fund lands are connected with water protection zones and belts to be set up by local authorities and agreed with Basin Water Departments.

Legislation of the Republic of Kazakhstan appoints the Water Resources Committee under the Ministry of Agriculture with a network of Basin Water Departments (BVOs). These are territorial bodies, authorized governmental agencies, dealing with water fund use and protection. The above-specified bodies are authorized to carry out administrative procedures and bring administrative or other action against offenders as stipulated in the current legislation of the Republic of Kazakhstan. The Code of the Republic of Kazakhstan “On Administrative Offences” of January 30 2001 sets out the responsibilities of legal entities and individuals for violation of the water legislation of the Republic of Kazakhstan.

On April 8, 2003 the Law of the Republic of Kazakhstan “On rural consumer cooperatives of water users” was adopted. This law deals with issues pertaining to rights and responsibilities of water users, water management at sources of irrigation and water-supply development, procedures for establishing rural water user associations, the legal capacity of such associations, membership, property rules, as well as procedures for the reorganization and liquidation of such associations.

The Water Code stipulates that citizens of the Republic of Kazakhstan have the right to unite and form a special pattern of ownership for waterworks facilities, known as a hydromeliorative condominium. Rural consumer cooperatives of water users shall be considered one of the most important forms of management of hydromeliorative condominium property and management of water resources at the level of end users.

Bylaws regulate issues pertaining to state management, use and protection of water resources. In particular, the following /13-40/ is dealt with in governmental decrees:

- Public planning in terms of water fund use and protection;
- Public monitoring and recording of water use, consumption and the water cadastre;
- Regulation of inter-oblast water relations;
- Issuance of approvals and licenses for special water use;
- Charges for water resources;
- Drinking water supply;
- Protection of water resources from detrimental effects and regulation of economic activities affecting water sources;
- The legal status of individual water sources with special regimes of use and protection;
- Subsidy assistance to individual water supply systems, etc.

Nearly all normative documents regulating the quality of water are proprietary. Specifications for the maximum permissible concentration of pollutants in water sources are developed by sanitary-epidemiological services under the Ministry of Health and agreed with the Ministry of Environmental Protection. Given that it takes several years and substantial sanitary research to develop normative documents related to water quality, the primary focus is now on editing the normative and methodological documents used during the Soviet period. Normative documents regulating the quality of water in Kazakhstan include many Russian specifications approved as the most appropriate for Kazakhstani circumstances.

3.2.2. Topical Issues of Water Legislation

The legal regulation of drinking water supply is an issue of the highest priority. Therefore, a draft law “On Drinking Water” is currently under development. This draft law will define the baseline legislative provisions pertaining to public access to drinking water. Currently, these issues are primarily governed by such normative papers as national standards, SanR&S, etc.

Current water legislation does not provide a financial mechanism of water activities. This results in payments for water resources to local budgets being spent on activities not related to water protection or replenishment. The lack of a financial mechanism hampers long-term planning of state actions related to water supply and water resource protection. Specifically, no work has been done in recent years to develop integrated schemes of water use and protection as the main planning tool. Such schemes were last developed within the Water Code of 1993.

The new Water Code uses new approaches to regulation of the quality of water sources, based on water indicators and water quality criteria, as well as the collective rating of all bodies involved in the water sector within each respective basin, watercourse or river section. At the same time, realization of the new requirement towards regulation of quality of water resources is time-consuming and requires great efforts to be made to develop relevant specifications to be included in departmental papers. Also, it requires a lot of time and labor investment to apply this in practice.

From the viewpoint of introducing an integrated approach to water resource management in Kazakhstan there is a need for further legislative improvements and enforcement of respective provisions of current water legislation. The creation of basin councils, provided for in Article 42 of the Water Code, is a particularly important tool to introduce an integrated approach to water resource management. Provisions are to be developed to provide a framework for basin council operation and further strengthening of the status of these regional water forums to solve issues of water use and protection, involving a wide range of water users, NGOs and local authorities.

In addition, no civil action has been brought for certain violations of water legislation, including irrational use of water resources.

Overall, the following actions should be taken in order to ensure environmental measures are beneficial for water relations:

- division of state management of natural resource use and operational functions;
- elimination of duplication of natural resource management functions in governmental agencies and definition of liability of each agency for carrying out functions of state management and control;
- strengthening of the normative and legal framework of water relations;
- development of an effective economic mechanism for natural resource use, ensuring replenishment and conservation of natural resources and conditions conducive to the economic use of natural resources;
- transition to integrated methods of management of protection, replenishment and use of natural resources, taking into account their interrelations in the environment;
- development and introduction of achievable and effective norms for the quality of water sources, ensuring conservation and step-by-step improvement of their condition.

At the initial stage of taking this approach a common state system of environmental monitoring should be set up. It should take into account the natural resources principle (air, land, water sources, earth resources, flora and fauna). Monitoring of water sources should be its baseline subsystem.

The main conditions for such work should be a determined political goal, a sustainable long-term institutional framework and highly-qualified professionals able to promote legislative solutions to the problems of rational use of natural resources.

Water users - both private individuals and waterworks organizations - are the main supporters of reforms to the normative and legal framework of the water sector. This is because deficiencies in water legislations are most obvious at an individual water user level, thus hampering effective use of water resources and implementation of waterworks activities.

3.3. Economic Mechanisms for Water Use and Protection

3.3.1. Economic Incentives for Water Conservation and Protection

A modern system of managing natural resources, including water resources, should enhance the sustainable development process. It is based on a number of principles:

Prevention Principle. Preventing impact on the environment through environmental forecasts and monitoring of environment protection.

The Polluter (or User) Pays. The resource user or polluter should cover all costs for proper maintenance of natural resources and compensate for any harm caused to the environment.

Cost Reduction. Cost benefit analysis has become more prevalent. It focuses on reducing costs in order to achieve certain standards or goals.

Involving the Private Sector. The private sector is becoming a more important source of environmental investment; participation of representatives of enterprises and associations of farmers can be a good basis for market mechanisms to carry out environmental protection measures.

The Decisive Role of Civil Society. The effectiveness of nature conservation measures depends to a great degree on support from civil society.

Paid-for water use is one of the ways of improving the effectiveness of water resource use and conservation because it provides a prerequisite for the reproduction of these resources based on a strong economy or good economics. Lack of well-developed economic mechanisms, including lack of consumers' good settlement index for water resources has led to the degradation of the country's water services, and has put them on the brink of bankruptcy. It is not feasible to determine the decentralization level based on the market tools. It results in the emergence of 'natural' monopolies, while mechanisms such as state regulation of pricing, competition, and conservation of water eco-systems, are usually ignored. Lack of funds for repairs and rehabilitation results in deterioration of water facilities.

To solve these problems, a mechanism has to be developed to transfer government-run water systems and structures to financially independent communal services and associations of water users – excluding reservoirs with hydraulic facilities, dams, and aqueducts of national, oblast and sectoral importance. It should be ensured that the water resource system not only distributes water but also ensures its quality. Therefore, more accurate determination of water quality and more thorough monitoring of water usage are coming to the forefront.

Considering the present economic situation, a rapid transfer of water facilities to self-financing is not beneficial; the economic mechanism should be introduced gradually, although it is impossible to set time limits without a long-term economic development plan.

Charges for the right to use water resources is essentially the realization of economic rights of an owner of natural resources located in its area. Hence, the calculation of fees for conservation and reproduction of water resources should be based on the recovery of costs for water source maintenance and rehabilitation, use of water facilities and structures within national ownership, water conservation and protection from environmental damage. The amount of payment for water resources should take into account water quality, terms of water use, the level of scarcity of water resources, water supply guarantees, and effectiveness of the sectors of economy.

The following principles should be used in developing and implementing an improved economic mechanism of paid-for water use and a gradual transition to self-financing of water facilities and structures:

- A differentiated approach to water charges;
- Self-repayment of costs for conservation and reproduction of surface water resources;
- Payment tariffs should consider changes in hydrological and meteorological conditions and provide privileges for consumers who use water resources rationally.

3.3.2. Economic Mechanisms of Water Use Regulation

An economic mechanism of paid-for water use and a step-by-step transition to recouping maintenance costs from water users’ payments was developed by the production cooperative, KazGiproVodKhoz, in order to realize the Government Order on Program 63 *Conservation and Rational Use of Water Resources* and Sub-program 30 *Applied Scientific Research of Water Resources* /69 /.

The economic mechanism provides three tariff versions regarding the cost of surface water resources, with a gradual transition to self-financing of water facilities within national ownership. The tariffs are calculated for three stages of transferring facilities within national ownership to self-financing paid for by charges to water users.

The main suggestions given by KazGiproVodKhoz, with regards to economic mechanisms of ‘paid-for’ water use and a gradual transition to self-financing, are as follows.

Setting payment for use of water resources aims to recover costs for conservation and reproduction of water resources, economic stimulation of rational water use and effective management of water resources, reducing environmental damage caused by water, and economic development of the area where the resources are located.

The suggested economic mechanism determines the principles of paying for water as a natural resource and payment rates for using surface water resources in the BVOs and economic sectors. It also sets out procedures of collecting and using payments, sanctions imposed for irrational and unlicensed water use, responsibility for untimely payments, as well as privileges in payments for water resources.

The mechanism considers only that part of the cost which is related to water as a natural resource. Payments for intake, treatment and the transportation of water from source to user are not included in this cost, but are collected separately as delivery and provision services.

Surface water resources also need to be paid for. The price is set for the part of water resources which are used for production, economic, and personal needs. However, there is no payment for the water resources used for supporting or rehabilitating the environment, such as sanitary needs and inflow to natural ponds.

Payers for Special Water Use

Payment is collected from all water consumers (those who use water taking it from the source) and water users (those who use water without taking it from the source), legal entities and individuals, irrespective of their ownership forms, from foreign legal entities and individuals, stateless persons, etc., excluding those water consumers and water users who are exempt from payments in accordance with current legislation.

Water consumers include enterprises and companies, industrial enterprises (including heat/power industry), agriculture and fisheries. Water users include the hydro-electric power industry, water transport and consumers fishing from water sources.

Calculation of Paymens for the Use of Surface Water Resources

According to the Republic of Kazakhstan's Law *On Environment Protection* /10/, payment for water resources consists of:

- Fees for the right to use water resources;
- Fees for conservation and reproduction of water resources.

Calculation of fees for conservation and reproduction of water resources is based on the need to recover costs for maintaining water bodies and their rehabilitation, maintenance of water facilities and structures within national ownership, water conservation and protection from environmental damage.

The amount of payment for water resources is determined depending on water quality, water use conditions, scarcity of water resources, water supply guarantees and the economic effectiveness of industries.

Collection of Payments for the Use of Water Resources

Payments for water resource use are collected from water users and water consumers: legal entities and individuals (including foreign) located in Kazakhstan, excluding those exempt from payments in accordance with the current legislation.

Payments for water resources are collected from primary water consumers who independently take water from natural bodies within the water stock of the Republic of Kazakhstan (excluding underground sources).

Water consumers who receive water from them are considered to be secondary and, as a rule, pay for water resources and water supply services to primary water users.

Use of Funds from Collecting Payments for the Use of Surface Water

Payments for surface water resource use go to local budgets and are used solely for the following:

- Activities to protect, improve and rehabilitate bodies of water;
- Activities to deliver water to the population and industry;
- Activities to prevent and alleviate damage caused by water;
- Repairs, construction and maintenance of water facilities and structures which are used for conservation and reproduction of surface water resources;
- Activities to help the survivors of emergencies on bodies of water

Economic Incentives for Rational Use of Water Resources

The economic incentive system for rational water use is established by the government and includes various privileges and exemptions for legal entities and individuals who work on the rehabilitation and protection of water facilities, prevention and alleviation of damage caused by water and emergencies, and reduction of water consumption.

Stages of Transition to Self-financing of Maintaining Water Facilities and Structures

The low paying capacity of water users, especially in agriculture, who cannot afford to pay for the resources used, has aggravated the economic situation of water facility services and has brought many of them close to bankruptcy.

Therefore, this transition has to be carried out in stages and must consider water users' economic growth and the following important factors:

- The first considers pay-back of maintenance costs, including preventive repairs, incurred by the water management services;
- The second considers pay-back of all costs including maintenance costs, current and capital repairs as well as allocations for renovations.

Depending on the economic situation, different sectors should be transferred to self-financing at different times.

Activities to Implement the Economic Mechanism of Paid-for Water Use

Currently, Kazakhstan has now special law on paid-for water use. Therefore actions are currently based on Articles 133 and 134 of the Republic of Kazakhstan's Water Code, and Article 30 of the Law *On Environmental Protection*, which provide only general instructions. In order to improve water legislation and to bring it into conformity with the laws of a market economy it is necessary to adopt the concept of agricultural water use; work out and approve a strategy of developing the water sector and the country's water policy; work out and approve a Law *On Paid-for Water Use*, which should include the following:

- General functioning principles of paid-for water use;
- A system of payments for water as a natural resource;
- Taxation and its principles;
- Economic incentives for rational use, rehabilitation and conservation of water resources;
- Government participation to fund work on regulating water use, plus rehabilitation and conservation of water resources;
- Procedures and control of calculating payments for water; collection of payments;
- Use of funds coming from payment for water resources;
- Establishing a state off-budget Water Fund;
- Resolving disputes and providing implementation of laws;
- Other provisions, as needed.

Assessment of Water Consumers' Demand for Water Resources by Sectors of the Economy

Evaluation of water consumers' demand for water resources in 1993-1995, 1999, and 2000 includes the main indicators of the state account of water provided by enterprises and companies, in accordance with Stat Report Form No. 2-TP (Vodhoz).

Table 7. Major Indicators of Water Use in Kazakhstan

Indicators	1993	1994	1995	1999	2000	2000, % of 1993
Number of water users	5,407	5,362	5,263	4,470	4,386	81.1
Water used – total, km^3	29.9	24.9	22.3	14.2	14.1	52.4
including the needs:						
- personal	1.32	1.33	1.24	0.65	0.62	47.2
- production	4.53	4.13	4.09	2.68	2.80	61.8
- agriculture	20.7	19.0	16.4	10.8	10.4	50.2
of these:						
regular irrigation	15.3	14.1	12.1	7.83	7.63	49.9
estuary irrigation	4.57	4.16	3.68	2.56	2.49	54.4
agricultural water supply	0.42	0.40	0.36	0.18	0.18	42.8
supplying with water	0.36	0.34	0.33	0.09	0.13	36.1
Diversion limit of surface sources	35.0	34.2	32.7	26.4	25.5	72.9
Water taken, % of the limit (surface sources)	89.6	87.0	81.0	66.4	66.6	-

Source: Water Resources Committee, 2001

This data shows that the number of enterprises using water fell by 19% from 1993-2000, while the use of water resources decreased by 53% over the same period. The level of usage limits also decreased as a result of a downturn in production (excluding the heat/power industry) and in agriculture, where sown areas were significantly less for irrigated lands.

Water consumers' demand for water resources has not yet been studied well and needs further elaboration.

Assessment of Water Consumers' Paying Capacity

Evaluation of water consumers' capacity to pay for water resources is determined according to data from BVOs and state enterprises (see Table 8).

Table 8. Levels of Payment for Water Use, million Tenge, %

Oblast	Level of Payment for Water Resources (million tenge; %)					
	1998		1999		2000	
	Plan	Paid, %	Plan	Paid, %	Plan	Paid, % (first 6 months)
Akmola	14.2	44.4	5.7	56.5	4.6	41.1
Almaty	75.0	46.9	40.0	98.8	62.0	18.8
Aktobe	4.8	31.8	1.6	105.4	1.5	37.2
Atyrau	17.0	19.0	10.4	41.7	11.0	37.7
East Kazakhstan	84.6	94.4	74.8	91.5	75.0	47.6
Zhambyl	74.0	17.2	29.2	68.3	49.0	11.0
West Kazakhstan	2.3	69.4	3.7	42.4	5.3	9.8
Karaganda	128.8	81.6	53.9	46.2	50.0	31.6
Kostanai	8.2	35.6	3.8	68.4	8.2	13.7
Kyzylorda	109.2	32.8	83.6	68.8	92.9	19.6
Mangistau	1.9	82.2	0.3	142.3	1.3	22.1
Pavlodar	125.2	95.6	88.7	106.8	108.6	54.9
North Kazakhstan	7.9	63.7	2.2	108.0	3.7	15.4
South Kazakhstan	44.8	65.2	40.6	84.7	65.0	11.0
Almaty city	-	-	3.5	112.4	3.5	53.7
Astana city	-	-	4.5	67.3	2.6	48.9
Total	**697.9**	**62.6**	**446.4**	**81.2**	**544.1**	**30.5**

Source: Water Resources Committee of MNREP RK, 2001

The data shows that the collection of payments for water resources is just a little more than half of their full cost. A higher level of payment can be seen in oblasts with better developed industrial potential, and smaller areas of irrigated lands. Oblasts with well-developed farming have very low levels of payment for water resources.

To increase the collection rate, methods for calculation of water charges need to be agreed, in the absence of which development of the needed infrastructure cannot be completed. The methodology should be based on real economic price of the water, however, at the same time the government should guarantee appropriate compensation for the poor population through a targeted social program.

Principles of Payment Calculation for Conservation and Reproduction of Surface Water Resources

The economic price mechanism of payment for protection and reproduction of water resources is based on the principle of recouping all costs for water resource management, maintenance of facilities at water sources, reproduction, transportation and protection of water resources.

The main water facilities where costs are most significant include facilities which regulate river run-off, territorial reallocation of water resources, mainline water transportation, protection from damage caused by water, environmental protection, as well as solid funds and current assets needed for the functioning of mains water facilities. Besides, the cost of water resources includes costs for studies, assessment and protection, which are made up of annual costs for developing comprehensive use schemes and conservation of water resources, evaluation and control of surface water use, scientific research, water conservation programs, KazGidroMet's expenses for maintaining, repairing, rehabilitating, and constructing new water stations; and costs for planned construction of new water resource conservation and reproduction facilities. In addition, an insurance fund is included in the costs. This accounts for water organizations' losses due to changes in water content each year. When calculating payment tariffs for use of water resources, payment for the right to use water resources is also included.

Based on the above, tariff calculations should be based on normative deductions from the initial book value of the main water funds.

Calculation, Collection and Payment of Charges for the Use of Surface Water Resources

These suggestions set out the order of calculating, collecting, and making payments for using surface water sources, according to economic sectors and basin water management units, as well as the use of funds received from collecting these payments.

1. Payment for use of water resources is set for all kinds of special water use from surface sources, with or without water intake, and is based on a permit issued by the authorized state body in charge of water resource management.
2. Payment for use of water resources is aimed at recovering costs for reproduction and conservation of water resources, providing economic incentives for rational water use, effective management of water resources, and reducing environmental damage caused by water.
3. Payment for use of water resources is introduced for enterprises and companies, which render housing and communal services, industries (including the heat/power industry), agriculture, the fishing industry, hydro-electric engineering and water transportation. It does not affect timber floating without vessels, recreation, use of earth-moving equipment, wetland reclamation, common water use when water resources are not owned by any citizens, nor use of facilities affecting the water condition.
4. Rates of the payment for use of water resources from surface sources are set and adjusted by the government as necessary, depending on the country's economic and water situation, and at the suggestion of the water resource management body in coordination with interested ministries and agencies.

The methodology of calculating payment for use of water resources is similar to the methodology developed at the Institute of Water Problems and Hydroelectric Engineering, at the Academy of Sciences of the Kyrgyz Republic. Calculations for the same water facilities give a good basis for establishing an economic mechanism of efficient apportioning of water in Central Asia.

CHAPTER 4. INTERNATIONAL COOPERATION ON TRANSBOUNDARY WATER USE AND PROTECTION

4.1. International Conventions and Agreements on the Use and Protection of Transboundary Rivers

On October 23, 2000 Kazakhstan adopted a law on joining the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. According to Part I of the Convention "…the Parties shall take appropriate measures to prevent, control and reduce pollution of waters causing or likely to cause transboundary impact; to ensure that transboundary waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection; to ensure that transboundary waters are used in a reasonable and equitable way, taking into particular account their transboundary character, in the case of activities which cause or are likely to cause transboundary impact…".

The Parties are governed by the *principle of prevention*, which stipulates that preventive measures must be taken where emissions that might have cross-border effects. This has to be done notwithstanding the fact of whether a cause-and-effect relationship has been scientifically identified to ascertain the link between the pollutant and cross-border effects or not; by the *"polluter-pays" principle*, according to which all expenses on the prevention, limitation and reduction of pollution are to be covered by the polluter; water resources are managed in such a way that the present generation's needs should not be met at the expense of future generations.

At the same time, that the Convention contains primarily the norms of a declarative nature and links to prospective interstate agreements and treaties. The Convention does not have a specific mechanism for cooperation between member states in resolving issues related to the use and protection of transboundary waters and international lakes. This raises a question of the effectiveness of the Convention's provisions /106,107/.

The Convention has been signed by 34 nations, including Russia, UK, Germany and France. At the same time, China, Tajikistan, Turkmenistan, Kyrgyzstan, and Uzbekistan are among those which have not joined the Convention.

Comparative analysis shows that, of all international documents currently in force, the 1997 UN Convention on the Law of Non-Navigational Uses of International Waters proves more effective than the previously mentioned Convention.

According to the UN 1997 Convention for non-navigational watercourses, a "watercourse" means a system of surface waters and ground waters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus. An "international watercourse" means a watercourse, parts of which are situated in different states.

As Paragraph 1 of Article 5 of the 1997 UN Convention states, "watercourse states shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse states with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse".

At the same time, according to Paragraph 1 of Article 6 of the 1997 UN Convention, "utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including: (a) geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character; (b) the social and economic needs of the watercourse states concerned; (c) the population dependent on the watercourse in each watercourse state; (d) the effects of the use or uses of the watercourses in one watercourse state on other watercourse states; (e) existing and potential uses of the watercourse; (f) conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; (g) the availability of alternatives, of comparable value, to a particular planned or existing use".

Article 11 of the 1997 UN Convention mentions, watercourse states shall exchange information, consult each other and, if necessary, negotiate on the potential effects of planned measures on the condition of an international watercourse.

It should be noted that Article 12 of the 1997 UN Convention stipulates that "before a watercourse state implements or permits the implementation of planned measures which may have a significant adverse effect upon other watercourse states, it shall provide those states with timely notification thereof. Such notification shall be accompanied by available technical data and information, including the results of any environmental impact assessment, in order to enable the notified States to evaluate the possible effects of the planned measures".

At the same time, a specific aspect of the 1997 UN Convention is that it is applies to uses of international watercourses and of their waters for purposes other than navigation and to measures of protection, conservation and management related to the use of those watercourses and their waters. Navigational use of international watercourses is not covered by the 1997 UN Convention, except for cases when other uses affect or are affected by navigation.

It should also be noted that according to the 1997 UN Convention a regional economic integration organisation means an organisation set up by sovereign states of a region which has the authority to deal with issues regulated by the Convention and which has been duly authorised to sign, ratify, adopt, approve or join the Convention according to internal procedures.

To date there are around 20 states participating in the 1997 UN Convention including Finland, Germany, Luxemburg, Norway, South Africa, Sweden, Tunisia and Venezuela. Such countries as China, Tajikistan, Turkmenistan, Kyrgyz Republic and Uzbekistan have not joined the Convention.

In 1992, the Commonwealth of Independent States adopted an Agreement on Cooperation on Environmental Protection. According to Article 1 of the Agreement, the Parties shall jointly develop and pursue policies related to environmental and nature protection (protection and use of land, soil, earth resources, forest, water, air, flora and fauna, natural resources of continental shelf, economic zones and open sea outside national jurisdiction) taking into account international agreements previously adopted by the USSR.

According to Article 2 of the Agreement, the Parties shall establish scientifically-proven norms of natural resources use in economic and other activities within their territories. Also, they shall determine limits of irrevocable withdrawal of water, taking into consideration overall environmental security and welfare, and observe obligations of international agreements adopted by the USSR.

As Article 3 of the Agreement says, to ensure coordination of policies related to environmental and nature protection the Parties acknowledge the need to jointly develop and implement interstate programmes and projects concerning the use of natural resources, environmental protection and environmental security, and to use agreed methodologies for assessing the environmental effects of economic and other activities. They should also set up and maintain an interstate environmental information system and share information with other Parties.

In order to observe Article 3 of the Agreement the Parties agreed to establish an Interstate Environmental Council, including an Interstate Environmental Fund to implement joint interstate environmental programmes. First of all this will help to cope with the consequences of natural disasters. The Interstate Environmental Council shall define procedures for the establishment and operation of the Interstate Environmental Fund.

The Parties authorise the Interstate Environmental Council to coordinate and pursue environmental and nature management policies, to perform environmental assessments involving representatives of the Parties concerned, to implement joint programmes, investment and other projects that involve or may involve the interests of two or more Parties and assist in deciding environmental disputes between the Parties.

Members of the International Environmental Council shall include heads of environmental agencies of the member states. The Council shall be guided by parity principles and make consensus-based decisions.

Thus, the Commonwealth of Independent States has set up a legal framework to regulate relations on a number of issues related to water use.

It can therefore be concluded that the Interstate Environmental Council is a **regional economic integration organisation** in accordance with the 1997 UN Convention. In the long-term, this will facilitate joining the 1997 UN Convention, thus laying necessary legal foundations for solving water supply issues in Central Asia and, at the same time, encourage Russia's inclusion in this "WATER CONSORTIUM".

4.2. Regional Cooperation in Water Resources Use and Protection in Central Asia

Water is a key factor for social and economic prosperity in the Central Asian nations. In some areas of the region - especially at the mouths of the main rivers - lack of water quality and quantity has already had a negative impact on socio-economic conditions. Bearing in mind climatic changes, water is likely to become even more scarce in the coming years, threatening sustainable development in arid zones and the region as a whole. Under current political, social and economic conditions, one of the most realistic ways of achieving prosperity in the region is through the execution of principles of ecosystem water resource management in Central Asia.

Development of Cooperation in the Region

The necessity of integration in water basin resource management was fully understood before the Central Asian nations gained independence. The USSR's Melioration and Water Ministry was responsible for the centralized water apportioning system based on consultations with the governments of the five republics. However, an analysis of water deficit in 1974-1975 and, especially, in 1982 revealed that water apportioning was environmentally reasonable and strictly controlled in terms of volumes, but was not feasible without a unified basin coordination and water management organization. The structure of such an organization was approved in 1986, and as a result basin water management organizations (BVOs) were set up: BVO Amudarya with its headquarters in Urgench and BVO Syrdarya in Tashkent.

As a consequence of the Soviet era, there are two approaches to water apportioning: in proportion to the area irrigated or to the needs determined for each crop and industry. Depending on hydrological forecasts, a BVOcould increase or decrease the limits of each country by 10%. BVOs did not control water quality and were not responsible for water apportioning in each country. Water supply in the Aral Sea and the Aral region was based on a "whatever is left" principle. The community had never been involved in the water management process and was not properly informed about the process.

A New Period of Cooperation

After gaining independence, there was a need to strengthen regional cooperation in water resources management. Based on the principle of equal rights and efficient use liabilities passed in 1992, the parties entered into a number of agreements, documents and decisions regulating cooperation in the field of joint management, protection and use of water resources.

The first intergovernmental agreement (1992) was devoted to establishment of the Interstate Commission for Water Coordination (ICWC).

In 1993, with the development of the Aral Sea Basin Program, two new organizations emerged: the Interstate Council for the Aral Sea (ICAS) to coordinate implementation of the Program, and the International Fund for Saving the Aral Sea (IFAS) to raise and manage its funds. In 1997, the two organizations merged to create IFAS.

Shortcomings of Regional Water Resources Management

The 1992 Agreement was a milestone in arranging regional water-management cooperation between the countries and was based on principles that were effective in the Soviet era. However, the original regulations of water management based on prioritization of irrigated farming contradicted the priorities of those countries located in the area of river formation, which included the use of water as a prime source of energy. This is where conflict of interest originated between the downstream and upstream nations. Any efforts to solve the conflict by simply exchanging energy and energy resources failed due to the absence of clear conditions of exchange.

Although the ICWC and BVO have been able to solve the complex issues associated with water appropriation and have prevented conflict even in low-water periods, their management abilities are obviously not sufficient

Future Trends of Regional Cooperation

Considering the shortcomings of existing regional cooperation, it is vital to integrate efforts in the following areas:

- Integrated water management and water saving through interstate partnership;
- Integration of the interests of industry and ecology through inter-industry partnerships in each country;

- Integration of the levels of hierarchy of the water management systems through vertical partnership;
- Involvement of water consumers in the water management process;
- Partnership between science, producers and water consumers, water-related organizations;
- Coordination and partnership between international financial organizations.

Integration of the outcomes of analysis of topical issues and relevant plans in the form of basic provisions of the region's water strategy requires use of available scientific potential.

The Role of Donors in Central Asia

To resolve water sector issues, the country is seeking the assistance of international financial institutions: World Bank, Asian and Islamic Development Banks, UNDP and others. Germany, Japan, France, Great Britain, Austria and Kuwait will also provide their assistance and support in resolving water issues in Kazakhstan.

The project management team at the Water Resources Committee of the Ministry of Agriculture is coordinating execution of the following water management projects funded by foreign loans and grants:

- Regulation of the Syrdarya riverbed and preservation of the northern portion of the Aral Sea (Phase 1);
- Water supply for the town of Aralsk;
- Water supply for the towns of Kazalinsk and Novokazalinsk;
- Water supply and sanitation for north-east Kazakhstan;
- Restoration and management of the environment in the area of the Nura-Ishim basin.

Project Regulation of the Syrdarya Riverbed and Preservation of the Northern Portion of the Aral Sea (Phase 1)

Loan Agreement No. 4609 for the sum of 85.79 million USD, including 21.29 million USD as co-financing from the budget of the Republic of Kazakhstan was signed on October 22, 2001. The loan validity period is 2002-2006. The Loan Agreement was ratified by the Law of the Republic of Kazakhstan No. 307 - II "On ratification of the Loan Agreement (Project *Regulation of the Syrdarya Riverbed and Preservation of the Northern Portion of the Aral Sea (Phase 1))* between the Republic of Kazakhstan and the International Bank for Reconstruction and Development", dated March 20, 2002.

Project Water Supply for the Town of Aralsk

The Kuwaiti Fund for Arab Economic Development provided a loan to Kazakhstan of 4.2 million Kuwaiti Dinars or 13.65 million USD (The Loan Agreement No. 596, dated 2 May 2002, was ratified by the Law of the Republic of Kazakhstan in February 2001). The loan validity period is 2001-2004.

The Project goal is to extend the water supply to the town of Aralsk - one of the locations most affected by the Aral Sea environmental disaster - by improving efficiency of the existing water supply system and extending the water distribution system in the town.

Project Water Supply for the Towns of Kazalinsk and Novokazalinsk

A Grant Agreement for 5.3 million USD was signed by the Republic of Kazakhstan and KFW German Bank on March 1, 2000. The grant validity period is 2001-2003.

The Project objective is to decrease the level of sickness in the target group arising from lack of potable water (mitigation of the negative consequences of environmental pollution) by preventing overall technical and economic disablement of the municipal water supply and providing medium-term (3-5 years) proportionate regular water supply in Kazalinsk and Novokazalinsk.

Project Restoration and Management of the Environment in the Area of the Nura-Ishim Basin

Grant Agreement No. TF 025802 worth 696,000 USD was signed by the Republic of Kazakhstan and IBRD on November 1, 1999. The grant validity period is November 1, 1999 to February 12, 2002.

The grant objective is assistance in the preparation of a large-scale project (preparation of a Project Feasibility Study) that is targeted to improve health and environmental conditions in the basins of the Irtysh and Nura-Ishim rivers in the north-east industrial area of the Republic of Kazakhstan.

The Consultant has already prepared the draft Final Report (Feasibility Study of the Project). In the second half, feasibility study data will be submitted to the National Construction and Environmental Expert Examination Office.

Project Water Supply and Sanitation of North-East Kazakhstan

Grant Agreement No. TF 026286 for 482,200 USD was signed by the Republic of Kazakhstan and IBRD on November 14, 2000. The grant validity period is from November 14, 2000 to December 31, 2002. The grant objective is to fund the preparation of a large-scale project to contribute to improving the quality, reliability, efficiency, financial solvency and sustainability of water supply services in the following target cities: Karaganda, Temirtau and Kokshetau.

The list of projects and programs financed by international organizations and donors is not limited to the projects mentioned above. The followings can also be noted. A project in the framework of the Community Action Investment Program (CAIP) is being executed in South Kazakhstan Oblast. The Project is funded by the United States Agency for International Development (USAID). Owing to the Program, two *auls* (villages) of Otrar District, Arys and Shoimanov, will be supplied with pure potable water. Previously, the 4,000 residents of these *auls* had to drink water from irrigation channels. Some 75% of the costs of construction of 11 km of water pipe were covered by the CAIP. The residents also made a contribution to execution of the project by participating in construction of the water pipe. In the framework of the project, around 13,000 USD will be provided for current repairs of water wells. Within the next 4 years, USAID is planning to execute 96 projects in 16 *auls* of South Kazakhstan (South Kazakhstan Regional Portal).

A more detailed information on projects in the Aral Sea Basin is available in a UNDP publication on “10 Years of Donors’ Activities in the Aral Sea Region”.

Donor support is essential in terms of interstate issues and the national potential of irrigation and water management. At the same time, the actions of donors and IFAS should be coordinated efficiently to avoid duplication of programs, deviation from the main strategy and conflict of interest between donors and recipient countries.

4.3. Interstate Agreements and Regional Organizations for Water Resources Management in Central Asia

The Progress of Foreign Policy and International Cooperation

The varying levels and rates of economic reform are a serious hindrance to the development of sub-regional cooperation between the Republic of Kazakhstan and other countries of the region. In order to encourage peace and trust in 1994 the Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan and Republic of Uzbekistan signed a treaty on the establishment of a united economic space, the Central Asian Community (CAC). The Integration Development Strategy until 2005 and the Program of priorities related to forming the united economic space approved by CAC, will contribute to equalizing the level of countries’ economic development. To achieve these objectives, the Central Asian Bank for Cooperation and Development was established. Today, the Bank funds fifty joint projects.

Further to the CIS integration processes, the leaders of five CA countries declared the commencement of practical activity of the Eurasian Economic Community (EEC) in Minsk in May 2001.

The next important step for expanding international cooperation was the establishment of the Shanghai Cooperation Organization (SCO), comprising the Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Republic of Uzbekistan, Russian Federation and the People’s Republic of China. The target of the Organization is development of a collective security system and multilateral cooperation in various fields. The agreements signed provide a basis for settlement of various border issues.

On the initiative of the leaders of CAC countries a Special Economic Commission for Central Asia was set up on the basis of UNDP Economic and Social Commission for Asia and the Pacific and the Economic Commission for Europe and later its regional consulting committee, with participation from the UNDP, European Unit Commission, Asian Development Bank, Islamic Development Bank and other international organizations. The goal of the Special Economic Commission is to assist the Central Asian nations in developing mutual collaboration, stimulating economic development and integrating their economies with Europe and America.

Important Initiatives of Regional Collaboration in Central Asia

1993

- Establishment of the International Fund for the Aral Sea (IFAS).
- Signing of the Collective Security Treaty (the Republic of Armenia, Republic of Belarus, Republic of Kazakhstan, Kyrgyz Republic, Russian Federation, Republic of Tajikistan and Republic of Uzbekistan).
- At a meeting of Central Asian leaders, Kazakhstan, Turkey, Iran and Pakistan supported the idea of collaboration between Eurasian countries on the basis of the revival of the Great Silk Road.
- Agreement on joint actions to solve current issues of the Aral Sea and Aral region, and to support environmental recovery and social and economic development of the Aral region.
- Signing of the treaty on the establishment of the Central Asian Regional Unit of Central Asian Countries and Kazakhstan (CARU).
- The European Commission approved the TRACECA Project.

1994

- establishment of the Central Asian Economic Community.

1995

- Nukus and Issyk-Kul Declarations. Establishment of the International Commission for Sustainable Development.

1996

- Establishment of the Shanghai Five.
- Tashkent Declaration of the UNDP Special Program for the Economy of Central Asia (SPECA).

1997

- Agreement on collaboration in the field of ecology and efficient use of nature. Almaty Declaration.

1999

- Treaty on the Customs Unit and United Economic Space between the Republic of Belarus, Republic of Kazakhstan, Kyrgyz Republic, Russian Federation and Republic of Tajikistan.

2000

- CAC mission participated in the Conference of Environmental Protection Ministers in Kita-Kusu. A meeting of the Economic and Social Commission for Asia and the Pacific (in Tehran) at which there was a decision to establish a Regional Program of Actions on Environmental Protection.
- April – the First Eurasian Economic Summit *Eurasia 2000* in Almaty; presentation of the Special Economic Commission for Central Asia.
- October – Agreement on establishment of the Eurasian Economic Unit and strengthening of the Collective Security Treaty.
- Ratification of the Aarhus Convention by the Republic of Kazakhstan, Republic of Tajikistan, Turkmenistan and the Kyrgyz Republic.

2001

- Establishment of the Shanghai Cooperation Organization.

2002

- At the World Summit on Sustainable Development (Johannesburg, September 2002), the Central Asian countries declared a sub-regional Initiative on sustainable development supported by the final decisions by the leaders of all countries and governments.
- In October, under the aegis of the UN and within the framework of the International Year of Mountains, the Global Mountain Summit, initiated by the Kyrgyz Republic, was held in Bishkek.

2003

- On the initiative of the Republic of Tajikistan, the UN General Assembly declared 2003 the Year of Fresh Water. The Dushanbe International Fresh Water Forum was held in August 2003. The parties approved a new stage of the Program for Aral Issues.
- At the 5th European Ministers' Conference within the framework of the Process *Environment*

for Europe held in Kiev, in May 2003, further to the development of the Sustainable Development Initiative, the whole region of the UN European Economic Commission supported the position of the Central Asian countries, in which they specified sub-regional goals. The delegates also signed a memorandum on strengthening and developing partnership on preservation of the environment as a basis for new forms of cooperation in this field.

The Central Asian governments were urged to search for integrated ways of management, which would consider economic, social and environmental factors. This can be explained by the regional nature of common ecosystems and the need for joint efforts to solve cross-border and inter-sectoral issues.

The use of transboundary water resources is still at the forefront in solving regional issues between the Republic of Kazakhstan and neighboring countries: China, Kyrgyzstan, Russia, and Uzbekistan.

Transboundary Cooperation in Central Asia

Improvement in international water relations is a key condition in providing national security, especially in the southern regions of the Republic of Kazakhstan. Despite the efforts of the International Aral Sea Salvation Fund and its structures, the issue of apportioning cross-border water resources in CAC is becoming more and more urgent.

In order to solve the issues of water relations in the Aral Sea basin, Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan signed the Interstate Agreement *On Cooperation in the Field of Joint Regulation of Use and Protection of Water Resources of Interstate Sources* in Almaty on February 18, 1992. Thus, settlement of water apportioning issues associated with cross-border waterways has a legal basis and the parties should follow the procedure of interstate water apportioning.

The political will of Central Asian states for fair distribution of the water resources of transboundary rivers, ensuring sustainable water use and strengthening regional water-related cooperation is stated clearly and logically in most of the agreements, declarations and statements below:

- **The Nukus Declaration of September 20, 1995:** the republics stated their commitment to the principles of sustainable development and assured that “the states shall accept agreements, contracts and regulatory documents signed earlier or currently effective that govern relations between the states in terms of water resources within the Aral basin, and ensure strict adherence to them”.
- **The Statement of May 6, 1996** indicates the need to develop coordinated strategies for **water apportioning** and management of water and power resources in order to identify the best ways to use them, namely:
  - Introducing a coordinated approach to using the water and power resources of the Toktogul HEPS cascade for irrigation and environmental needs;
  - Planning rational consumption of water and power resources with consideration given to the economic development needs of the member states;
  - Strengthening existing organisational, legal and financial mechanisms.
- **The Agreement of January 10, 1997,** declares that priority is given to ensuring environmental security as stipulated in respective bilateral and multilateral agreements, developing and implementing collaborative environmental programmes and projects.
- **In the Almaty Declaration of February 28, 1997** the heads of Central Asian states emphasize that environmental security is a strategic component of national security and an important aspect of national self-interest, thus recognizing the global nature of the Aral problems.
- **At the Summit of July 24, 1997 the heads of Kazakhstan, Kyrgyzstan and Uzbekistan** looked at further actions to enhance economic integration of the member states under the Agreement on establishment of a common free market zone and decided to set up international consortiums for power, water resources, food, communications and the extraction and processing of mineral resources.
- **The Agreement on the Use of Water and Power Resources of the Syrdarya basin of March 17, 1998** between Kazakhstan, Kyrgyz Republic and Uzbekistan commits the parties to not violating the water use and power supply procedures jointly agreed upon or striking at the rights of other parties to receive set volumes of water, power resource supplies and their transit through the states.
- **In the Ashgabat Declaration of April 9, 2001** the heads of Central Asian states point out the need to develop collaborative actions to implement regional strategies, as well as specific steps for

rational use of the region's water resources be based on ecosystems and integrated principles of water management.

- **In the Tashkent Statement of December 2001** the heads of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan emphasised the importance of rational and mutually beneficial use of water and power resources, transport communications and economic potential. They also assigned their respective governments to speed up mechanism development for interstate use of transboundary water resources.
- **The Dushanbe Declaration of October 6, 2002** declares an aspiration for the collaborative implementation of a programme of specific actions for the Aral Sea and development of a concept of sustainable development of the Aral basin states, prioritizing an improved social and environmental situation in the region in order to create acceptable living standards for the population.
- **The Central Asian Presidential Summit held on October 6, 2002** in Dushanbe approved "Major directions of the action plan to improve the environmental, economic and social situation in the Aral basin over the period 2003-2010" and assigned IFAS to develop the action plan. The IFAS administration approved this Programme and ASBP-2 on August 28, 2003 in Dushanbe.

Cooperation with the Russian Federation on Transoundary Water Issues

Taking into account the considerable number of transboundary waterways running between Russia and Kazakhstan, the Republic of Kazakhstan and the Russian Federation signed an interstate agreement on the joint use and protection of cross-border water bodies on August 27, 1992 in Orenburg. The Russia-Kazakhstan Intergovernmental Commission on joint use and protection of cross-border water bodies has been operating since 1992. The regular tenth meeting of the Commission was held in Tyumen, October 9-11, 2001.

In Orenburg, on June 26, 1997, the akims of Aktobe, West Kazakhstan and Kostanai oblasts of the Republic of Kazakhstan and the Governor of Orenburg Oblast of the Russian Federation signed a Treaty *On Collaboration in the Field of Environmental Protection, Use of Water Resources and Environmental Safety in the Neighboring Areas*. Within the framework of the Treaty, in Aktobe, on December 10, 1998, the representatives of the environmental protection bodies of Orenburg and Aktobe oblasts and AZKhS OJSC held a joint meeting to arrange actions to localize a spot in the Ilek River polluted with hexavalent chromium produced by the mud ponds of AZKhS OJSC. At the moment, the local water flow is divided on the basis of a protocol on joint use and protection of the cross-border water bodies of the Ural River basin.

Cooperation with China on Transboundary Water Issues

Three rounds of experts' negotiations have been held with China to discuss managing cross-border rivers. As a result, the Republic of Kazakhstan and the People's Republic of China have approved a regulation on the Joint Working Team of Experts on cross-border rivers.

At the first meeting of the Joint Working Team of Experts on cross-border rivers of Kazakhstan and China, the parties agreed on a list of 23 cross-border rivers and the scope of work, comprising three stages.

In Astana, in September 2001, the governments of the Republic of Kazakhstan and the People's Republic of China signed an agreement on cooperation in the use and protection of cross-border rivers.

4.4. Water Partnership in Central Asia

Development of a legal mechanism to take into account international experience of common management of water resources of the Aral Sea basin is the basis for a solution to the numerous contradictions in the use of water resources of Central Asia, both at regional and national levels. Sustainable economic development in the region depends on effective intergovernmental collaboration and cooperation, which requires an improved legal basis in the field of water relations.

Proceeding from such understandings, interstate use of water resources in Central Asia should be based on the conventions generally accepted in international practice and framework agreements because these are of a universal character, fixing common obligations for all member-states and not limiting the contracting parties with enumeration of forbidden actions. It is on the basis of such conventions, such as the Convention on Protection and Use of Transboundary Waterways and International Lakes (1992) and the Convention on the Right of Non-Navigational Uses of International Watercourses (1997) that regulation of interstate relations should be developed in the field of common use of water resources in the region. These norms of interstate law establish common principles of a state's behavior in the use of cross-border waters and are of great significance in maintaining equal legitimate rights of the water user states.

As mentioned above, the Republic of Kazakhstan is the only country among the Central Asian countries that has acceded to the Convention on Protection and Use of Transboundary Waterways.

Other Central Asian states' recognition of this Convention will represent an important stage in the system of interstate relations regulating the common use of water resources. In future, this will allow development of a uniform approach to the subjects of international law or to the participants of contractual processes of the Central Asian countries. Unfortunately, this form of interstate relations in the use of common water resources has not yet been properly developed for regional cooperation in Central Asia.

The fact that other Central Asian states have not yet acceded to the Convention on Protection and Use of Transboundary Waterways and International Lakes should not be reflected in the character of interstate relations in the field of water resources and in multilateral (or bilateral) intergovernmental agreements on the common use of water resources. But it would be legally justified if all parties were guided by common norms of international law in relation to the common use and protection of water resources.

In the Nukus declarations of September 20, 1995, the heads of the Central Asian states declared their support for the Convention on Transboundary Waters and underlined the necessity to create an International Convention on Sustainable Development of the Aral Sea Basin. There were also a number of other statements and declarations by the heads of the Central Asian states regarding issues of common use of water resources and these should be considered in terms of substantiation of political aims and objectives in interstate cooperation. It would be useful to shed the light on the positive activity of the International Fund of Aral Salvation and its structural divisions - specifically the Interstate Commission on Water Coordination and the Syrdarya and Amudarya BVOs. Such an approach is indeed relevant, not only due to the possibility of providing a legal solution to the issue of the status of cross-border waters and to unify the norms and terminology used in multilateral contracts and agreements, but also the fact that this would allow the creation of a legal basis for institutional provision of observance and execution of the agreements signed. At the same time, the interstate institutions should be given specific control or advisory functions.

Guided by the principles of international conventions in the field of cross-border waters and taking into consideration the specific economic and social features of the countries of the Aral Sea basin, the regional institutions could support the governments in solving hydro-economic and environmental problems of common water use. Rational use of water resources and improvement of their quality, as well as improvement of water resources and environmental management should be seen as top priorities. Appropriate regional and national programs should be developed to achieve these aims. Actions by the governments in terms of legislation, scientific progress, integration of economic and social policies, involvement of the community, and international cooperation are among the prerequisites for their fulfillment.

Adopted by the Heads of the Central Asian states in Nukus in 1994, the Program of Specific Actions in the Aral Sea Basin (ASBP) had been in the design stage for 3-5 years and was completed by the year 2000. In this regard, the International Convention on Sustainable Development of the Aral Sea Basin should be adopted and a new Program of Actions should be developed, which would identify the priorities of regional development from 2000 onward. All these issues should be clearly substantiated in order to delimit objectives and tasks at regional and national levels, to establish authorities and responsibilities in making and implementing decisions, and the functions necessary for the management and protection of water resources.

At the same time, the need to elaborate issues of strengthening interaction potential should be noted. A decision of the heads of states of July 24, 1997, adopted in the town of Cholpon-Ata, stipulated the creation of international consortiums on energy, water resources, foodstuffs, communications, production and processing of minerals. This decision, however, has not been implemented. At the same time, it is becoming obvious that there is a need for an adequate legal basis and an effective administrative system of water resources management, which should ensure the required degree of interstate integration and regional cooperation.

The economic reforms carried out in the Central Asian countries have their particular characteristics and their own pace. In Kazakhstan, privatization of agriculture has been fully completed, generating electric power sources have been rented out on a long-term basis, preparations are underway for privatization of electricity distribution networks, and the water industry and water resources are managed by departments, at an administrative level lower than elsewhere in the region. All these factors undoubtedly influence the character of regional cooperation and should be assessed in order to determine strategic directions for strengthening the legal, administrative and economic bases of water resource management and environmental protection on a regional basis.

At the same time, when elaborating issues of regional cooperation, it should be remembered that virtually all international conventions and agreements on the use of water resources acknowledge the following:

- water resources are common property and the basis for future development - their volumes are very limited;
- water resources exist irrespective of borders;
- the principal purpose of water resource management is the common welfare of peoples and states;
- the priority of common basin interests over individual interests, including individual states using water resources;
- observance of the principle of fair and reasonable use of water resources and the rule of ‘no damage’. This is the basic provision of international waterways law and countries must use international waterways in ways that are fair and reasonable, with respect to other states involved in the use of the waterways.

By design, the UN conventions are preventive and include a number of mechanisms for prevention of conflicts: obligations of the Parties to cooperate; consultation mechanisms; trans-border notification; information and technology interchange; informing and involving the community; bilateral and multilateral cooperation; mutual assistance; joint assessment and monitoring; bilateral and multilateral agreements. All the listed provisions of conventions should provide the basis for regulation of water relations and development of a legal mechanism of cooperation in this field.

CHAPTER 5. GUIDELINES AND STRATEGIES FOR SUSTAINABLE AND SAFE WATER CONSUMPTION

5.1. Integrated Water Resources Management

The economic and social development of Kazakhstan is largely determined by the sustainability of the water sector and its institutional and legal framework. In 2003 Kazakhstan adopted a new Water Code to replace the Water Code of 1993. Kazakhstan's water sector offers significant potential, which, coupled with its institutional framework, can ensure sustainable operation of the water industry provided there is sufficient legal, financial, research, technical and staff support. At the same time, a multistage hierarchy and duplication of duties and responsibilities within government agencies leads to poor coordination and limited cooperation within the water sector. Authority is delegated to different water agencies in such a way that they are often duplicated or supplementary, which affects the accountability of each department for water-related decision-making, while certain actions are either delayed or not taken at all. Departmental interests do not foster the choice of the most effective decision and collaborative problem-solving and restrain information sharing while causing interdepartmental tension. All this greatly reduces the research and technological potential of the water sector. Highly-qualified professionals and experts are scattered between different agencies. There is no body for interdepartmental water coordination, while governmental structures for water management are not sustainable enough. The fact that state-run public authorities are frequently reorganised, sometimes apparently without genuine need, followed by their abolishment and later re-establishment hinders the development of an institutionally sustainable framework in the water sector and makes it difficult to pursue water-related legal reforms. The Water Code is the only legislative document governing the water sector and the use and protection of water. Unfortunately, the Water Code is not a law of direct action. It is complimented with multiple bylaws, regulations and normative documents, all of which, in their turn, are complimented with plural rules, specifications, guidelines and requirements set by various agencies. Legal documents governing other sectors also deal with water-related issues. Collectively, these factors hamper legal regulation of water relations and cooperation between governmental bodies and civil society involved in the water sector.

Kazakhstan still uses the old set of environmental specifications, covering a great many water pollutants with recklessly low indicators (concentrations). At the same time, the set requirements are not effectively achieved and neither is the higher quality of the aquatic environment. Strategies for control and regulation of water resource quality should use a systemic approach to developing specifications of quality of the aquatic environment. They should also include the development of new and adjustment of existing normative requirements to new social, economic and environmental conditions, with extensive public involvement.

The legal framework for environmental specifications is a set of ad hoc bylaws, often with inconsistent implementation conditions, discrepant requirements and unclear distribution of authority and responsibilities among the environmental departments of various agencies. Legislative and normative instruments often cause double interpretation of norms, resulting in unreasonable actions taken by environmental agencies and legal 'nihilism' on the part of water users.

The lack of an integrated institutional approach to developing environmental specifications and uncoordinated development methodologies that environmental agencies use prevents the creation of comprehensive specifications for water quality. Control and standardisation in the water sector still lacks a systemic approach to ensuring environmental sustainability and security of the whole river basin. Environmental specifications and norms developed by various agencies without agreeing them with each other are not regulatory documents of direct action and this affects the effectiveness of environmental activities. Many regulatory requirements are not supplemented by standing orders about responsibilities of water users for their observance and environmental agencies for ensuring timely information distribution about introducing new or changing existing norms.

The terms of reference for monitoring the quality of the aquatic environment are limited and do not include all pollutants accessible for supervision. In rural areas there is a steady trend towards decentralised water supply using ground water. However, there is no control of the quality of such water. Fines for polluting the aquatic environment have ceased to be an effective economic tool for assuring water quality and do not encourage reduced discharge of pollutants into water sources.

Interdepartmental exchange of information on quantitative and qualitative water indicators is very difficult, with respective databases designed only for departmental use. Public access to information on water source quality is very limited. There is still no common informational or legal framework for all aspects of water use and water quality control. Such a framework should ensure methodological identity and consistency of development of departmental regulatory requirements and timely access of water users to normative and legal information.

The effectiveness of water reforms is contingent on the legal and normative framework of the water sector that will agree with the nature of economic and social change pursued in Kazakhstan. In this regard, it is important to develop guidelines for each stage of reform that will contribute to the legal regulation of water sector diversification. These can include strengthened management capacity of the water sector through better skills of staff in economics and management and easy access to scientific and technological information.

It should be emphasised that there should be a strict division of authority and responsibilities between executive bodies and limits should be set for delegating authority by agency to a different level of control. Lawmaking should strictly adhere to the principle of balance and equality of all legal entities. Legislative and normative acts should ensure maximum economic effect from the use and protection of water resources in different sectors and reduced risks to the health and security of the population and the environment. The indicators, criteria and indices set out in these documents should be realistic, achievable and controllable.

It is essential to make lawmaking open and transparent and encourage public involvement in the development of normative and legal documents. Legislation and normative requirements should use clear and understandable language.

The choice of the most effective solutions to water problems of the new century determines the need to use consolidated principles of water management that ensure development, use and protection of water resources within the framework of fair and equal access to water, maintenance of environmental sustainability and the security of water ecosystems. Integrated water management should be considered as a rational approach to improving water use and protection systems, thus promoting sustainable development. Nearly all rivers of Kazakhstan are transboundary. When assessing the status of water resources, it should be noted that river basins are located both within Kazakhstan and some neighboring countries. These natural and geopolitical factors predetermine the need for regional integration and joint management of river basins to be based on international law. Such cooperation should deal not just with distribution of river water resources and their quality control but also ensuring security of hydro-technical facilities based on long-haul transboundary rivers. Such rivers as the Syrdaria, Irtysh and others flow through sharply contrasting natural and climatic zones and, therefore, form their waters – primarily flood waters – differently. They also differ in the conditions under which this water flows through different river stretches. Given that there is a great number of water reservoirs, as a rule, impounding reservoirs, on the rivers' safe floodway can only be ensured when all reservoirs operate in a concerted way. This is most applicable to spring and especially the winter period.

Integrated water management is a way to achieve such strategic goals as effective use of deficit water resources, fair water distribution and enhanced sustainability of water ecosystems.

Integrated management of water resources is a process which promotes coherent development and management of water, land and other resources in order to ensure maximum social and economic benefits on a fair basis without damaging the sustainability of vitally important ecosystems. Thus, an integrated water management plan can be considered as a plan for the development and management of water resources, to include such components as favorable legal conditions, organizational, environment and management tools.

Plans for integrated management of water resources and effective water use are seen as a starting point for sustainable development. Until quite recently, water-related planning included development of various schemes for comprehensive water use and protection, such as general, basin and territorial schemes that have played a positive role in the long-term development and protection of water resources. Plans for integrated management of water resources can be used to agree socio-economic and environmental requirements to water with required water services and infrastructure, ensuring sustainability and security of water ecosystems. These plans take into account a wider range of social factors.

Integrated management of water resources involves the creation of adequate political, legal and financial conditions to solve problems of priority water supply; establishment of functional and effective organizational structures; the availability of economic and social tools to regulate development of water resources and water conservation; fair water distribution and conflict resolution; access to information and information sharing at state and community levels; civil society involvement and partnership in setting up rational water use systems, and maintaining the sustainability of water ecosystems.

The introduction of the integrated water resource management system should be based mainly on institutional reform. At the moment the topical issue is the preservation of the ecological sustainability of water basins.

From the experiences of countries where the ecological sustainability of water basins has been restored over a relatively short period, the principal strategy of water quality protection, and consequently the preservation of river systems, should aim to let no more discharges of even purified waste water into ponds and channels. The technological aspects of introducing systems of water rotation and repeated natural water consumption, which could be suitable both for individual enterprises and large industrial complexes, have been thoroughly developed. The essence of this issue is that the water purification and circulation system should be considered as the principal technological component. Keeping the self-purification ability of rivers contributes to dealing with the qualitative and quantitative aspects of water supply.

It should be emphasized that regional efficiency of natural resource protection and effective consumption to a large extent depends on improving the legal regulations governing water relations, as well as strict observance and unification of water laws. This is the basis of reaching favorable conditions for the water environment and providing efficient use of water resources. It is crucial to move beyond the engineering and technological approach to the consumption of natural water resources. Economic development interests must be secured not by exhausting available water resources but by their efficient use, thereby providing environmental protection of the river basins.

The most urgent strategic objective is to take measures to provide the population with high-quality potable water. It is vital to apply various scientific and technical solutions to make it possible to provide the population with potable water as soon as possible. These include improving the condition of water facilities and sources and upgrading potable water treatment technologies.

The water-management balances showing the ratio between the water resources available and prospective water consumption prove that there will be an ever-growing demand for water resources. There are two approaches to solving the water supply issue: to increase the water resources available, on the one hand, and introducing more economic and efficient consumption of water resources on the other. Increasing the available water resources includes further control of river flow and extensive use of underground water to provide the population with water.

Efficient use of water resources includes slowing down the development rates of water consuming enterprises in water deficit regions, actions to reduce water demand in industry and agriculture, as well as the protection of water resources from pollution and exhaustion.

It is advisable to reconsider the agricultural approach in assessing the feasibility of farming in irrigated areas: it is vital to gather the maximum yield not only per hectare of irrigated land but also per cubic meter of water. In the agricultural sector, water can be saved mainly by replacing non-engineering irrigating systems, which constitute the majority of existing systems, with up-to-date units. This will allow the sector to reduce considerably filtration losses between the water source and the irrigated field. It is also necessary to improve irrigation equipment and technologies and to adopt new water consumption skills and techniques on the basis of automated machinery. An essential water saving element is the strict control of water use for agricultural needs.

Water resource protection is one of the most complicated issues in water management. The main reason for surface water pollution is the discharge of untreated industrial and municipal waste water.

To preserve and restore the purity of surface reserves the following actions should be taken:

- Improvement and modification of industrial and agricultural technology; development and introduction of less water consuming or waterless technology in order to reduce water consumption.
- Overall treatment of industrial and municipal wastewater.
- Large-scale introduction of recycling of the water supply; increase of secondary use of treated wastewater discharged into rivers.
- Development and execution of national plans on water preservation actions in rivers basins and

ponds with a concern for up-to-date and prospective arrangement of enterprises. And also with consideration of these actions as part of a specific plan of action to provide management of the water resources of those basins.
- Strengthening of intergovernmental cooperation to provide efficient management of cross-border waters of contiguous river basins, plus cooperation with international organizations in the field of food, irrigation, water resources (FÀÎ, ICID etc.) to obtain new technologies and share experience.
- Creation of conditions for the sustainable operation of water management bodies.
- Development of laws and norms regulating the efficient use and protection of water resources; establishment of national control of observance of water laws.

The scope of the actions on water protection proves the need to implement a number of organizational measures on strengthening water management and water protection agencies.

Water protection agencies are basin-based water management offices, which have to plan the actions required, manage the subsequent systems and control the water quality. Improving the economic mechanism of water use should become an essential economic tool in water resource management. To accomplish these nationwide strategic objectives, a specific plan of action is based on municipal and private levels of water management. The plan includes the following actions:

- To stop the discharge of untreated industrial and utilities wastewater by industrial enterprises and agricultural facilities by constructing new treatment plants and upgrading and modifying existing ones.
- To reduce pollution of water ponds depending on their status, to meet sanitation and fishery requirements and to make a strict inventory of water ponds suitable for potable water supply; reproduction and preservation of valuable species of fish and other resources.
- Protection of residential areas, industrial zones and agricultural farms from waterlogging.
- Fortification of water ponds and coasts, establishment of recreational areas, construction of new systems protecting adjoining areas from flooding and waterlogging, plus reconstruction of existing systems.

In view of the above it can be concluded that:

1. The limited nature of water resources is a key hindrance to sustainable development and environmental protection. Development of the available reserves of crude oil, gas, coal, ferrous and non-ferrous metals and agricultural lands requires more efficient measures to improve water supply in regions with poor water resource potential.
2. After the collapse of the USSR, the geopolitical situation changed. The new neighboring countries which emerged provided a major portion of the country's surface water resources. In some of these countries population and industry are growing rapidly and this is contributing to increased exploitation and pollution of cross-border waters. Acknowledging the ever-growing water deficit in cross-border river basins and water quality deterioration, it is vital to develop political and legal measures to govern water relations in order to protect the interests of all parties and maintain an environmentally safe regime in the rivers.
3. The country's economy is currently undergoing structural reform: land ownership and the means of production are changing, often resulting in a changing balance of water consumption and subsequently in re-distribution of investment among the economy's sectors.

With these factors in mind, a strategic objective of national water resource policy is to create long-term and complex measures to eliminate the negative effects of water scarcity and to create a foundation for economic growth, as well as solutions to social and environmental issues and regulation of intergovernmental water relations. This must be seem in the context that water is an economically valuable resource that determines the sustainability of a country's development, and that issues of water quality - both of internal and cross-border rivers - cannot be discussed in isolation from those of water quantity.

Thus, the basic principles of water management policy are: a basin-based approach to water resource management; reducing water pollution and the volume of water taken from natural water sources; economic regulation of water use based on a balanced tariff system.

Cutting the volume of water taken from natural water sources should be considered the most crucial aspect of preserving and restoring the environmental safety of rivers. This will create a significant ‘multiplier effect’ in all sectors of the economy associated with water use. Lower volumes of water consumption will reduce costs of construction and maintenance of water facilities, reduce discharges of wastewater and mitigate environmental impact. It is important that under such conditions a water source will keep its functional status as an essential environmental component. Regardless of the levels and objectives of the water management policy, it must be targeted at the economic use of water as a result of reduction of the demand or prevention of negative environmental impacts.

It is also important to involve the population in coming up with the decisions on water management actions; to establish relations between water consumers and the administration; to set up and develop water users’ associations as a tool of executing the water management policy at the social and private levels of water resource management.

In order to meet the water needs in the future, along with efficient and economic use of water resources, it is necessary to expand cooperation between the countries with common cross-border water resources, the countries should join the Convention on protection and use of cross-border waterways and international lakes, develop the national actions to observe the guidelines of the Code of conduct in case of emergency pollution of cross-border internal waters and other international documents regulating the legal regime of cross-border rivers and pollution prevention. Undoubtedly, an essential role should be given to cooperation with international environmental organizations.

5.2. National Policy for Sustainable Water Use and Its Principal Provisions

The main objective of the water management policy is to secure and accomplish the long-termed goal declared by the Government in the *Strategy 2030*: perseverance and efficient use of water resources for the health and prosperity of the Republic’s citizens.

The following are the top priorities needed to accomplish this goal:

- Efficient and solicitous use and protection of water resources;
- To provide the population with potable water of the guaranteed quality; and
- To meet the future development needs of the economy’s sectors, specific regions and complexes.

Within the framework of future development of the Strategy, the Government of Kazakhstan approved *the Concept for Development of the Economy’s Water Sector and Water Management Policy of the Republic of Kazakhstan until 2010*. The Concept takes into account the latest requirements of Environmental Law and international agreements and conventions on use and protection of cross-border water resources. The Document has provisions reflecting the up-to-date views on reaching and maintaining the economically efficient and safe level of water use, and it also assesses development trends and sets up the priorities.

The main tasks on executing the national water policy listed in the Concept includes development and implementation of the following program:

- Efficient use and protection of water resources in the basins of big rivers;
- Water saving, management of the level and saline regimes of the internal and marginal ponds (Balkhash, Aral, Caspian Sea); and
- Introduction of water saving technologies; circulation and closed water use systems in the industry and agriculture, reduction of water losses in the field of water use, provision of water management bodies with up-to-date water metering and regulation equipment.

In order to improve the national water management, it is suggested to reform the structure of the economy’s water sector and to differentiate the sector’s functions and the functions of national management and control.

The Government of Kazakhstan approved the Sectoral Program *Potable Water* to provide the population with potable water of the guaranteed quality and of the required amount on a permanent basis. The Program will cover 3.7 thousand rural areas, where about 4.0 million people live, and over 3 million urban dwellerss. The positive changes in potable water supply will create satisfactory social and sanitation conditions, which will favorably affect the health of the population.

Keeping in mind that the country is suffering a lack of water resources, the only solution to provide the population and the industry with water is efficient use and protection of water. Given that practically half of the surface water resources of the Republic of Kazakhstan are cross-border ones, an integral part of the national water policy is the interrelations with the neighboring countries on the use of water resources, based on the fair and reasonable use of the latter by solving any disputes on the basis of mutual trust and benefit.

To accomplish the said objectives, the water management policy must be based on the following:

- A water basin must be considered as the whole ecosystem, water resource management and protection of surface water shall be based on the basin principle.
- Water supply systems must be based on the contemporary water treatment technologies, complex use of water resources and reduce water losses during transportation.
- The ground for sustainable development of the water sector should become involvement of water consumers in compensating the costs for operation and maintenance of water management facilities.
- Priority of the potable water supply and environmental discharges over industrial and agricultural water use.

Common Tasks Associated with Implementation of the National Water Policy and Strategy:

In the field of efficient use of water resources and water supply

- Development of the National Program of efficient use and protection of water resources in the basins of big rivers;
- Development of an economic mechanism on efficient use and protection of water resources by adjustment and differentiation of the fee for water resource use;
- Creation of the conditions to introduce economic mechanisms;
- Improve current normative legal acts in the field of efficient use and protection of water resources;
- Creation of a unified information system of water use monitoring to assess and analyze use of water resources; and
- Formation of a social opinion on the necessity of careful use and protection of water resources.

In the field of perseverance and maintenance of a healthy environment

- Protection of water ecosystems in the major water basins through the creation and maintenance of water protection zones;
- Formation of economic conditions for efficient use;
- Prevention of discharges of untreated wastewater in water sources through the introduction of new technologies in the secondary and recycling water supply systems during construction and reconstruction of the wastewater treatment facilities; and
- Development of the Chart of complex use of river basins' water resources and validation of the scope of environmental and complex discharges in the river basins.

In the field of national management of the economies water sector

- Reforming (decentralization and restructuring) and improving the structure of water resource management, as well as a two-stage differentiation of management and the sectoral functions.

5.3. Strategy of Regional Environmental Safety Based on Sustainable Water Use

Regional water policy is the readiness of each country to execute a national plan of action on the basis of unified environmental criteria and water use standards. The progress of sustainable water use will be determined by the efficiency of water demand management, including improvement of the current Law, and the introduction of economic mechanisms and requirements for water ecosystems' environmental safety, as well as changes to the economic structure towards water conservation.

Institutional reforms in the water sector should provide well thought-out solutions to social and economic issues and the restoration and maintenance of river basin water resources. In so doing, the government's controlling role shall be a fundamental one, and business activities in industrial, agricultural and other enterprises must also include environmental priorities.

A search for balance between irrigation and hydro-power engineering, and the provision of equal water use conditions for cross-border rivers among the sharing countries are the main objectives for the development of a coordinated policy related to water resource management. Therefore, progress in accomplishing the objective will depend on a gradual adjustment of the national law to meet international legal requirements of water resource management. Development of such a legal base should be based on international practice and should take into account regional realities. It is advisable to strengthen regional cooperation on the basis of international management practices of cross-border rivers. The guidelines and legal requirements of international conventions and agreements should contribute to making positive achievements in settling unresolved cases arising from joint water use.

International practice indicates that commonality of legal positions, mutual observance and respect of interest are the best grounds for regional stability, solution of joint management issues and the prevention of pollution of cross-border rivers, making it possible to resolve issues of regional security. Development of a legal mechanism taking into consideration international practices associated with joint water management is a basis for solving numerous disputes in water resource use in Central Asia. Sustainable economic development of the region depends on efficient intergovernmental relations and cooperation, which requires improvement of the legal base governing water relations.

On the basis of this understanding, intergovernmental use of water resources in Central Asia should be based primarily on common international conventions and framework agreements. These agreements should be developed in the form of basic regional water management actions aiming to improve the condition of water sources and the environment by conducting inexpensive organizational, administrative, technical and other preventive measures.

Technical Note:

Water Pollution Indices (WPI)

Water Quality Category	Quality Characteristic	Hydro-chemical Indicator (IPW)	Biotic Indicator	Hydrobiological Indicators			Water Use Practices	
				Phyto-plankton, zooplankton	Bacteriaplankton		For Drinking and Economic Use	For Domestic Use
					Total number of bacteria ,000 colonies/ milliliter	Total number of saprophytes ,000 colonies/ milliliter		
I	Very clean	0.0-0.3	III	Up to 1.W	Up to 0.5	Up to 0.5	Suitable	Suitable
II	Clean	0.3-1.0	7-9	1.00-1.50	0.5-1.0	0.5-5.0	Suitable	Suitable
III	Moderately Polluted	1.01-2.5	5-6	1.51-2.50	1.1-3.0	5.1-10.0	Suitable with treatment	Suitable
IV	Polluted	2.6-4.0	4	2.51-3.50	3.1-5.0	10.1-50.0	Not suitable	Not suitable
V	Very Polluted	4.1-6.0	2-3	3.51-4.0	5.1-10.0	50.1-100.0	Not suitable	Not suitable
VI	Highly Polluted	6.1-10.0	0-1	Over 4.0	Over 10.0	Over 100.0	Not suitable	Not suitable
VII	Extremely Polluted	Over 10.0					Not suitable	Not suitable

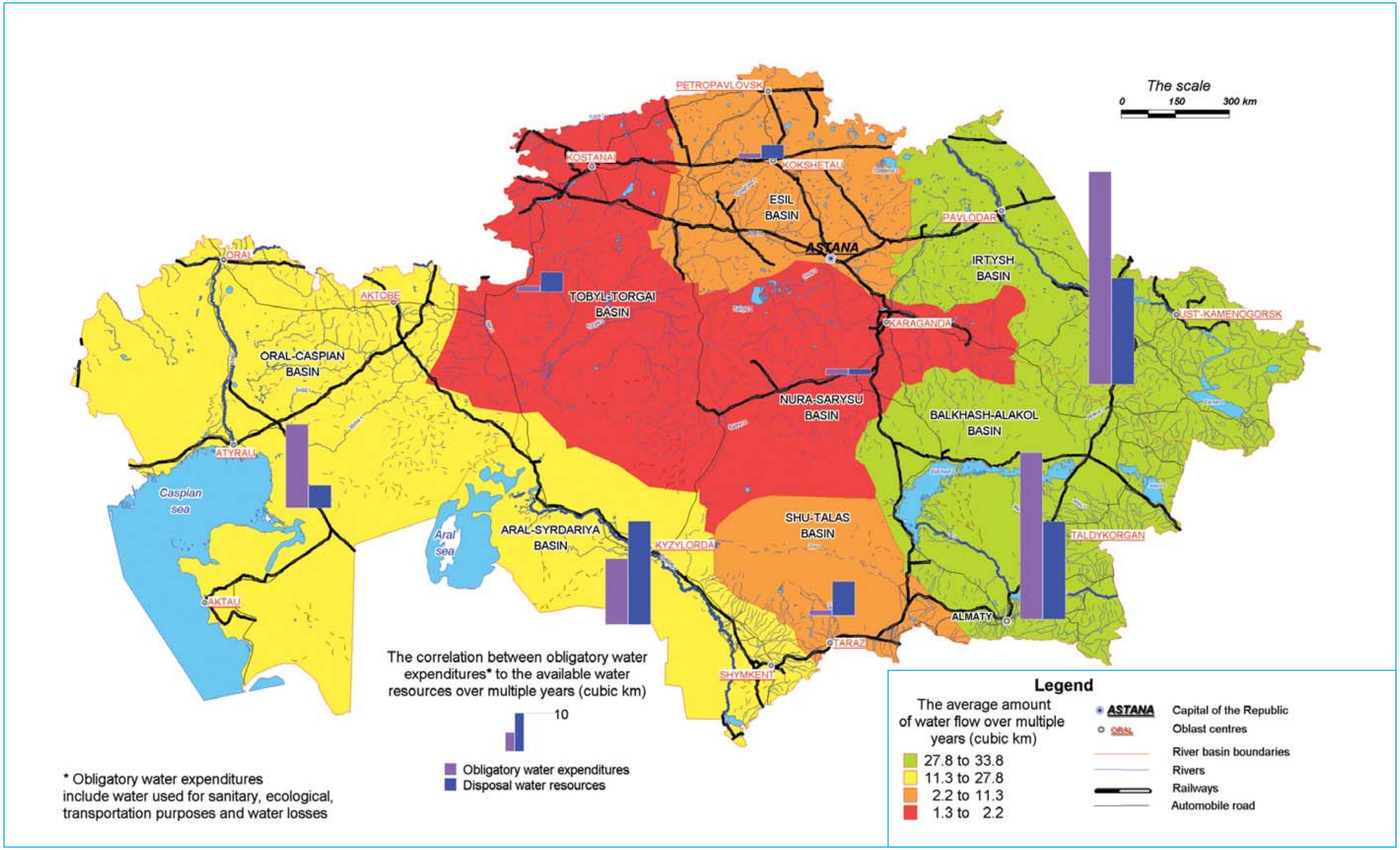
Note: Sanitary and biological test considers the followings:

1. Bacteria plankton: total number of bacteria, quantity of saprophytes, ratio of these two indicators as well as quantity of oil and phenol oxidizing bacteria;
2. Phytoplankton and zooplankton: species size, data on mass species and flag species, total number and biomass of organisms, index of saprophytes capacity
3. Periphyton: data on mass and flag species, species diversity in main groups, index of saprophytes capacity;
4. Macrozoobenthos: total number, biomass, species diversity, absolute number of oligohaetes, the biotic index of Woodiviss and its modification across the regions of Central Asia; GOST 17.1.3.07-82 "Nature Conservation. Hydrosphere. Rules for water quality control in water flows and reservoirs".

ANNEXES

Annex 1.

Figure 1.1: Water Resourses of River Basins in the Republic of Kazakhstan



Annex 1.

Table 1.1: Contemporary Hydro-Economic Balance, êì^3

#	Balance item	Mean annual water content	75% - water supply	95% - water supply
	WATER INPUT			
1.	Natural river runoff	100.5	76.1	58.2
2.	Ground water (in use)	1.7	1.7	1.7
3.	Inflow of return waters to rivers	1.9	1.4	1.1
4.	Long-term reservoir drawdown	-	0.4	0.4
5.	Mine, waste, drain and sewage waters not discharged into rivers (in use)	1.1	1.1	1.1
6.	Sea water (in use)	1.8	1.8	1.8
	TOTAL	**107.0**	**82.5**	**64.3**
	WATER OUTPUT			
1.	Water consumption by the economy (from all watersources)	35.5	35.5	31.5
2.	Reservoir water	1.4	1.0	0.5
3.	Release of water into low reaches of river for environmental, fish husbandry and regulating purposes.	28.8	28.8	28.8
4.	Transportation and power release (to Russia)	88	8.8	8.8
5.	Evaporation and seepage loss	12.1	11.0	100
6.	Unmanageable flow during spring floods	4.8	4.0	30
	Total Output	**91.4**	**89.1**	**82.6**
	Water flow overbalance	**15.6**		
	Water flow deficit		**6.6**	**18.3**

Source: Water Resources Committee under the Ministry of Agriculture, 2002

Annex 1.

Table 1.2: ProspectiveHydro-Economic Balance until 2020, km^3

#	Balance item	Mean annual water content	75% - water supply	95% - water supply
	WATER INPUT			
1.	Natural river runoff	95.5	71.1	53.2
2.	Groundwater (approved reserves)	15.1	15.1	15.1
3.	Inflow of return waters into rivers	1.7	1.2	1.0
4.	Long-term reservoir drawdown	-	0.5	0.5
5.	Mine, waste, drain and sewage waters not discharged into rivers (in use)	1.5	1.5	1.5
6.	Sea water (in use)	2.0	2.0	2.0
	TOTAL:	**116.3**	**91.4**	**73.3**
	WATER OUTPUT			
1.	Water consumption by the economy (from all watersources)	43.0	43.0	39.0
2.	Reservoir water	1.5	1.0	0.5
3.	Release of water into low reaches of river for environmental, fish husbandry and regulating purposes .	30.0	30.0	30.0
4.	Transportation and power release (including Russia's contributions)	12.2	12.2	12.2
5.	Evaporation and seepage loss	12.0	11.0	10.0
6.	Unmanageable flow during spring floods.	4.5	4.0	3.0
	TOTAL Output	**103.2**	**101.1**	**94.7**
	Water flow overbalance	**13.1**		
	Water flow deficit		**9.8**	**21.4**

Source: Water Resources Committee under the Ministry of Agriculture, 2002

Annex 2.

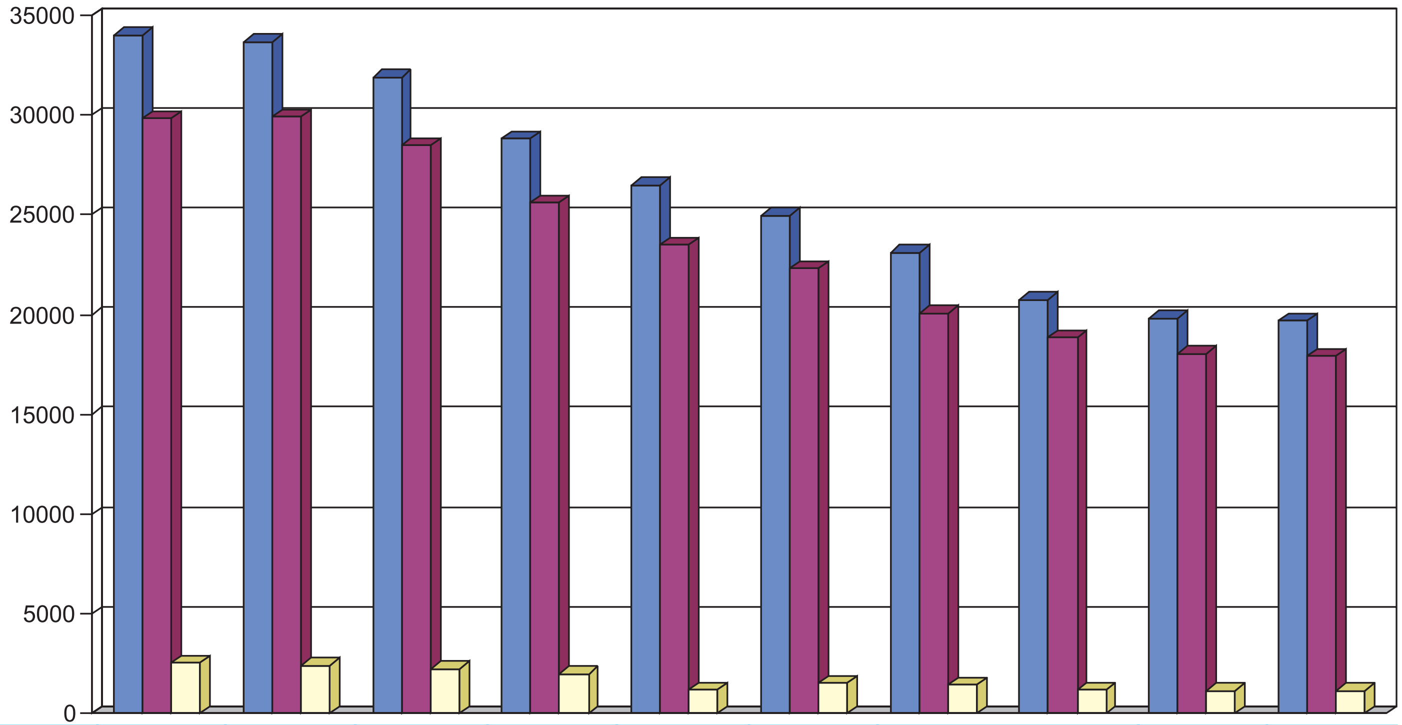
Table 2.1: Main Indicators of Water Use, 1992-2001, in the Republic of Kazakhstan, million m^3

#	Indicator	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1.	Water user 5414	5407	5362	5263	4830	4530	4555	4470	4386	4542	
2.	Water withdrawal, total	34017.65	33673.47	31910.70	28807.10	26482.80	24978.00	23177.20	20748.42	19830.06	19694.66
	of which										
	- surface water	29845.77	29926.15	28483.13	25597.69	23511.45	22320.61	20074.51	18860.64	18040.70	17925.54
	- subsurface water	2576.46	2418.44	2257.93	2013.58	1203.42	1540.98	1443.17	1209.38	1169.49	1157.44
3.	Unaccounted-for water	5404.31	4986.98	6221.11	5521.46	5172.64	5236.32	5149.74	5391.78	945.67	4977.84
4.	Consumed water. total	27477.36	26916.46	24936.46	22239.17	20495.23	18337.60	16004.79	14186.85	14058.77	13945.62
	of which for										
	- domestic and drinking needs	1333.99	1323.25	1331.40	1241.58	1141.39	826.29	736.95	649.88	623.93	602.21
	- industrial needs	4821.47	4531.09	4132.79	4089.51	3211.86	3016.01	2826.58	2675.90	2803.67	2911.74
	- regular irrigation	16821.48	15258.42	14123.0	12115.11	12243.37	10222.48	8927.21	7828.08	7628.52	7599.67
	- estuary irrigation	3218.68	4575.65	4161.98	3679.76	2936.42	3421.04	3001.75	2555.86	2486.84	2336.31
	- agricultural water supply	446.21	421.41	400.92	355.19	298.92	236.80	190.76	179.11	179.02	185.20
	- watering of pastures	380.65	356.13	342.46	327.69	276.49	227.64	99.52	89.35	130.88	114.51
	- pond fish establishments	377.77	356.92	338.46	319.88	242.11	169.72	108.77	122.06	123.84	113.08
	- other needs	77.11	95.26	65.95	72.69	106.91	217.12	123.25	86.61	82.07	82.90
5.	Water disposal, total	8717.68	8344.08	7692.96	7069.67	6118.87	5293.19	4813.95	4029.62	4055.63	4081.40
	of which into										
	à) surface water sources	6934.20	6778.45	6015.91	5780.80	4970.37	4308.06	3800.37	3222.88	3404.08	3325.77
	including – polluted water	312.42	289.97	235.85	229.84	190.65	188.04	178.83	158.08	154.82	155.05
	of which:										
	raw waste water	48.80	62.54	26.49	26.64	27.02	23.90	24.73	26.88	35.11	32.60
	clean water (by norms)	6371.49	6214.79	5531.70	5293.81	4470.18	3854.00	3317.27	2836.68	3036.83	2958.63
	purified water (by norms)	250.29	273.69	268.35	257.13	309.54	265.2	254.27	228.12	212.43	212.09
	b) subsurface waste storage	9.13	6.99	15.01	15.24	11.48	9.20	7.61	2.87	1.56	1.31
	c) collecting lay of the ground	1774.35	1556.29	1642.04	1273.63	1137.02	976.10	925.97	803.87	649.99	754.32
6.	Set limits to water withdrawal	39612.5	37587.90	36718.6	35172.90	3309.10	3246.40	31219.60	28051.70	27055.20	24384.90
	including ground water	2643.80	2630.80	2489.3	2451.60	2249.30	2017.01	1968.50	1622.10	1549.30	15.9.40
7.	Circulating water supply	10813.77	9201.08	7546.51	7906.55	7169.96	6066.22	5348.39	4677.40	4845.20	5162.98
8.	Water recycling	665.59	684.27	505.02	565.04	580.75	484.20	491.99	499.60	622.36	592.72

Source: Water Resources Committee of MoA, 2002

Annex 2.

Figure 2.1. Water Withdrawal in the Republic of Kazakhstan, 1992-2001

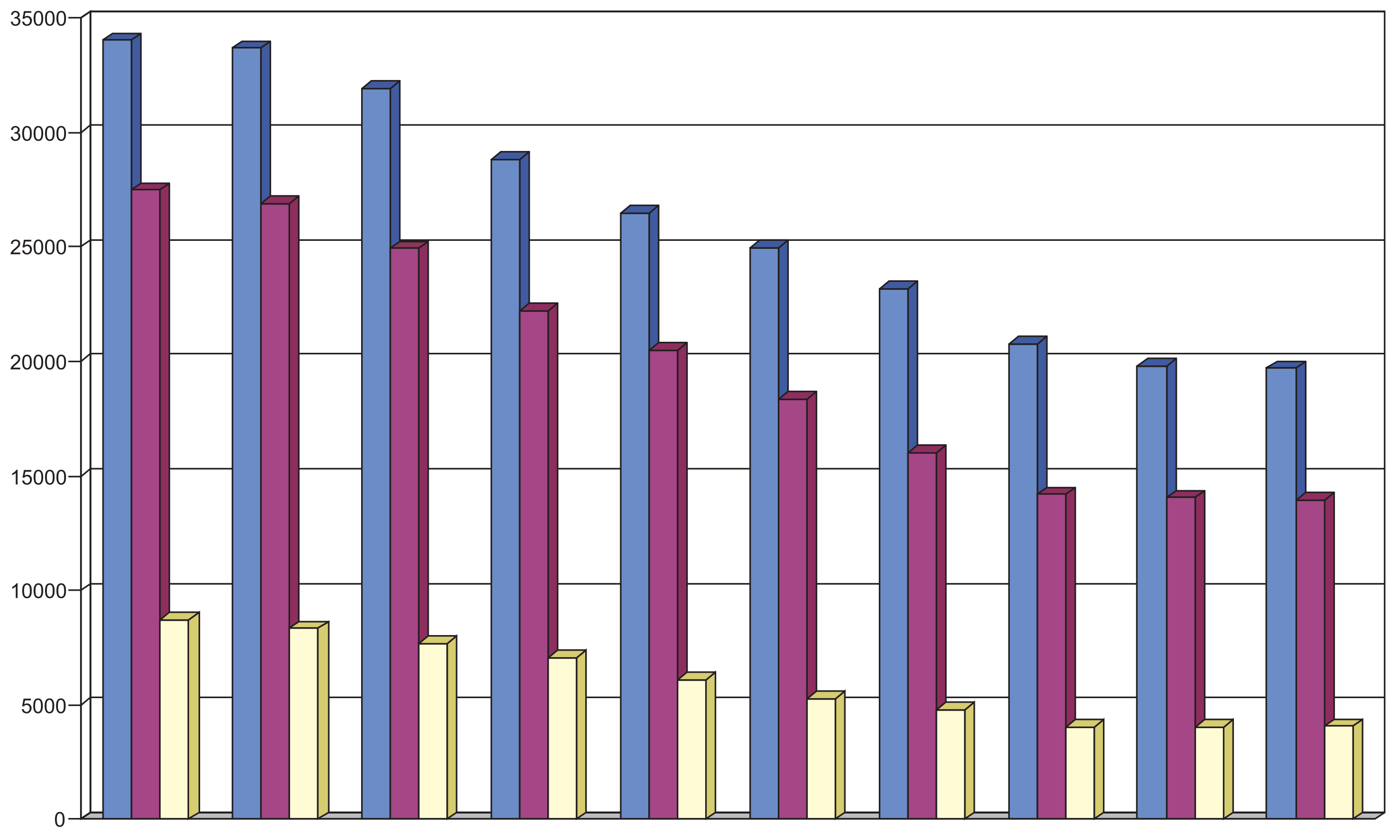


	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Overall withdrawal	34017.65	33673.47	31910.7	28807.1	26483.8	24978	23118	20748.42	19830.06	19694.66
Withdrawal of surface water	29845.77	29926.15	28483.13	25597.69	23511.45	22320.61	20074.51	18860.64	18040.7	17925.54
Withdrawal of ground water	2576.46	2418.44	2257.93	2013.58	1203.42	1540.98	1443.17	1209.38	1169.49	1157.44

Source: WRC, 2002

Annex 2.

Figure 2.2. Water Intake, Use and Allocation, 1992-2001

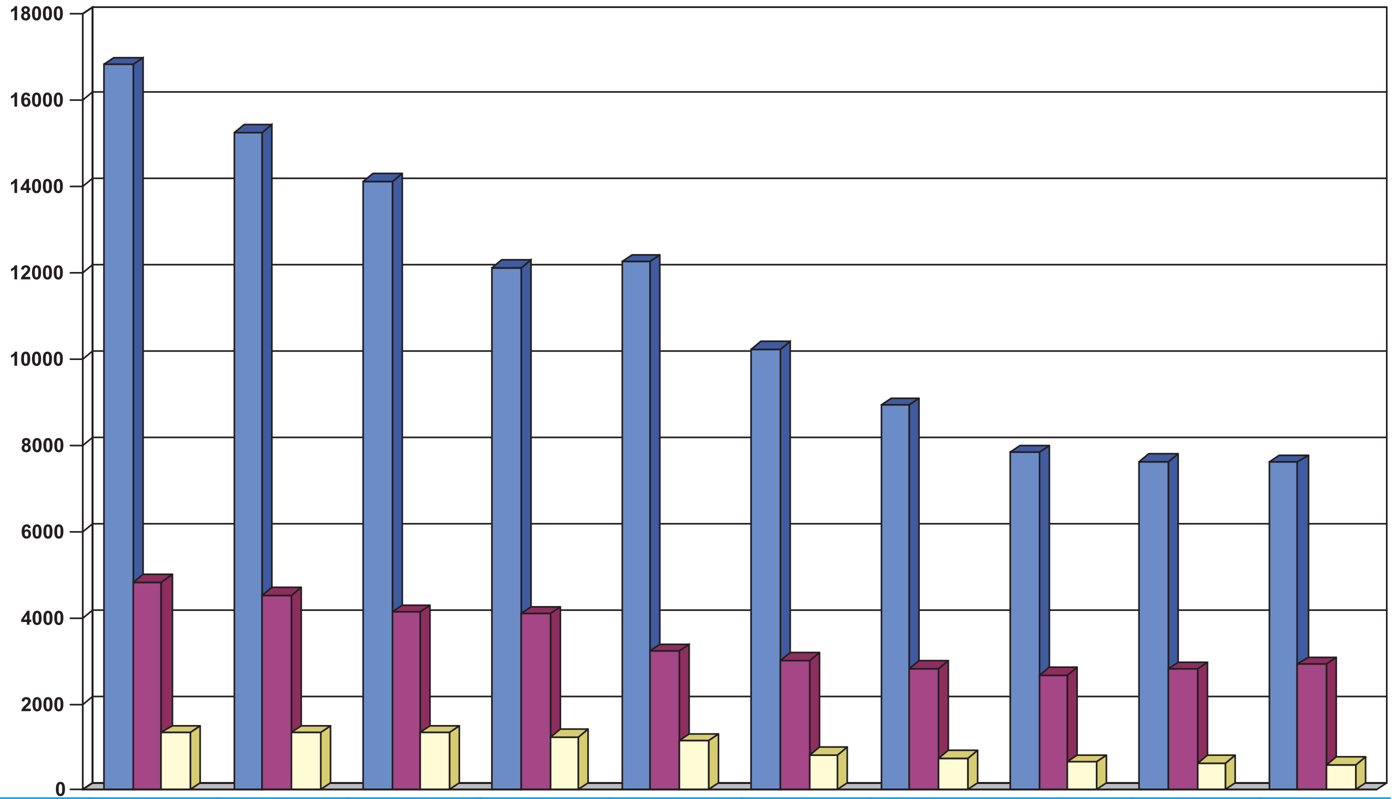


	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Water intake	34017.65	33673.47	31910.7	28807.1	26482.8	24978	23177.2	20748.42	19830.06	19694.66
Used water	27477.36	26916.46	24936.46	22239.17	20495.23	18337.6	16004.79	14186.85	14058.77	13945.62
Allocated water	8717.68	8344.08	7692.96	7069.67	6118.87	5293.19	4813.95	4029.62	4055.63	4081.4

Source:WRC, 2002

Annex 2.

Figure 2.3. Water Use for Irrigation, Industrial and Municipal Needs

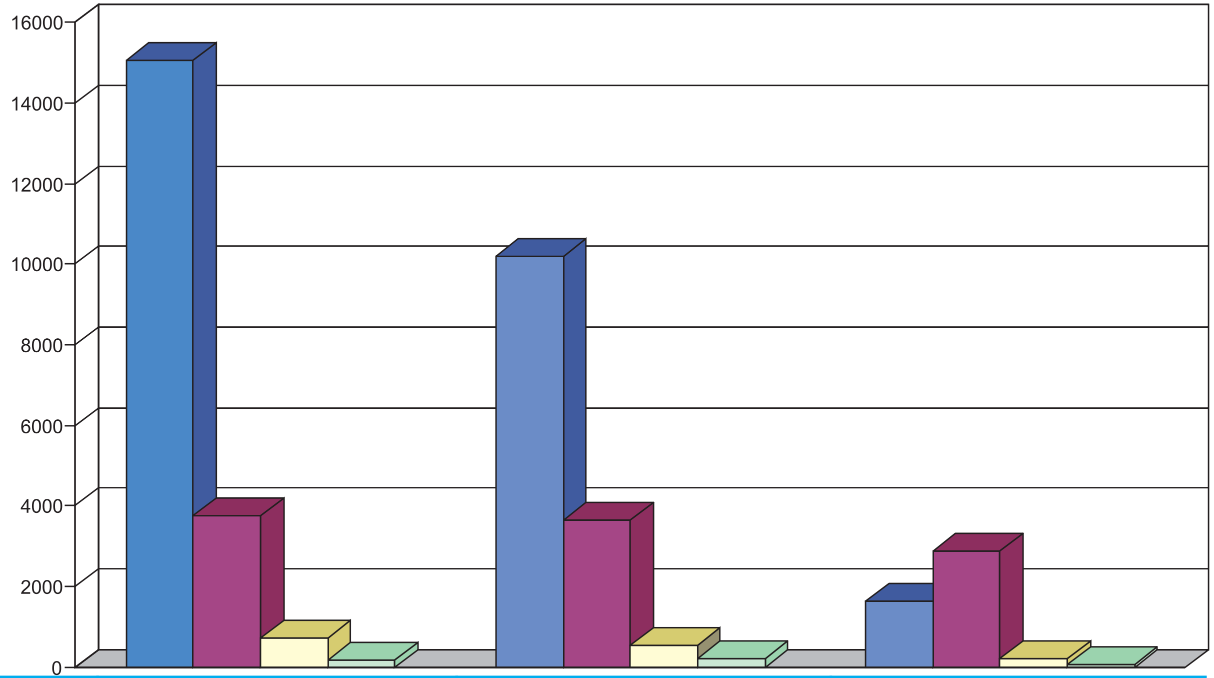


	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
- regular irrigation	16821.48	15258.42	14123	12115.11	12243.37	10222.48	8927.21	7828.08	7628.52	7599.67
- industrial needs	4821.47	4531.09	4132.79	4089.51	3211.86	3016.01	2826.58	2675.9	2803.67	2911.74
- domestic and drinking needs	1333.99	1323.25	1331.4	1241.58	1141.39	826.29	736.95	649.88	623.93	602.21

Source:WRC, 2002

Annex 2.

Figure 2.4. Water Intake, Use and Allocation by Sectors in 2001



	Water intake	Water use	Water allocation
agriculture	15065.29	10209.99	1622.72
industry	3749.13	3645.79	2869
public utilities	705.94	528.84	216.73
other sectors	174.24	191.05	57.79

Source:WRC, 2002

Annex 3.

Table 3.1. Hydro-Economic Balance in Kazakhstan in 2002, km³

#	River basin	Water input											Water-resources output											
		Natural river run-off	Inflows from other basins, areas and states	Inflow of return waters and fallouts	Drawoff	Ground water use	Treated sewage water use	Drainage and sewage water use	Mine water use	Water turnover at the Samarkand, Sherubainurin and Kengir reservoir released by the Aksu State District Power Plant	Water withdrawal from the Caspian Sea	TOTAL	Water withdrawal from surface sources	Withdrawal of hydraulically bound groundwater	Storage water	Gross added surface evaporation	Water release required to fill delta lakes	Mine water drawoff	Water delivery to the Aral and Caspian Sea and outside Kazakhstan	Water turnover at the Samarkand Kengir reservoir, water withdrawal by the Aksu State District Power Plant	Water release into the Arnasai reservoir, water lowering and withdrawal for environmental purposes and flooding of Shu-based grassland	Anabranch	TOTAL	Residual error (+) inflow of > outflow (-) inflow of < outflow
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	19	20	21	22	23	24
1	Ili	25.13	0.00	0.16	0.27	0.21	0.03	0.02				25.82	2.20	0.21	0.01	8.18	14.60					0.35	25.55	0.27
2	Lake Balkhash	5.82		0.14	0.00	0.05	0.04		0.00			6.05	0.97	0.05	0.00	0.01	4.28	0.00				0.75	6.05	0.00
3	Lake Sassykkol and Alakol	4.35				0.01					0.00	4.36	0.14	0.01			3.99					0.22	4.36	0.00
4	Ishim (including Chaglinka)	4.85		0.02		0.02			0.01			4.90	0.12	0.02	0.09	0.55	0.05	0.01	4.06				4.90	0.00
5	Tobol	1.28	0.00		0.04	0.02			0.06			1.40	0.07	0.02	0.20	0.13	0.00	0.06	0.93				1.40	0.00
6	Turgai	1.17				0.00						1.17	0.01	0.00	0.00	0.00	0.92		0.24				1.17	0.00
7	Shu	0.33	4.20		0.02	0.01						4.56	1.44	0.01		0.12	0.70				2.30		4.56	0.00
8	Talas	0.09	1.13			0.04						1.26	0.40	0.04		0.06	0.76						1.26	0.00
9	Asa	0.33	0.14			0.01			0.00			0.48	0.21	0.01	0.04	0.04	0.18						0.48	0.00
10	Syrdaria *	5.35	21.90	0.70		0.23	0.02	0.00	0.02			28.22	8.61	0.23	0.17	4.49	3.03	0.09	10.37		1.23		28.22	0.00
11	Northen side of Karatau mountains	0.16			0.00	0.01						0.16	0.02	0.01		0.13						0.00	0.16	0.00

1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16	17	18	19	20	21	22	23	24
12	Nura	1.79	0.00	0.46	0.00	0.00	0.11		0.00			2.36	0.98	0.00	0.06	0.06	0.90	0.00		0.36			2.36	0.01
13	Sarysu	0.91		0.10	0.02	0.00	0.02		0.00	0.00		1.05	0.14	0.00	0.21	0.05		0.00		0.00		0.65	1.05	0.00
14	Ural	2.76	10.02	0.01	0.01	0.09	0.03					12.92	0.68	0.09	0.06	0.17	0.39		10.19		0.39		11.96	0.95
15	Caspian Sea	0.02				0.05	0.03		0.03		0.64	0.77	0.67	0.05		0.00	0.02	0.03					0.77	0.00
16	Volga (including Bolshoi and Maliy Uzen)	0.00	0.26	0.00		0.00						0.26	0.13	0.00		0.00	0.10				0.03		0.26	0.00
17	Uil. Emba, Sagiz and rivers flowing within the Aral region	1.37				0.03			0,01			1.40	0.08	0.03		0.03	1.26	0.01					1.40	0.00
18	Irtysh	28.53	8.92	0.28	0.14	0.18			0.00	1.07		39.12	1.59	0.18	0.10	7.64		0.04	28.50	1.07			39.12	0.00
19	Iirtysh-Ishim interfluve	0.63			0.03	0.01						0.67	0.02	0.01	0.00	0.05	0.59					0.00	0.67	0.00
	TOTAL national	84.87	46.56	1.87	0.52	0.96	0.28	0.02	0.14	1.07	0.64	136.93	18.47	0.97	0.93	21.70	31.77	0.24	54.29	1.43	3.94	1.97	135.71	1.22

Source: WRC, 2002

Annex 3

Table 3.2. Water Use and Payment Rates in 2002

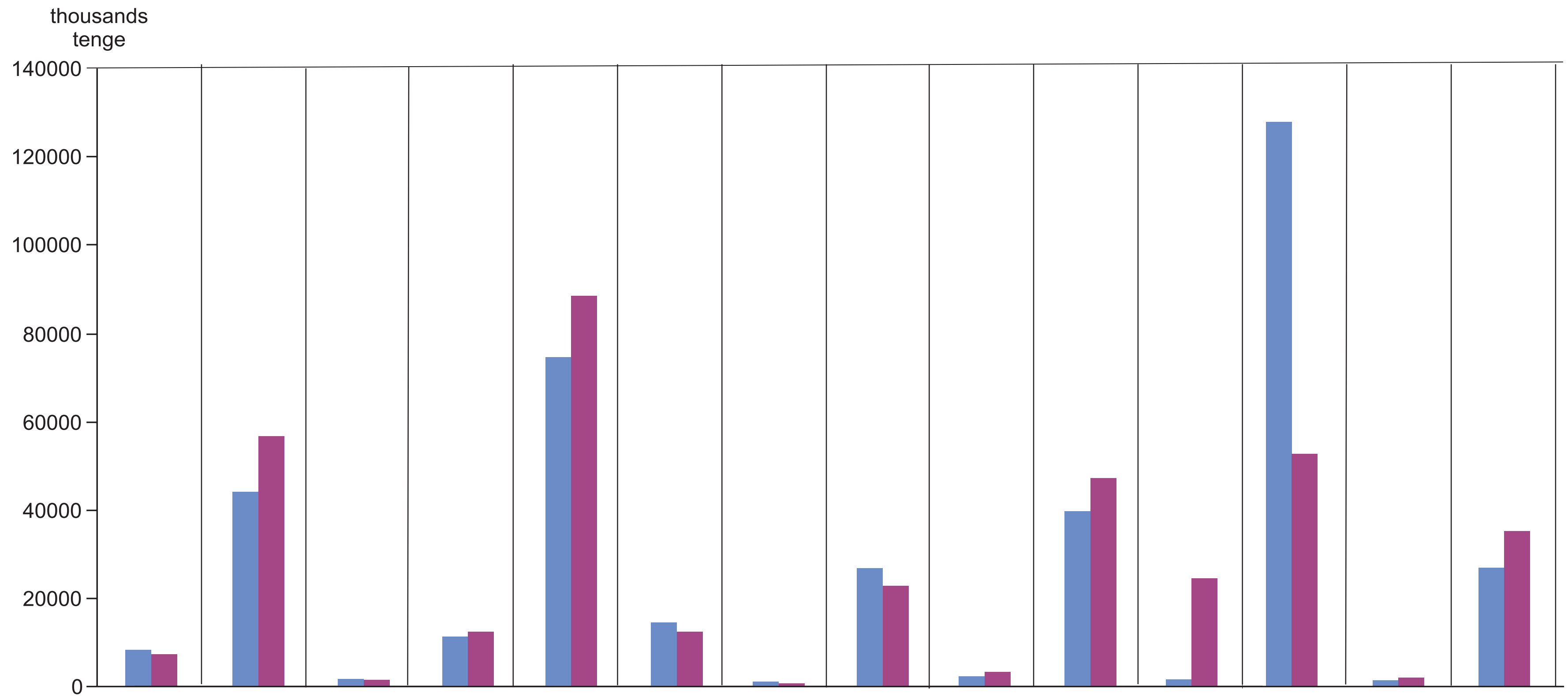
.

1	Oblast	Volume of Water Consumed, m3			Payments Received for Water Use, thousands Tenge		
		plan	actual	%	plan	actual	%
1	Akmola	142.1	137.6	97	7572	5179	68
2	Almaty	2283.49	1089.38	48	84859.28	52824	62
3	Aktobe	42.3	31.85	75	771	960	125
4	Atyrau	126	75.4	60	7385	9580	130
5	East Kazakhstan	206.5	179.25	87	78954	87127	110
6	Zhambyl	1447.7	493	34	16100	10200	63
7	West Kazakhstan	241	166	69	500	500	100
8	Karagandy	853.7	966.9	113	33333.7	26920	81
9	Kostanai	74.5	69.53	93	3370	3320	99
10	Kyzylorda	2632.8	2230.1	85	50079	51660	103
11	Manghistau	201	188.2	94	15000	20267	135
12	Pavlodar	1275.7	1271.6	100	131565	58270	44
13	North Kazakhstan	41.7	35.4	85	2379.6	2108	89
14	South Kazakhstan	2012.1	1728.1	86	37910	39883	105
	Total for the Republic	**11580.59**	**8662.31**	**75**	**469779**	**368798**	**79**

Source:WRC, 2002

Annex 3.

Figure 3.1. Payment Rates for Water Use in Kazakhstan, 2000-2001



	Akmola	Almaty	Aktobe	Atyrau	East Kazakh-stan	Zhambul	West Kazakh-stan	Kara-gandy	Kostanai	Kyzyl-orda	Manghi-stau	Pavlodar	North Kazakh-stan	South Kazakh-stan
in 2000	6965	42415	1122	7972	72516	12462	1084	31178	2779	39292	884	128621	1564	27903
actual	5179	52824	960	9580	87127	10200	500	26920	3320	51660	20267	58270	2108	39883

Source: WRC, 2002

Annex 3.

Figure 3.3. Hydro-Economic Balance of Ground Water Use by Oblasts, as of January 2002

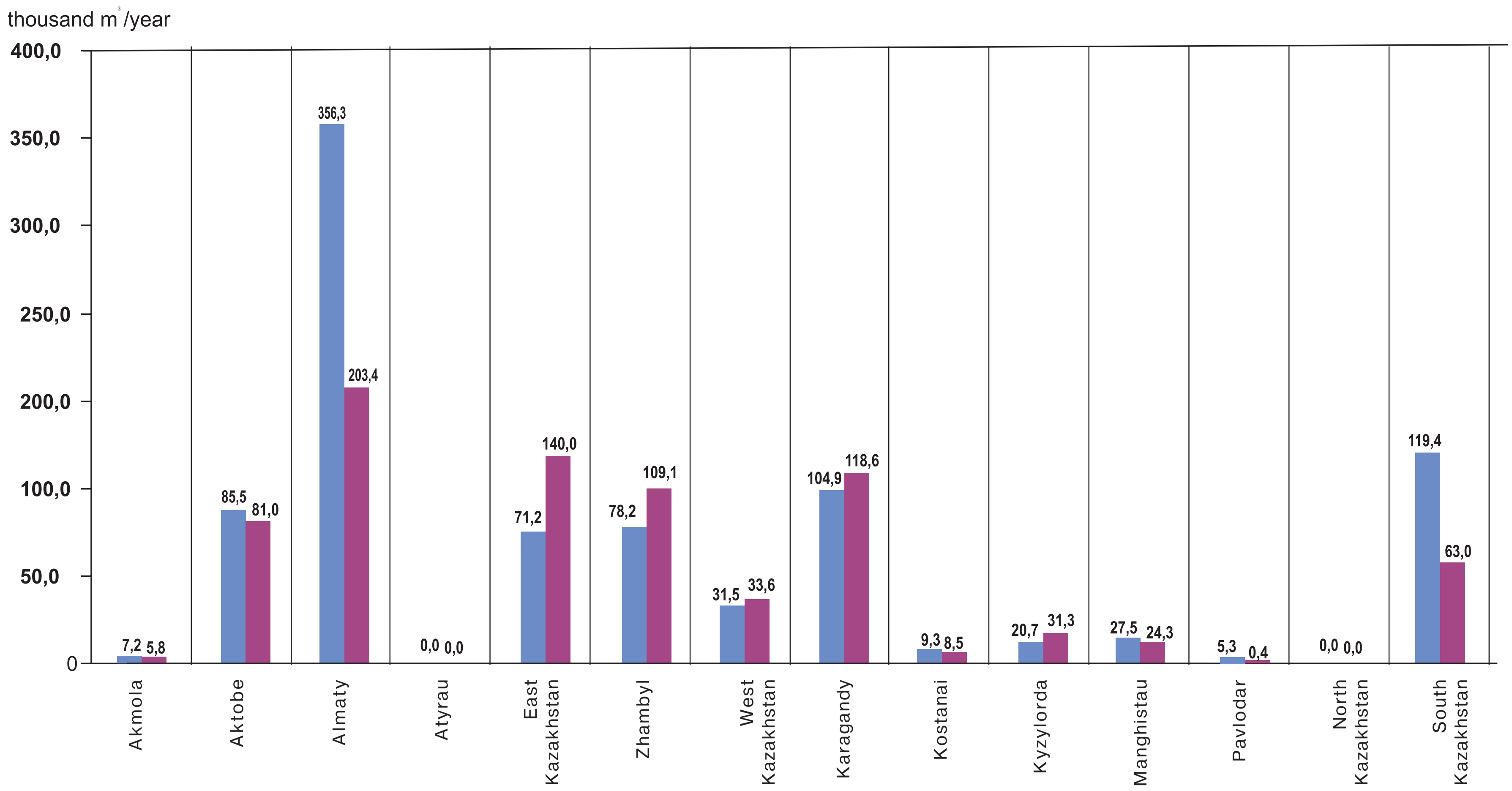
1	Oblasts	Confirmed reserves by categories					Water Consumption						Total	Surplus(+) Deficit(-)
		À	Â	Ñ1	Ñ2	Total	Domestic Needs	Industrial Needs	agricul water sup	Agriculture watering	irrigation	Fisheries		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Akmola	107.34 39.18	185.15 67.58	60.08 21.93	30.38 11.09	382.11 139.47	5.84 2.13	0.25 0.09	6.03 2.2	0.00 0	0 0	0 0	12.11 4.42	370.00 135.05
2	Aktobe	821.57 299.872	759.57 277.243	290.29 105.957	156.75 57.215	2028.18 740.287	81.01 29.57	13.38 4.885	2.33 0.85	6.24 2.278	1.21 0.44	0.00 0	104.17 38.02	1924.01 702.26
3	Almaty	5923.8 2162.2	4184.9 1527.46	4201.19 1533.47	2544.31 928.67	16854.2 6151.8	203.42 74.25	191.75 69.99	27.23 9.94	49.51 18.07	2.02 0.74	2.68 0.98	476.63 173.97	16377.6 5977.8
4	Atyrau	108.14 39.47	80.16 29.26	106.99 39.05	15.36 5.605	310.64 113.38	0.03 0.012	1.08 0.394	0.72 0.264	1.09 0.397		0.459	2.92 1.53	307.72 111.85
5	Western-Kazakhstan	2374.6 866.73	2033 742.3	1444.6 527.68	661.6 241.5	6513.80 2378.21	140.00 51.1	120.60 44.02	4.58 1.67	0.58 0.21			265.75 97.00	6248.05 2281.21
6	Zhambyl 1873,97	1526.58 684	616.71 557.2	500.55 225.1	4517.81 182.7	109.12 1649.00	53.86 39.83	5.89 19.66	0.60 2.15	0 0.22	0	169.48	4348.33 61.86	1587.14
7	Eastern Kazakhstan	166.33 60.71	166.05 60.61	41.42 15.12		373.81 136.44	33.62 12.27						33.62 12.27	340.19 124.17
8	Karaganda 1169,51	1176.88 426.87	444.25 429.56	395.59 162.15	3186.22 144.39	118.63 1162.97	104.44 43.3	4.93 38.12	0.00 1.8			228.00	2958.22 83.22	1079.75
9	Kostanai	286.85 104.7	435.07 158.8	273.97 100	137.81 50.3	1133.70 413.80	8.49 3.1	76.99 28.1	3.84 1.4	0 0	0 0	0 0	89.32 32.60	1044.38 381.20
10	Kzyl Orda	693.37 253.08	403.45 147.26	259.75 94.81	17.21 6.28	1373.78 501.43	31.32 11.43	50.49 18.43	37.70 13.76	20.05 7.32			139.56 50.94	1234.22 450.49
11	Mangistau 128,41	116.79 46.87	29.10 42.63	0.00 10.62	274.30 0	24.25 100.12	25.21 8.853	0.32 9.202	0.00 0.115	0.00 0	0	49.78	224.52 18.17	81.95
12	Pavlodar	1387.95 506.6	1323.84 483.2	506.00 184.69	632.79 230.97	3850.58 1405.46	0.41 0.15	0.14 0.05	15.01 5.48	9.67 3.53	0.00 0	0.00	25.23 9.21	3825.34 1396.3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	Northern Kazakhstan	48.05 17.54	67.21 24.53	18.99 6.93	8.99 3.28	143.23 52.28	0.03 0.01						0.03 0.01	143.21 52.27
14	Southern Kazakhstan	1414.61 516.332	923.45 337.061	652.56 238.184	0.00 0	2990.62 1091.58	63.01 23	66.22 24.17	138.63 50.6	42.66 15.57	65.92 24.06	162.47 59.3	538.90 196.70	2451.72 894.88
Total Confirmed Reserves		**6024.154**	**4884.694**	**3265.691**	**1862.00**	**16036.224**								**14850.39**
Total Water Intakes							**418.77**	**456.76**	**149.26**	**68.89**	**31.87**	**60.28**	**1185.83**	
confirmed reserves, mln m³ **projected reserves, mln m³** **mine and ore water, mln m³**							**299.01** **87.77** **32.00**	**257.11** **6.15** **193.50**	**90.23** **20.03** **39.00**	**47.60** **21.30** **0.00**	**25.24** **4.13** **2.50**	**60.74** **0.46** **0.00**	**779.92** **138.91** **267.00**	

Source:WRC, 2002

Annex 3.

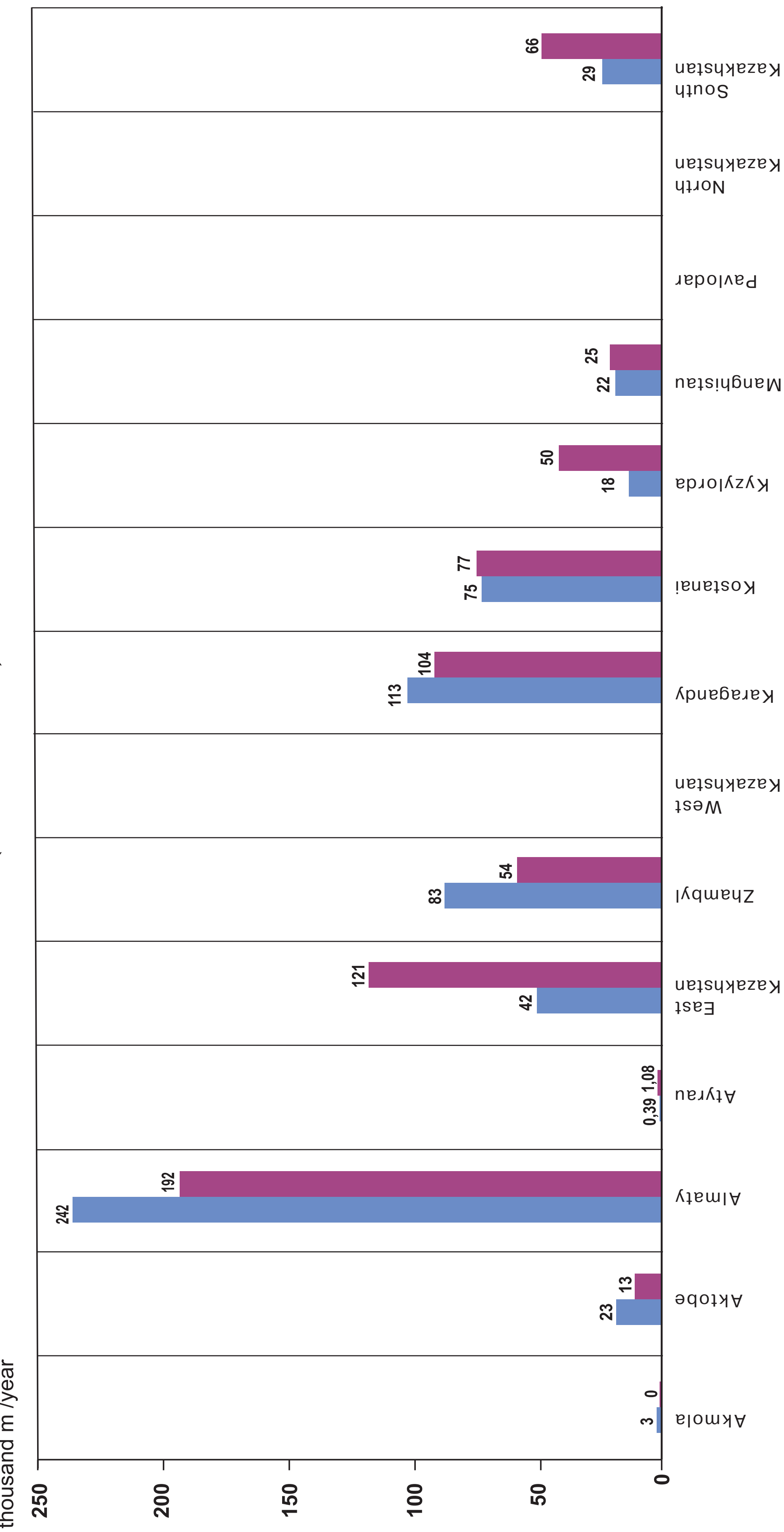
Figure 3.2. Ground Water Use by Sectors of the Economy, 2000-2001
(for domestic needs)



Source: WRC, 2002

Annex 3.

Figure 3.3. Ground Water Use by Sectors of the Economy, 2000-2001 (for industrial needs)



Source: WRC, 2002

Annex 3.

Figure 3.4. Ground Water Use by Sectors of the Economy, 2000-2001 (for regular irrigation)

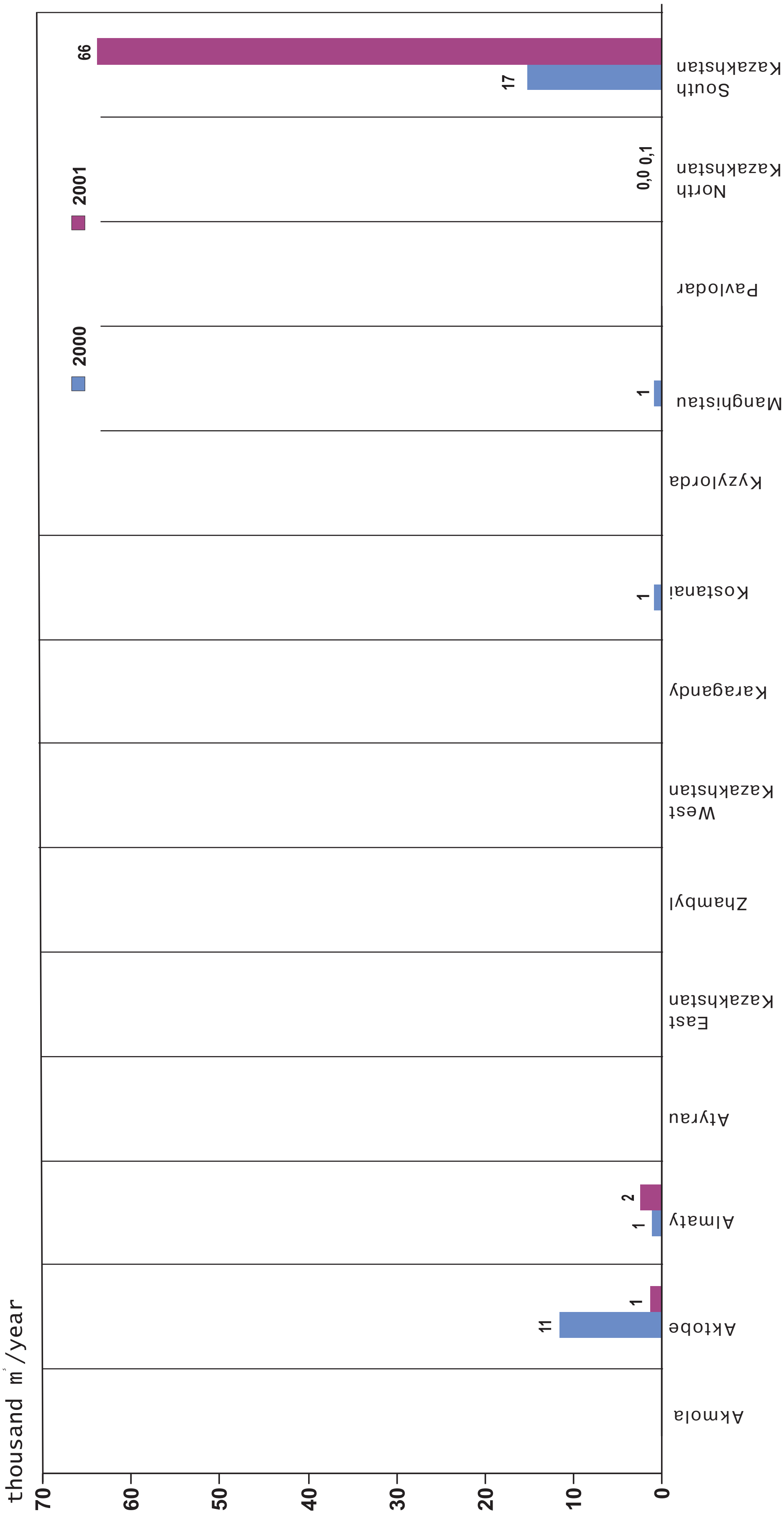
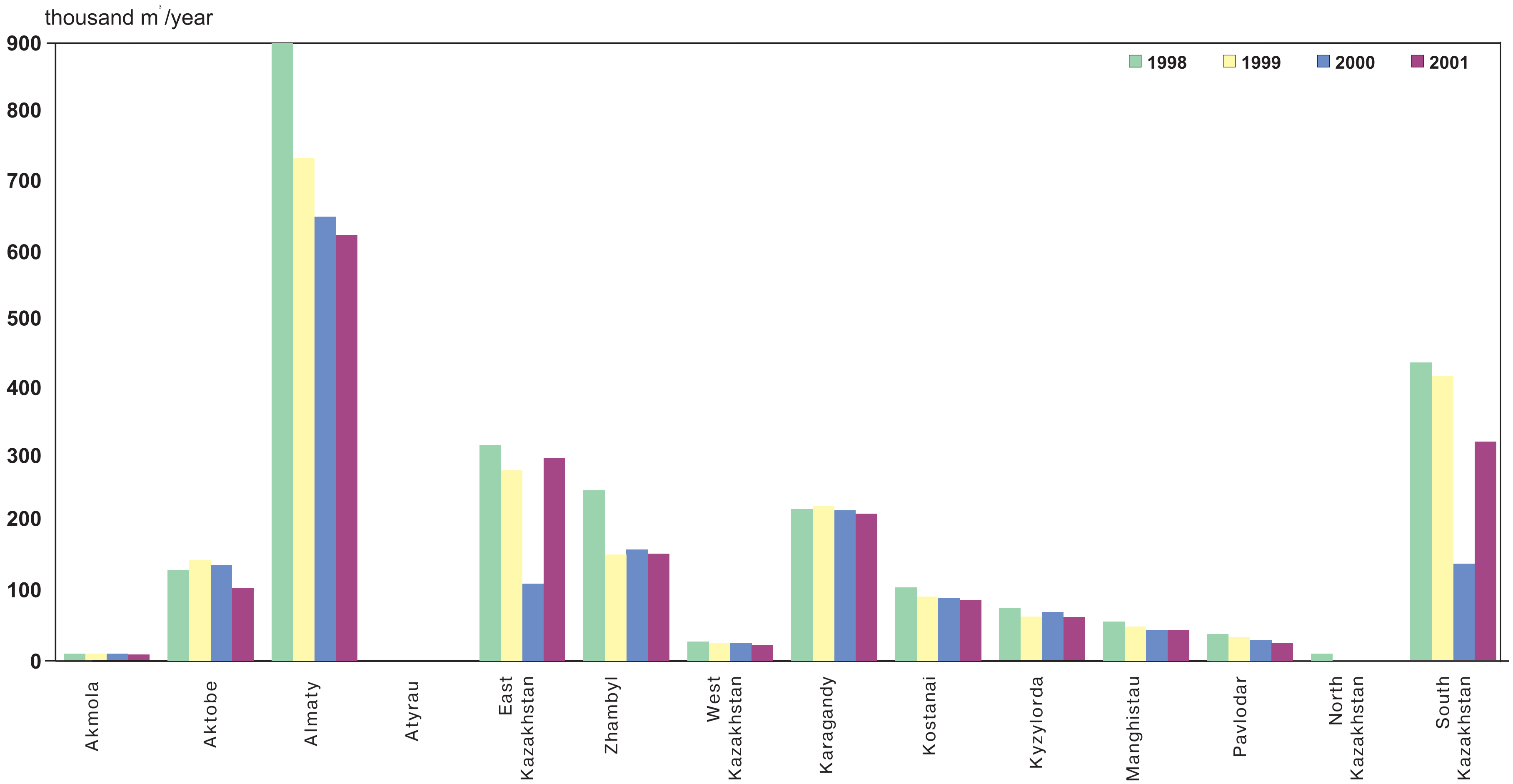


Figure 3.5. Dynamics of Ground Water Use by Oblasts, 1998-2002



Source: WRC, 2002

Annex 4

Table 4.1. Drinking Water Supply and Health of Population

Oblast of Kazakhstan PopulationTotal\ rural,thousand people	State of water supply	Health implications of lack of water and its low quality
Akmola oblast: *The population of the oblast* is 719,900 people with 432,200, or 60% of the population, residing in rural areas.	Supply of piped water is 70.6%. Out of 727 settlements 311 are part of centralized water supply network, 361 use local water sources, 55 use imported water. Over several years the percentage of the population using water from open water pools doubled.In Enbekshilder, Zhaksyn, Zharkain and Zerenda rayon 11.8, 57, 46 and 48% of the population, respectively, use imported water and water from local sources.	30.9% of tested water is unacceptable by chemical standards. Incidence of acute intestinal infections, digestive and urino-genital apparatus diseases are high in most rural rayons, while cancer incidence is growing.
Aktobe oblast:*The population of the oblast* is 669,700 people with 300,800 or 44.9% of the population residing in rural areas.	Supply of piped water is 73.6%. Out of 471 settlements 114 are part of the centralized water supply network, while 334 use water from local sources. 423 villages of the oblast experience lack of quality drinking water. The highest supply of piped water is observed in Mugalzhar rayon (83%), while the lowest is in Baiganin rayon (19%).	9.8% of tested water is not acceptable by microbiological standards with the worst indicators observed in Mugalzhar (23.0), Khromtau (26.5) and Irgiz (20.0) rayons. Overall, 15.5% of tested water from decentralised sources is unacceptable by chemical standards, while this indicator is 25% in Aitekebi rayon. Unsatisfactory quality of drinking water causes high rates of disease. The oblast's rates for digestive and urino-genital system diseases are 3,228.8 and 3,459.6 per 100,000 people respectively, which is significantly higher than the national average. The highest rates for such diseases are registered in Aitekebi, Kargaly, Uil, Kobdy and Khromtau rayons. In 2001 incidence of acute intestinal infections grew by 13.3%.
Almaty oblast:*The population of the oblast* is 1,558,200 people with 1,113,900 or 71.4% of the population residing in rural areas.	Supply of piped water is 72.3%. Out of 826 settlements 384 are part of the centralized water supply network, 415 use water from local sources, while 27 remote villages use imported water. The lowest supply of piped water is observed in Panfilov (66%), Sarkand (52%), Uigur (42.3%) and Aksu rayons (41.8%).	Quality of water is unacceptable by microbiological standards in Koksu (22.5), Balkhash (18.1) and Eskeldy (12.9) rayons. In 50% of rural rayons incidence of digestive and urino-genital disease is at least double the national average.
Atyrau oblast:*The population of the oblast* is 450,200 people with 187,600 or 41.7% of the population residing in rural areas.	Supply of piped water is 62.7%. Out of 27 water-supply facilities 3.7% of water pipelines are not operational, while 15.4% do not meet sanitary requirements. Only 32 settlements are part of the centralized water supply network. 155 use water from local sources, with a further 16 using imported water of unsecured quality.	Water quality is unacceptable by microbiological standards in Zhylyoi and Kurmangazy rayons. In these rayons the incidence of acute intestinal infections and viral hepatitis is consistently high. Unsatisfactory chemical quality of water causes growing morbidity rates. In Kyzylkogy, Inder, Makat, Zhylyoi and Isatai rayons incidence of digestive and urino-genital disease is 2-3 times higher than national average.

East Kazakhstan oblast:*The population of the oblast* is 1,485,500 with 816,400 or 55% of the population residing in rural areas.	Supply of piped water is 67%. Out of 290 water-supply facilities 54 are not operational, while 120 do not meet sanitary requirements. Out of 884 settlements 204 are a part of the centralized water supply network. 191 out of these 204 have local water pipes. 662 settlements use water from local sources with 18 using imported water. In 10 villages of Tarbagatai rayon water pipelines need to be renewed. The lowest water supply indicators are observed in Urdjar (27.1%), Beskarai (28.3%) and Abai (34%) rayon. This indicator stands at 50-60% for the remainder of rayons, while it goes up to 92% for Shemonaikhin rayon.	In Ayakoz, Glubokov, Zharmin and Shemonaihin rayons 20-25% of tested water is unacceptable by microbiological standards. The quality of water by chemical standards is unacceptable in Zyryanovsk, Ayakoz, Abai and Shemonaihin rayons. Incidence of acute intestinal infections occurs quite often.
Karagandy oblast:*The population of the oblast* is 1,350,800 people with 374,700 or 27.7% of the population residing in rural areas.	Supply of piped water stands at 88%, but is significantly less (50-60%) for the majority of rural rayons. Out of 169 water supply facilities 36 are not operational, with a further 48 not meeting sanitary requirements. 193 settlements are part of the centralised water supply network. The majority of villagers use local water sources, with around 100 settlements using imported water.	Quality of water is unsatisfactory by microbiological and chemical standards in Karkaraly and Abai rayons. In Ulytau, Shet and Osakarovskiy rayons water can only be used for drinking after proper treatment.
Kostanai oblast:*The population of the oblast* is 938,800 with 548,400 or 58.4% of the population residing in rural areas.	The overall oblast indicator of piped water supply is 59%, while this indicator is 8-40% for rural areas. Out of 104 water supply facilities, 7% are not operational, while 43.8% are in a poor sanitary and technical state. Centralized water supply networks operate in 227 rural settlements. The population of 520 rural settlements use local water sources, while imported water is used in 70.	28%, 26.4% and 25.4% of tested water is unsatisfactory by microbiological standards in Zhetykara, Amangeldy and Uzunkol rayons respectively. 37.4% of tested water from decentralised sources is not acceptable by chemical standards, with the situation being more serious in Denisov (88% of tested water), Sarykol (78.7%), Amangeldy (50%) and Kostanai (46.5%) rayons. Percentage of viral hepatitis incidence stands at 31.1%.
Kyzylorda oblast:*The population of the oblast* is 606,600 with 409,600 or 67.5% of the population residing in rural areas.	Supply of piped water is 74.1%. There are 86 water supply facilities in the oblast, of which 15 are not operational, with a further 16 not meeting sanitary requirements. 130 settlements are part of the centralised water supply network, while 118 use water from local sources of unsecured quality. 10-23% of the population use imported water.	19% of water tested in rural rayons is unacceptable by microbiological standards. Quality of water is unacceptable by bacteriological standards in all rayons excluding Zhalagash rayons (no more than 10% of water). The highest level of bacteriological pollution of water is registered in Zhanakorgan (67.9%), Aral (26.5%), Karmakshy (20%) and Kazaly rayon (15.1%). 49.7% of water is not acceptable by chemical standards. The situation is worst in Kazaly (99.1% of water), Karmakshy (54.1%), Zhalagash (54.5%) and Aral (38%) rayons, while it remains satisfactory in Syrdaria rayon (9%). Annually, up to 20,000 cases of viral hepatitis and parasitic diseases are registered, with 80% of those affected being children. Incidence of typhoid has increased by 5-6 times. Incidence of cancer, especially of the gullet and liver, is steadily growing. The epidemiologic

		situation around incidence of Crimea haemorrhagic fever remains tense. High rates of disease not typical for children, such as atrophic gastritis, urolithiasis and chronic deforming bronchitis, are registered in Aral rayon. Overall morbidity rates have doubled, with the rate of inborn disorders increasing by 3.2 times.
Manghistau oblast:*The population of the oblast* is 332,400 people with 94,500 or 28.4% of the population residing in rural areas.	Piped water supply is at 69.2%, while in such rural rayons as Manghistau, Tupkaragan and Beineu this indicator stands at 36.3%, 26.6% and 23.6% respectively. 22 settlements are part of the centralized water supply network. Cross-oblast water pipelines are very worn out. Out of 17 water facilities, 3 are not operational, with a further 5 not meeting sanitary requirements. Up to 23% of the oblast population use imported water of unsecured quality.	10.8% of tested water is unacceptable by microbiological standards, while in Manghistau rayon this indicator reaches 19%. Up to 27% of tested water is not acceptable by chemical standards in specific periods in Beineu and Karakiya rayons. Incidence of infectious diseases remains high. Incidence of viral hepatitis has increased by 1.5 times and is 3 times higher than the national average. One of the main causes of morbidity growth is deteriorating social and living conditions. Thus, the oblast has the highest rates of lice and rash incidence.
North Kazakhstan oblast:*The population of the oblast* is 691,600 with 496,500, or 72%, of the population residing in rural areas.	Piped water supply is 74.7%, while in rural areas it hardly reaches 50%. This indicator stands at 36%, 34%, 31% and 19% for Aktogai, Mai, Irtysh and Pavlodar rayons. Out of 779 settlements 493 are part of group water supply networks, of which only 164 use water. Water supply networks are in a state of breakdown in 154 villages, so they do not use them. 175 villages use water from local sources, with another 46 using imported water.	10.7% of tested water is not acceptable by microbiological standards. 42%, 22%, 20.2% and 18.9% of tested water is unacceptable by bacteriological standards in Akzhar, Akkayi, Ayirtau and Ualikhanov and Zhamabaev rayons respectively. 34.2% of water tested in rural settlements is unacceptable by chemical standards. Deaths resulting from digestive and infectious/parasitic diseases have increased by 29.9% and 8.6% respectively.
Pavlodar oblast:*The population of the oblast* is 758,900 with 244,700, or 32%, of the population residing in rural areas.	105 settlements are a part of centralized water supply networks, while 343 use local water sources, with a further 50 having access only to imported water. Of all water facilities 18% are not operational, with a further 60% not meeting sanitary requirements. 221 rural settlements of the oblast (43%) use water that does not meet national standards. The highest percentage of people using low-quality drinking water is in Aktogai, Bayanaul, Irtysh and Kachir rayons.	The quality of Pavlodar's drinking water is the most unsatisfactory of all oblasts. 20-70% of villages use water unacceptable by mineralization, organic and bacteriological standards. Microbiologically unacceptable water is registered in Mai (16%), Zhelezy (16.6%), Pavlodar (20.9%), Sharbakty (35.7%) and Irtysh (77.7%) rayons. Up to 30% of tested water is chemically unacceptable in specific periods in Mai, Aktogai, Uspenskiy and Pavlodar rayons. Incidence of intestinal infection in rural people is 2.5 times above the national average.
South Kazakhstan oblast:*The population of the oblast* is 2,045,400 with 1,316,300, or 64.4%, of the population residing in rural areas.	Piped water supply is 67.4%. Rayon indicators vary from 92% in Mahtaaral rayon to 12% in Saryagash, 24% in Kazygurt, 27.6% in Sozak and 33% in Shardary rayon.	13.4%, 22.2% and 27.3% of water tested in Tulkubas, Kazygurt and Sairam rayons respectively are not acceptable by bacteriological standards. Over 20% of tested water is unacceptable by chemical standards in Tulkubas, Ordabasy and Shardary rayons. Incidence of viral hepatitis is growing in the majority of rayons. In Tulkubas, Baidibek and Tolebi rayons this indicator has increased by 1.9, 1.7 and 1.1 times respectively.

***West Kazakhstan oblast:** The population of the oblast* is 602,600 with 351,800, or 58.4%, of the population residing in rural areas.	The main sources of centralized drinking water supply are surface water pools. Piped water supply is 58.2%, while in rural areas this indicator hardly reaches 35%. The situation is the most acute in Akzhaik (1.7%), Zhanybek (5.5%), Djangalin (8.9%), Chingirlau (14%) and Zelenov (22%) rayons. 204 settlements (39%) are part of centralized water supply networks with a further 305 using local water sources. There are 101 water facilities in the oblast, of which 38 are not operational and 29 do not meet sanitary requirements. Some southern rayons use imported water.	The percentage of tested water that does not comply with chemical standards in specific periods reaches 22.1% in rural rayons of the oblast. In 2001 this indicator was highest in Chingirlau rayon (35.2%). The quality of piped water and water from decentralised sources that is unacceptable by microbiological standards is 8.5% and 50%, 18% and 31.2%, 3.6% and 26.6% and 19.8% and 16.6% in Zhanybek, Taskaly, Syrym and Burly rayons. Overall morbidity rates in most rural rayons are 1.5 times higher than national rates. The highest rates of infectious and parasitic diseases are registered in Akzhaik, Karatoby, Terekty and Chingirlau rayons. The highest incidence of cancer is registered in Burly, Zelenovskiy, Taskaly, Kaztaly, Terekty and Chingirlau rayons.
***Zhambyl oblast:** The population of the oblast* is 980,600 people with 536,800, or 54.7%, of the population residing in rural areas.	Piped water supply is at 57.7%. Out of 186 water facilities 79 are not operational, with a further 96 not meeting sanitary requirements. The worn-out state of wells and water pipelines affects the quality of drinking water. Thus, 47% of wells and water pipelines are in a very worn-out state or out of service. 30% of them have been used for 21-30 years, with 14% and 2% for 31-40 and over 50 years respectively. Populations of many settlements use surface water sources such as springs, etc. or untreated, waste or well water. There are no plumbing systems in over 10 villages of Kordai rayon. Artesian wells have broken down in 10 villages of Ryskulov rayon. Mountain river water withdrawal systems have fallen out of service in 3 villages.	The situation remains difficult regarding diseases caused by social conditions in rural areas. Thus, TB and viral hepatitis incidence rates keep increasing. The TB rate for Shu rayon is 290.8 per 100,000 people, which is nearly double the national rate. In 2001 viral hepatitis rates were 352.3 and 250.0 in Sarysu rayon and Ryskulov rayon, respectively. This was significantly higher than the national rate. The low indicator of reproductive health in the oblast indicates a high incidence of iron-deficient anemia and kidney diseases. This oblast is a natural breeding ground for Crimea hemorrhagic fever.

Sourse: UNDP Human Development Report for Kazakstan, 2002.

GLOSSARY

Anthropogenic factors	natural processes that originate from human activities and human effects on the environment.
Aridity	dryness of climate causing lack of moisture for organic life.
Environmental security:	1) a complex of activities, states and processes which do not directly or indirectly cause any detrimental effect (or pose a threat of such effects) to the environment, individual people or mankind; 2) a complex of states, phenomena and activities ensuring environmental balance on Earth and in any of its regions to such a degree which the mankind is ready for (or can adapt to without serious detriment) physically, socially, economically, technically and politically. Environmental security can be looked at from global, regional, local and site perspectives, including country-wide and country unit level.
Water withdrawal	withdrawal of water from a reservoir, watercourse or subsurface water body.
Purified water	water with a level of impurities not exceeding the natural background or the standard.
Drinking water	water with bacterial and organic qualities and levels of chemical toxicity not exceeding the norms of drinking water supply.
Industrial water	water with such resources and composition that are sufficient to extract its components in production quantities.
Service water	water, excluding drinking, mineral and industrial water, usable for domestic needs.
Water treatment	technological processes of water treatment to adjust its quality to water users' requirements
Water balance	ratio of water needs to supply and quality of water resources available at a particular time and place.
Ground water	water contained in the soil and rocks of the earth crust in any physical state, including chemically-bound water.
Water resources	all water contained in water sources such as lakes, glaciers, rivers, etc. as well as in soil and water beds of rocks.
Water pool	a water body in a land hollow with slow or no water flow. There can be natural water pools, which are a natural accumulation of water in hollows, and artificial water pools, which are a specially formed accumulation of water in artificial or natural ravines.
Water use	procedures, terms and types of water resources use: 1) use of water bodies to meet the needs of the population and economy; 2) water use for economic

or municipal needs without withdrawing it from water bodies; 3) a complex of all types of water resources use in the overall natural resource management system.

Water use — use of water from a water body or water supply systems. There can be return water use when the water source is replenished with amounts of withdrawn water and consumptive water use when water is used for filtration, evaporation, etc.

Water reservoir — artificial pool made by a water retaining structure on a watercourse to store water and regulate flow.

Water body — accumulation of natural water on the surface of land or in rocks that have special types of location and regime characteristics.

Wastewater: — 1) water that has been used for industrial, municipal or agricultural needs and has flowed through a polluted area, including a human settlement (industrial, agricultural, sewage, municipal, rain-storm and other types of runoff);
2) water disposed of after being used for municipal and industrial needs.

Environmental capacity — quantified capacity of the environment (species per area, limits of environmental potential for development, etc.) that enables the ecosystem to operate harmlessly for its components.

Natural pollution — environmental pollution with pollutants being some natural processes and phenomena not directly affected by human activities (for example, volcanic explosions, dust storms, floods, wildfire, etc.)

Water pollution — injection or formation (through synthesis, reproduction, etc.) of physical, chemical or biological agents in water that have a detrimental effect on the environment or damage material values.

Pollutant(s): — polluting substances, any natural or anthropogenic physical agent, chemical substance or species (primarily microorganisms) entering the environment or formed in it in such quantities that exceed the accepted maximum natural fluctuations or mean natural background level at any given time.

Ice jam — sludge lumps, including small pieces of ice on the river-bed, causing narrowing of the river channel and a related water level rise.

(Human) health — objective state and subjective feeling of complete physical, psychological (psychic) and social comfort (as defined by the World Health Organization).

Pollution index(ices) — qualitative and quantitative characteristics of a pollution sources (substances, radiation, etc.). It embraces the notion of concentration (quantity) of the polluting substance in the environment and its time-intensity impact on objects, including people.

Source of water pollution — the source discharging polluting substances, microorganisms and heat into surface and subsurface waters.

Quality of water — a characteristic of water composition and property determining the suitability of water for a specific use.

Maximum allowable concentration (MAC) — timed standard concentration of a noxious substance in the environment that does not affect human health when contacted on a regular basis or from exposure to it and does not produce a detrimental effect on human well-being.

MAC is determined in legislation or recommended by competent agencies (commissions, etc.). Both the health impact of a pollutant and its overall effect on the ecosystem are taken into account when determining MAC.

Environmental crisis: strained relations between human beings and nature that can be described as a disparity between the development of production forces in human society and the resource and environmental potential of the *biosphere*.

Landscape relatively genetically homogenous area with many identical features, in terms of geological composition, landform, hydrology, microclimate and soil. This is the lowest category of geographical zoning.

Environmental monitoring monitoring of the state of the environment and prevention of critical situations detrimental and hazardous for human health and the health of other living organisms.

Effluent treated to standard quality waste water disposal in water bodies which, after treatment, does not violate quality standards of water in monitoring sections or water use stations.

Desertification 1) loss of vegetation in an area due to natural degradation or destruction to the point where the area loses its ability for self-renewal;
2) extermination or reduction of biological capacity of land causing emergence of desert environment.

Waste raw materials not suitable for production; leftovers that cannot be employed or substances (solid, liquid or gaseous) and energy resulting from a process. 'Undisposable' wastes from certain production operations can serve as raw materials for another. Unusable wastes turn into refuse.

Soil special organic and mineral growth formed as a result of mineral substratum exposure to living organisms and the breakdown of necroorganisms; effects produced by water and air on rocks under different climatic and relief conditions in the gravitational field of Earth. Soil can be fertile. Soil depth is up to 203 metres. Soil is one of the most important natural resources.

Use of natural resources: 1) Use of *natural resources* to meet the material and cultural needs of society. Use of natural resources includes extraction and processing of natural resources, and sometimes their replenishment; use and protection of the environment and conservation (maintenance), replenishment (reproduction) and rational change of environmental balance.

Water quality control station a point on a water pool or watercourse where a range of activities is undertaken to obtain data on water quality.

Natural resources: 'free' goods that people use as instruments of labor (land, waterways, and irrigation water), power sources (hydropower, oil, coal), raw materials (minerals, wood, water), commodities (potable water, plants, flowers, poultry, seafood), recreation, gene pool. Natural resources can be recoverable and unrecoverable, renewable and non-renewable, replaceable and irreplaceable, reproducible and irreproducible.

Self-purification of natural water a complex of all natural processes in polluted waters aiming to restore the primary composition and property of water.

Maximum allowable discharge (of substances into water body - MAD) the maximum allowable quantity of a substance to be disposed of in a set order at a given point in time, to ensure quality of water at the control station. MAD is determined taking into account MAC of the substance at water use points, the water assimilation capacity of the water body and the optimal

	distribution of the mass of discharged substance between water users discharging waste water.
Status of water body	characteristics of a water body by its qualitative and quantitative indicators related to water use. Qualitative and quantitative indicators include flow rate, stream velocity, depth, water temperature, pH, etc.
Waste water (the term "sewage" is not acceptable)	water disposed after use for industrial and municipal needs.
Sustainable development	a model of step-by-step development of society where basic needs of the present generation are not met at the expense of future generations.
Disposal of waste water	use of good dissolved or weighted components contained in municipal, rain and industrial waters or use of such waters, after treatment, for irrigation.
Eco system:	ecological system – any community of animate beings and their habitat united in a single whole based on interdependence and cause-and-effect links between individual ecological components.
Erosion	disintegration of rock, soil and any other surface when their integrity is broken and their physical and chemical properties are changed. This process is usually accompanied by particle transport from one place to another.
Water erosion	the process of disintegration of soil, rocks and construction materials under melt, rain and stream water. Water erosion can be lateral, vertical, deep, irrigational, raindrop, gully, subsurface, etc.

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