6. Current Status of the Environment

6.1. Natural Environment

6.1.1. Desertification

Kazakhstan has more deserts within its territory than any other Central Asian country, and approximately 66% of the national land is vulnerable to desertification in various degrees.

Desertification is expanding under the influence of natural and artificial factors, and some people, called "environmental refugees," are obliged to leave their settlements due to worsened living environments. In addition, the Government of RK (Republic of Kazakhstan) issued an alarm in the "Environmental Security Concept of the Republic of Kazakhstan 2004-2015" that the crisis of desertification is not only confined to Kazakhstan but could raise problems such as border-crossing emigration caused by the rise of sandstorms as well as the transfer of pollutants to distant locations driven by large air masses.

(1) Major factors for desertification

Desertification is taking place due to the artificial factors listed below as well as climate, topographic and other natural factors.

- Accumulated industrial wastes after extraction of mineral resources and construction of roads, pipelines and other structures
- Intensive grazing of livestock (overgrazing)
- Lack of farming technology
- Regulated runoff to rivers
- Destruction of forests

1) Extraction of mineral resources

Wastes accumulated after extraction of mineral resources have serious effects on the land. Exploration for oil and natural gas requires vast areas of land reaching as much as 17 million hectares for construction of transportation systems, approximately 10 million hectares of which is reportedly suffering ecosystem degradation.

2) Overgrazing

Overgrazing is the abuse of pastures by increasing numbers of livestock. In the grazing lands in mountainous areas for example, the area allocated to each sheep for grazing is 0.5 hectares, compared to the typical grazing space of 2 to 4 hectares per sheep. In addition, in the stock farms in deserts, the area for each livestock for grazing is only 0.5 to 1 hectares compared to the typically required space of 4 to 8 hectares. In these grazing lands, pasture plants are decreased, while weeds and harmful plants are increased, and the consumption and reproduction of feed crops are thrown out of balance. Furthermore, in recent years, desertification due to overgrazing is also taking place around residential districts because livestock have been cleared from grazing land distant from residences and crowded into stock farms near residential areas.

3) Lack of farming technology

Due to the incomplete irrigation farming systems and poor irrigation skills, accumulation of salinity to the land and resultant land erosion are accelerated, and the use of chemical fertilizers and chemical pesticides causing organic pollutant contamination constitutes one cause of desertification. In addition, land degradation is taking place also in non-irrigation farming and 17 million or more hectares of the total 24 million hectares of the non-irrigation farming arable land in Kazakhstan have became degraded to degrees in which they cannot be called cropland any longer due to the lost leaf mold, accumulated salinity, impaired production ability of land, organic pollutant contamination and resultant land erosion.

4) Regulated runoff to rivers

Regulated runoff to rivers is one of the most critical factors for desertification. In all of the river basins, ground water levels have dropped and the land is drying. Land degradation and desertification would be worse if the flow of the transboundary rivers such as Ili, Syr Darya, Irtysh, and Ural were to be further regulated within the territories of the neighboring countries.

5) Deforestation

Of the total 272.7 million hectares land area of Kazakhstan, the forest reserve accounts for 26.5 million hectares, and the wooded area is only 12.3 million hectares (5.75 million hectares, or 2.3%, of saksaul forests and bushes not included) which accounts for only 4.5% of the land area.

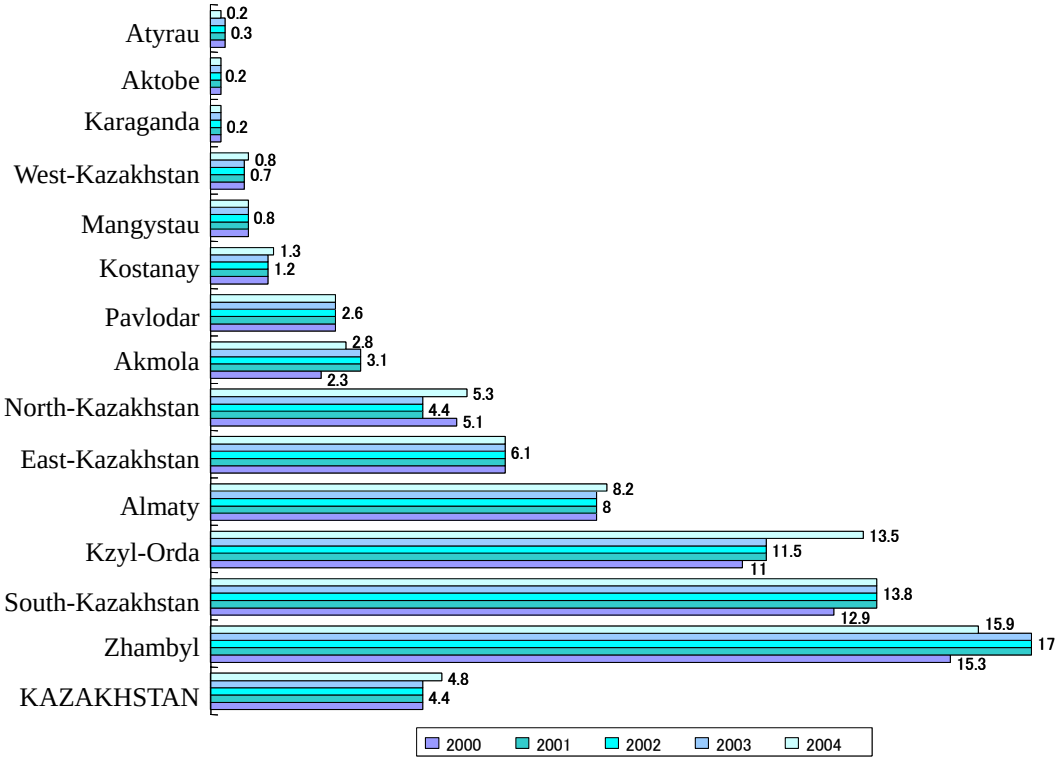
Coniferous forests dotted in the northern steppe

From central Kazakhstan to the western region, there is a vast expanse of sand with few forests. Approximately 70% of forests are located in the southern and southeastern parts, though they are mostly composed of saksaul and bushes.

The mountainous forests located in the southern and southeastern parts (accounting for 20% of the total forests in the country) are rich in biodiversity and are of high value as places of recreation. In addition, groves of mixed trees of birch and conifer are dotted throughout the fertile farm lands of the north, which serve as the primary sources firewood and are also valuable environments for recreation. In the western and central parts of the country, there are no forests due to the extremely dry conditions.

Deforestation is taking place at an ever-increasing speed due to forest fires, illegal harvesting, overgrazing, water shortage, outbreaks of noxious insects and other factors. Over the period from 1996 to 2001 in particular, a series of large-scale forest fires occurred in the oblasts, East-Kazakhstan, Kostanay, Akmola, and Almaty, which had serious effects on deforestation.

The Government of RK has launched programs to put a check on the deforestation. As part of the programs, the government designated the coniferous forest zones in the Irtysh district in Pavlodar Oblast in the northern and northeastern parts of Kazakhstan, where approximately 80% of forests are concentrated, as "special valuable forests," in which extensive tree cutting is prohibited. In addition, on April 23, 2004, the government decided to prohibit large-scale harvesting of conifers and saksaul over the next ten (10) years in order to consolidate the protection of forests against illegal harvesting.



Source:「Millennium Development Goals in Kazakhstan」

Fig.6.1 Changes in percentage of forest land by oblast, 2000-2004

(2) Desertification prevention program

The United Nations Development Programme (UNDP) states in the "Environment and Development Nexus in Kazakhstan (2004)" that, as the factors for accelerated desertification, the following institutional and legal barriers restrict the effective fight against desertification.

- Insufficient legislative framework for environmental management
- Absence of efficient management of land and water resources
- Absence of a system for monitoring and controlling natural processes
- Absence of programs and funds of the nature protection organizations (Committee of Land Resources, local Committee of Ecology) to carry out their work to combat desertification
- Dominance of short-term economic benefits over environmental considerations in decision-making

The Government of RK has developed "The Republic of Kazakhstan Desertification Prevention Program 2005-2015" based on the "Environmental Security Concept of the Republic of Kazakhstan 2004-2015." The government will allocate a budget of 313.585 billion tenge during the period between 2005 and 2007 to this program for the purposes of collecting and assessing information about land degradation, coordinating with the communities involved in the process of policy establishment, and planning and implementing the pilot project for recovery and prevention of land degradation.

Grazing in the northern steppe

6.1.2. Conservation of Biodiversity

(1) Current situations of fauna and flora

Kazakhstan has extensive territories where the climates vary widely according to the region, and fauna and flora also vary according to the region.

For the flora in Kazakhstan, 6,000 or more species of high fiber vessel plants, approximately 5,000 species of fungus, 485 species of lichens, 500 or more species of mushrooms, 2,000 or more species of algae, and approximately 500 species of lichen plants are listed. Among these, in 1981, 279 species of the most important plants were designated as endangered species in Kazakhstan. According to the publication in 2001,

the endangered species exceeded 400, including 81 protected species in the protected areas.

For the fauna, the vertebrate animals are recognized to include 178 species of mammals, 489 species of birds (396 species of nestlings), 49 species of reptiles, 12 species of amphibians, and 104 species of fish. In addition, Kazakhstan's List of Endangered Species (LES) includes 126 species of vertebrates (56 species of birds, 40 species of mammals, 17 species of fish, 3 species of amphibians, and 10 species of reptiles) and 99 species of invertebrates.

Table 6.1 Biodiversity Indicators (number and status of species)

Taxon/ Biota group	Total species in the World	Total endangered species	REPUBLIC OF KAZAKHSTAN				
			Total species	Endemic species	Endangered species	Total in LES/ % of total in LES	Biodiversity density, quantity of species per 10,000 km^2
Mammals	4,629	1,130/24%	178	4	15	40/22%	0.65
Birds	9,672	1,183/12%	396 nestlings	0	15	56/14%	1.5
Amphibians	4,522	-	12	1	1	3/25%	0.042
Reptiles	6,900	-	49	0	1	10/20%	0.18
Freshwater fish	25,000	-	104	0	5	17/16%	0.38
Higher plant species	270,000	25,971/9.6%.	6,000	-	36	207/4%	22.2

Source: "Environment and Development Nexus in Kazakhstan (2004)"

(2) Conservation of biodiversity in specially protected areas

For the purposes of ensuring the biological diversity, specially protected areas (SPAs) have been established in Kazakhstan.

At present, there are 106 SPAs in Kazakhstan, including 57 protected areas, 26 nature monuments, 10 national nature reserves, 8 national parks, 4 national landscape protected areas, 3 oblast-run zoological gardens, 5 oblast-run botanical gardens, 3 water-marsh areas of international significance listed in the Ramsar Convention, and 2 oblast-run forest protected areas.

Table 6.2 National nature reserves of Kazakhstan

No.	Oblasts	Year of creation	Title	Area (thousand ha)	Protected landscape
1.	South-Kazakhstan	1926	Aksu-Dzhabagly	85.7	Mountains, forests
2.	Kostanay	1931	Naurzum	87.6	Steppes, lakes
3.	Almaty	1960	Almaty	71.7	Mountains, forests
4.	Kzyl-Orda	1960	Barsa-Kelmes	71.7	Deserts
5.	Akmola	1968	Kurgaldzhino	252.3	Wetlands
6.	East-Kazakhstan	1976	Markakol	75.0	Mountains, forests, lakes
7.	Mangystau	1984	Ustyurt	223.3	Deserts
8.	East-Kazakhstan	1992	West-Altay	56.1	Mountains, forests
9.	Almaty	1998	Alakol	12.5	Wetlands
10.	South-Kazakhstan	2004	Karatau	34.3	Mountains, valleys
	Total area			970.2	

Table 6.3 National nature parks of Kazakhstan

No.	Oblasts	Year of creation	Title	Area (thousand ha)	Protected landscape
1.	Pavlodar	1985	Bayanaul	50.7	Lakes, pinery
2.	Almaty	1996	Ile-Alatau	165.4	Mountains (fir woods, Alpine meadows)
3.	Akmola	1996	Kokshetau	135.8	Forest-steppe (pineries, rivers, steppes)
4.	Almaty	1996	Altyn-Emel	209.6	Desert (sandy and rocky)
5.	Karaganda	1998	Karkaraly	90.3	Steppe (pineries, lakes, steppes)
6.	Akmola	2000	Burabay	84.1	Mountains and steppes (pineries, lakes, steppes)
7.	East-Kazakhstan	2001	Katon-Karagay	643.4	Mountains and forest
8.	Almaty	2004	Charyn	93.5	Steppes, mountains, rivers, valleys
	Total area			1472.8	

Source: “Millennium Development Goals in Kazakhstan”

Although SPAs are important in terms of conserving biodiversity, no additional SPAs were designated in the mid-1990s. This was due to attempts to secure plots of land for agriculture, forestry, and hunting, the shortage of funds for proper management of protected areas, and underestimation of the possible national economic effects obtained from natural landscapes and biodiversity. However, the Government of RK has been actively working toward conservation of biodiversity since its signing and ratifying of the "Convention on Biodiversity" in 1992 and 1994 respectively. As a national strategy for conservation and sustainable use of biodiversity, the government laid out the "National Strategy and Action Plan for Conservation and Sustainable Use of Biological Diversity" in three years starting in 1996, and in the course of the implementation of this plan, the proportion of SPAs in the Kazakhstan territories reached 14.1 million hectares or 5.1% (based on the 2004 data of the Committee on Forestry and Hunting). However, this figure is still below the 10% standard recommended by the International Union for Conservation of Nature and Natural Resources (IUCN), which suggests extreme insufficiency in preserving the ecological balance of biodiversity. The Government of RK established a goal in the "Concept of Development and Allocation of SPA till 2030 in the Republic of Kazakhstan" to increase the total area of SPAs to 17.5 million hectares by 2030. This goal includes 1.6% of national nature reserves, 1.4% of national nature parks, and 3.4% of oblast-designated nature monuments and protected areas, the total area of which corresponds to 6.4% of the Kazakhstan territory.

Baraboye National Park (Akmola Oblast)

6.2. Air Quality

Air pollution in Kazakhstan is common in the major cities and industrial areas where about a half of the population is concentrated. The major pollution sources include non-ferrous metallurgy, thermal power plants, steelmaking plants, petroleum and natural gas extraction and motor vehicles.

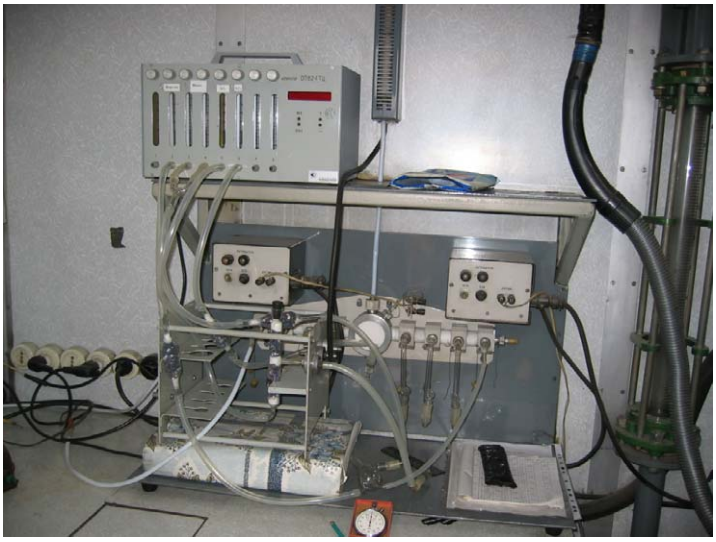
In the rapidly progressing extraction of petroleum and natural gas in the Caspian Sea coasts, emissions of air pollutants caused by the combustion of associated gas are serious. In addition, in the metallurgical plants in the non-ferrous industry in the eastern industrial area, poor-quality fuel is used and the conventional, inefficient pollution control equipment has not been improved. Therefore, it is reported that increasing numbers of workers are flowing into urban areas and seeking employment without the risk of pollution-related health damage. In the urban areas, in turn, traffic restrictions and fuel regulations are not yet improved in spite of the recent rapid increase in motor vehicles, and the air pollution from car exhaust emissions has become serious.

6.2.1. Current Status of Air Pollution

Monitoring of ambient air pollution is carried out at observation posts installed by the Hydro-meteorological Office (Kazhydromet) in 20 major cities and villages. The items measured include suspended dust, nitrogen dioxide, sulfur dioxide, carbon monoxide, phenol, and formaldehyde. Samples are collected once to three times every day and analyzed based on the gravimetric method or colorimetric method.

As the environmental quality standards for ambient air, Kazakhstan has defined the Maximum Permissible Concentration (MPC) for a total of 14 substances (See Table 6.4). In addition, the degree of the overall ambient air pollution is indicated by the Index of Air Pollution (IAP). This is a composite index determined using an excess multiplication factor for the MPC in measured pollutants.

Air pollution observation post (Almaty City)



Internal view of observation post

Table 6.4 Maximum Permissible Concentration (MPC) in air in the residential area

Pollutants	MPC (mg/m^3)	
	Per hour	Daily mean
Carbon monoxide	5	3
NOx	0.4	0.06
Nitrogen dioxide	0.085	0.04
Suspended dust	0.5	0.15
Phenol	0.01	0.003
Formaldehyde	0.035	0.003
Lead	-	0.0003
Ammonia	0.2	0.04
Sulfur dioxide	0.5	0.05
Hydrogen sulfide	0.08	-
Chlorine	0.1	0.03
Hydrogen fluoride	0.02	0.005
Copper	0.003	0.001
Hydrogen chloride	0.2	0.02

Source: Yearbook on the Environment of the Republic of Kazakhstan 1998

Table 6.5 provides a comparison of the Index of Air Pollution (IAP) averaged over 9 months for individual cities in 2005 against the measured results in 2003 and 2004. In addition, Table 6.6 provides details on the measured results in 2005.

Of the points ranking the most highly for severe air pollution in 2005, formaldehyde was found to be in excess of MPC more times than other pollutants, which implies that the pollution is primarily attributable to car exhaust emissions. The city of Almaty, which is exposed to the most serious ambient air pollution, exhibited concentrations of 0.07 mg/m^3 of nitrogen dioxide and 0.019 mg/m^3 of formaldehyde in the first half of 2005, indicating that air pollution caused by car exhaust emissions is serious. The city of Almaty is located in a basin, which causes a climate condition conducive to pollutant build up throughout the year. There are days in which the concentration of formaldehyde per hour exceeds the 0.035 mg/m^3 Maximum Permissible Concentration (MPC) by 10 times.

In addition, in the industrial cities, Karaganda, Shymkent, Aktobe and Ust-Kamenogorsk, due to the higher ash content of coals used as fuel and the inefficient flue-gas treatment facilities in the plants and power stations, emissions of pollutants are increasing with the recent brisk economic activities. Furthermore, in Atyrau Oblast, crowded with petroleum and natural gas extraction enterprises, the air pollution is worsening due to the sulfur oxides (SOx) and soot and dust (fly ash) from the combustion of associated gas.

Industrial area in Karaganda

Table 6.5 Ambient air pollution by city (2003-2005; Mean value from January to September in each year)

City	Index for Air Pollution (IAP) Mean over 9 months			Industry sectors affecting the air pollution
	2003	2004	2005	
Almaty City	11.0	13.7	15.4	Automobile, Energy
Karaganda City	11.6	11.8	14.8	Energy, Coal mining, Automobile
Shymkent City	13.3	15.6	11.7	Non-ferrous metallurgy, Chemical, Oil refinery
Aktobe City	9.2	9.0	9.9	Steelmaking, Chemical
Ust-Kamenogorsk City	9.4	7.2	8.3	Non-ferrous metallurgy, Energy
Taraz City	7.2	7.9	8.2	Chemical
Temirtau City	7.8	8.4	8.2	Chemical, Steelmaking
Ridder City	8.6	7.3	8.1	Non-ferrous metallurgy, Energy
Zhezkazgan City	5.3	5.0	5.6	Non-ferrous metallurgy, Energy
Semipalatinsk City	5.1	4.3	4.9	Energy, Construction material
Glubokoye Village	5.1	3.7	4.3	Non-ferrous metallurgy, Energy
Petropavlosk City	3.5	4.6	4.0	Energy, Machinery and equipment manufacturing
Aktau City	5.4	4.9	3.9	Chemical
Astana City	4.0	3.2	3.7	Energy, Automobile
Kostanay City	3.6	3.5	3.3	Energy
Balkhash City	2.5	3.3	3.2	Non-ferrous metallurgy, Energy
Atyrau City	1.4	1.5	2.3	Oil refinery
Pavlodar City	1.3	1.3	1.3	Oil refinery, Energy
Ekibastuz City	1.9	1.4	1.3	Energy
Uralsk City	0.8	1.2	1.0	Energy
Mean Index for Air Pollution	5.90	5.89	6.17	

Source: Materials provided by Hydro-meteorological Office (Kazhydromet)

Table 6.6 (1) Ambient air pollution by city in 2005 (Mean value from January to September)

City, Village	Index for Air Pollution	Pollutant exceeding MPC	Daily mean concentration		Maximum concentration		% of excess over the standard
			mg/m^3	MPC exceeding times	mg/m^3	MPC exceeding times	
Almaty City	15.4	Suspended dust	0.19	1.3	0.9	1.8	2.5
		Carbon monoxide	2.2	-	17	3.4	5
		Nitrogen dioxide	0.07	1.8	0.80	9.4	30
		Phenol	0.002	-	0.014	1.4	0.3
		Formaldehyde	0.019	6.3	0.062	1.8	9
Karaganda City	14.8	Suspended dust	0.13	-	1.80	3.6	2
		Carbon monoxide	1.6	-	8	1.6	0.5
		Nitrogen dioxide	0.6	1.5	0.33	3.9	24
		Phenol	0.007	2.3	0.027	2.7	9
		Formaldehyde	0.015	5.0	0.042	1.2	0.4
Shymkent City	11.7	Suspended dust	0.25	1.7	14.9	29.8	2
		Carbon monoxide	1.9	-	12	2.4	1
		Nitrogen dioxide	0.05	1.3	0.29	3.4	6
		Ammonia	0.041	1.0	0.16	-	-
		Formaldehyde	0.014	4.7	0.086	2.5	1
Aktobe City	9.9	Suspended dust	0.05	-	0.6	1.2	0.1
		Nitrogen dioxide	0.05	1.3	0.21	2.5	7
		Hydrogen sulfide	0.005	-	0.008	1.0	-
		Formaldehyde	0.013	4.3	0.025	-	-
Ust-Kamenogorsk City	8.3	Suspended dust	0.22	1.5	3.0	6.0	1.1
		Sulfur dioxide	0.081	1.6	2.205	4.4	1
		Carbon monoxide	1.1	-	17	3.4	1
		Nitrogen dioxide	0.07	1.8	0.52	6.1	35
		Phenol	0.004	1.3	0.047	4.7	5
		Chlorine	0.03	1.0	0.30	3.0	1
		Formaldehyde	0.004	1.3	0.024	-	-
		Arsenic	0.003	1.0	0.012	-	-
		Hydrogen fluoride	0.002	0.5	0.070	3.5	2
		Hydrogen chloride	0.123	1.2	0.25	1.3	18
Taraz City	8.2	Suspended dust	0.13	-	1.3	2.6	0.3
		Carbon monoxide	2.0	-	24	4.8	4
		Nitrogen dioxide	0.05	1.3	0.25	2.9	11
		Hydrogen fluoride	0.004	-	0.021	1.1	0.1
		Ammonia	0.042	1.0	0.22	1.1	0.1
		Formaldehyde	0.009	3.0	0.038	1.1	0.1
Temirtau City	8.2	Suspended dust	0.23	1.5	1.4	2.8	7
		Nitrogen dioxide	0.02	-	0.13	1.5	0.7
		Hydrogen sulfide	0.002	-	0.026	3.3	2
		Phenol	0.008	2.7	0.049	4.9	24
		Ammonia	0.091	2.3	0.57	2.9	6
Ridder City	8.1	Sulfur dioxide	0.092	1.8	0.158	-	-
		Nitrogen dioxide	0.07	1.8	0.15	1.8	25
		Phenol	0.006	2.0	0.012	1.2	0.8
Zhezkazgan City	5.6	Suspended dust	0.32	2.1	1.1	2.2	12
		Nitrogen dioxide	0.04	1.0	0.19	2.2	10
		Phenol	0.005	1.7	0.017	1.7	12
Semipalatinsk City	4.9	Suspended dust	0.10	-	1.3	2.6	0.3
		Sulfur dioxide	0.021	-	0.875	1.8	0.1
		Carbon monoxide	4.5	1.5	24	4.8	27
		Nitrogen dioxide	0.05	1.3	0.340	4.0	14
		Phenol	0.003	1.0	0.019	1.9	6

Source: Materials provided by Hydro-meteorological Office (Kazhydromet)

Table 6.6 (2) Ambient air pollution by city in 2005 (Mean values from January and September)

City, Village	Index for Air Pollution	Pollutant exceeding MPC	Daily mean concentration		Maximum concentration		% of excess over the standard
			mg/m^3	MPC exceeding times	mg/m^3	MPC exceeding times	
Glubokoye Village	4.3	Suspended dust Sulfur dioxide Nitrogen dioxide Phenol	0.05 0.052 0.06 0.002	- 1.0 1.5 -	2.0 0.328 0.25 0.020	4.0 - 2.9 2.0	0.6 - 2.7 1
Petropavlosk City	4.0	Carbon monoxide Nitrogen dioxide Formaldehyde	1.7 0.03 0.004	- - 1.3	7 0.14 0.016	1.4 1.6 -	0.1 1 -
Aktau City	3.9	Suspended dust Nitrogen dioxide	0.27 0.04	1.8 1.0	0.9 0.13	1.8 1.6	9 4
Astana City	3.7	Suspended dust Carbon monoxide Nitrogen dioxide Hydrogen fluoride	0.33 1.0 0.03 0.002	2,2 - - -	2.6 9 0.17 0.107	5.2 1.8 2.0 5.4	21 0.9 5 1
Kostanay City	3.3	Carbon monoxide Nitrogen dioxide	1.5 0.06	- 1.5	23 0.29	4.6 3.4	1 16
Balkhash City	3.2	Suspended dust Sulfur dioxide	0.17 0.067	1.1 1.3	2.8 5.742	5.6 11.5	3.0 4
Atyrau City	2.3	Suspended dust	0.18	1.2	0.8	1.6	5
Pavlodar City	1.3	Suspended dust Carbon monoxide Nitrogen dioxide Hydrogen sulfide Phenol Hydrogen chloride	0.08 1.2 0.02 0.001 0.001 0.04	- - - - - -	1.80 13 0.14 0.012 0.018 0.52	3.6 2.6 1.6 1.5 1.8 2.6	0.7 0.2 0.8 0.1 1 2
Ekibastuz City	1.3	Suspended dust	0.06	-	1.0	2.0	0.1
Uralsk City	1.0	Nitrogen dioxide	0.02	-	0.10	1.2	0.3

Source: Materials provided by Hydro-meteorological Office (Kazhydromet)

6.2.2. Emissions of Air Pollutants from Stationary Sources

(1) Emissions of air pollutants

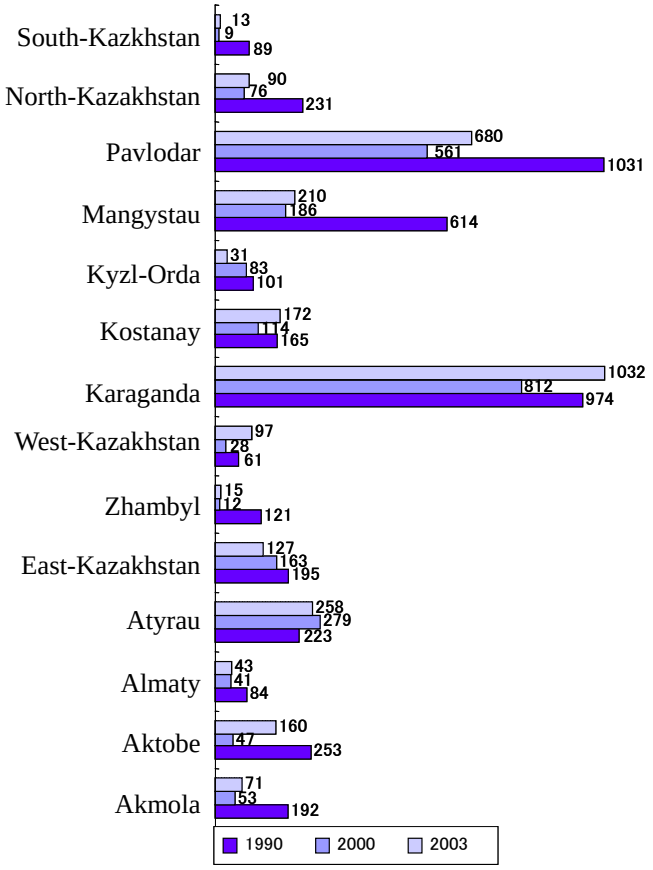
Emissions of pollutants from factories, plants and other stationary sources constitute the major factors for air pollution in the industrial areas.

Table 6.7 provides per-capita emissions of air pollutants from stationary sources in Kazakhstan. With the brisk economic activities in recent years, the emissions are increasing. Fig. 6.2 shows emissions by oblast. Greater emissions occurred in the oblasts of Karaganda, Pavlodar, Atyrau, Mangystau, Kostanay and West-Kazakhstan, and it is in these oblasts that the enterprises of mining and metallurgy industries are concentrated.

Table 6.7 Per capita air polluting emissions from stationary sources in Kazakhstan (t)

	1999	2000	2001	2002	2003	2004
Emissions from stationary sources	0.155	0.163	0.174	0.170	0.193	0.200

Source: “Millennium Development Goals in Kazakhstan”



Source: “Millennium Development Goals in Kazakhstan”

Fig.6.2 Per capita air pollutant emissions from stationary sources by oblast (t)

(2) Air pollutant emission control

In Kazakhstan, there is no established emission standard to be applied commonly to all air pollutants emitted from plants, but the emission control is based on the Maximum Permission Concentration (MPC) defined by the department of environment in individual oblasts or cities. MPC is determined based on a simulation model for the spread

Power plant in Astana City

of air pollutants to limit the concentration of pollutants to the environmental quality standards at a point 2 m above the ground on the border of a hygienic protected area, 1,000 m distant from a plant.

The oblasts or cities carry out annual in-plant inspections of plants to which the emission control is applied. The items inspected include the concentration of exhaust gas, wastewater, waste, soil, in-plant ambient air, neighboring ambient air, and water quality of neighboring rivers.

6.2.3. Emissions of air pollutants from motor vehicles and other mobile sources

The amounts of air pollutants emitted from motor vehicles in Kazakhstan over the period between 2000 and 2003 are shown in Fig. 6.3. In big cities, vehicles produce 60% or more of the overall emissions of air pollutants. Table 6.8 provides the emissions of pollutant from mobile sources (vehicles) between 1990 and 2000 by oblast or city. Up to 1998, due to the improved fuel efficiency of vehicles and changes in the composition of vehicles (increased passenger cars and less trucks and buses), emissions had been decreasing, though from 1999, the emissions have been increasing. In addition, as can be seen from Fig. 6.3, in 2003, the emissions increased by about 1.5 times compared with 2001.

The Department of Environment in Almaty City has defined the solutions for car exhaust emissions as the most important challenging task and it estimates that 80% of the pollutants emitted in the atmospheric air come from vehicles. Recently, the number of vehicles exceeds 300,000, and the use of inferior quality gasoline and the increase in diesel-fueled vehicles make the air pollution more serious. Therefore, Almaty City established the “Clean Air Program” and allocated an annual fund of 500 million tenge [KZT] (approx. 3.57 million US$) to this program in 2005 for tightened regulation on the plants, control of the number of vehicles, and improved quality of fuel.

Exhaust emissions from motor vehicles hang over Almaty City

The Department of Environment in the capital city of Astana also considers the exhaust emissions from motor vehicles a most important issue along with the air pollution caused by the dust produced in the construction work for relocation of the capital. The number of vehicles has been increasing year by year and exceeds 100,000 at present. This has caused traffic congestion, which had never been seen even in the central part of the city a few years ago. Astana City is attacking the issue by reducing exhaust gas concentration by catalysts, using good-quality gasoline, and establishing a regular vehicle safety check system. The city is also improving the transportation infrastructure by increasing one-way streets and constructing and improving signals.

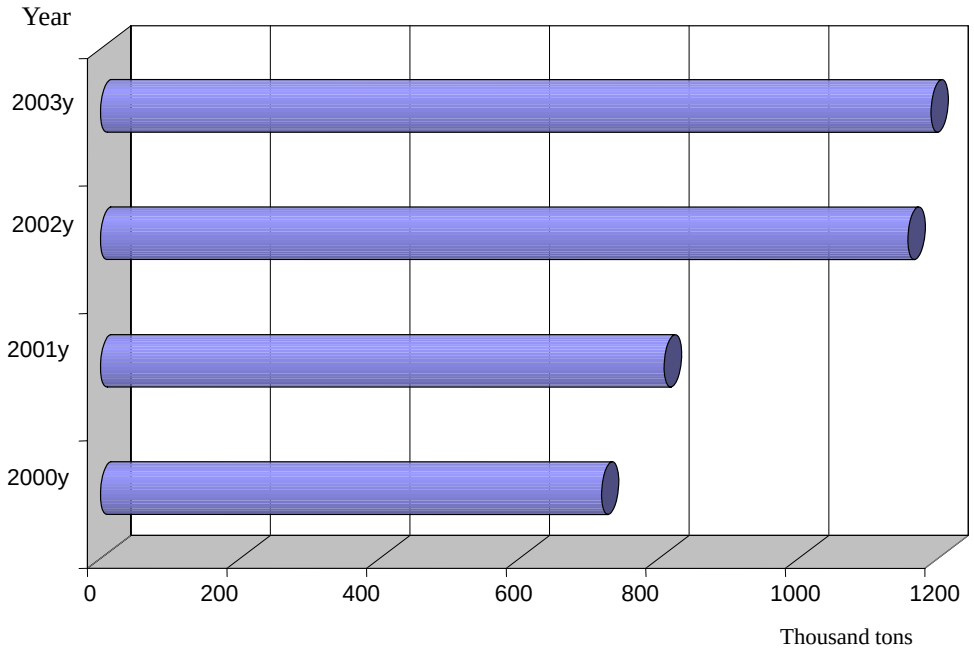


Fig. 6.3 Total gross emissions of air pollutants from vehicles

Table 6.8 Emissions of air pollutants from mobile sources (vehicles) by oblast and city (thousand tons)

Year / Oblast, City	1990	1995	1998	1999	2000
Kazakhstan	2610.6	997.1	1320.1	1099.8	1098.0
Akmola	186	66.8	42.8	25.4	25.4
Aktobe	107.1	49.1	34.9	36.4	36.0
Almaty	323.3	113.4	160.0	112.7	131.0
Atyrau	58.8	28.9	27.0	23.1	20.2
East Kazakhstan	266.3	71.5	-	-	-
Zhambyl	143.9	40.2	35.0	34.5	35.0
West Kazakhstan	104.2	38.4	41.0	57.9	68.0
Karaganda	224.9	81.6	100.0	100.0	100.0
Kzyl-Orda	76.1	36.4	60.2	51.2	50.0
Kostanay	243.3	128	334.5	195.4	163.2
Mangystau	41.8	28.9	85.6	88.6	88.0
Pavlodar	172.4	74.7	29.9	31.5	32.0
North Kazakhstan	274.4	101.7	48.1	48.6	49.0
South Kazakhstan	224.4	87.3	99.6	101.3	106.0
Astana City	-	-	21.5	23.8	24.2
Almaty City	163.7	50.2	200.0	169.4	170.0

Source: “Environment and Development Nexus in Kazakhstan (2004)”

6.3. Water Environment

6.3.1. Water Resources and Utilization

Kazakhstan has a total of approximately 540,000 km^3 of freshwater reserves within its territory, which contains the glaciers, rivers, lakes and marshes, water reservoirs and ground waters as listed in Table 6.9, though 44% of the surface waters depend on the neighboring states, China (43%), Uzbekistan (33%), Russia (17%), and Kyrgyzstan (7%).

Table 6.9 Kazakhstan's water resources

Unit: thousand km^3

Lakes and marshes	Rivers	Ground waters	Water reservoirs	Glaciers	Total
190	101	95	95	58	539

Source: Water Resources of Kazakhstan by the Water Resources Committee of the Ministry of Agriculture, 2004

In 2002, the annual water consumption was 20,000 km^3, of which, utilization for irrigation accounted for 78%, followed by industrial use (16%), drinking water (5%) and aquaculture and other uses (1%). In the 1990s, annual water consumption was 30,000 to 50,000 km^3, though it was considerably decreased due to the reduced area of irrigated farm lands and decreased degree of capacity utilization in the plants.

6.3.2. Water Quality Standards

The environmental quality standard have been established by individual authorities within their own spheres of jurisdiction for the subjects requiring environmental protection. Water quality standards are defined individually for water supply for drinking and household use, and fishing water, though the standards for the fishing water are used as the environmental quality standards for the environmental waters. The water quality standards are applied directly from the Resolution of the Government of Republic of Kazakhstan (No.11) “Water Quality Standards for Piped Water and Rules on the Inspection Methods,” which was established December 1997 by the Ministry of Health with regard to hygiene and medical care. The water quality standards are summarized in Table 6.10 and come from the water quality standards of the Russian Federation in accordance with the “Approval for Application of the Russian Federation Health and Hygienic Standards to the Republic of Kazakhstan” concluded between Kazakhstan and the Russian Federation.

Table 6.10 Water quality standards (standards for microorganisms not included)

Unit: mg/l (other than pH)

Item	Standard value	Item	Standard value
pH	6-9	Selenium	0.01
Evaporation residue	1,000	Strontium	7.0
Hardness	7.0	Sulfate	500
COD (Bichromate)	5.0	Fluorine	1.2-1.5 depending on the region
Oil content	0.1	Chlorine ion	350
Anionic surfactant	0.5	Hexavalent chrome	0.05
Phenol coefficient (PC)	0.25	Cyanogen	0.035
Aluminum	0.5	Zinc	5.0
Barium	0.1	γ-GHTSG (agrichemicals)	0.002
Beryllium	0.0002	DDT	0.002
Boron	0.5	2, 4-D	0.03
Iron	0.3	Chlorine	-
Cadmium	0.001	Residual free chlorine	0.3-0.5
Manganese	0.1	Residual fixed chlorine	0.8-1.2
Copper	1.0	Chloroform	0.2
Molybdenum	0.25	Residual ozone	0.3
Arsenic	0.05	Formaldehyde	0.05
Nickel	0.1	Polyacrylamide	2.0
Nitrate	45	Active silicon oxide (as the Si content)	10
Mercury (Hg)	0.0005	Polyphosphoric acid	3.5
Lead	0.03		

6.3.3. Monitoring of Water Quality

Water quality is monitored at a total of 176 monitoring sites established for 49 rivers, 7 lakes and marshes, 7 water reservoirs, one canal, the Caspian Sea and Aral Sea. The monitoring sites are divided into three classes and the frequency of monitoring is defined as every 10 days, every month and every quarter for the three respective classes. The monitoring is carried out by the Hydro-meteorological Station, a branch office of the Hydro-meteorological Office established in individual oblasts.

After the independence of Kazakhstan, monitoring sites were decreased to a half of those in the era of the former Soviet Union due to financial pressure, though the number of monitoring sites is recovering with the increased government budget by approximately 12% per year and the analytical equipment and facilities are improving.

In addition, in FY 2003, the Regional Monitoring Center was established to provide the monitoring of water quality by river basin instead of the conventional oblast-run monitoring. In 2003, the first Center was opened in Kzyl-Orda to be responsible for the Syr Darya Basin and then the Ural-Caspian Basin Center and Balkhash-Alakol Basin Center were formed in succession in Atyrau. The Basin Center does not involve any construction of new buildings for analysis of water quality, but the Ural-Caspian Basin Center, a generic name for the Hydro-meteorological Stations in the oblasts of Mangystau, Atyrau, West-Kazakhstan, and Aktobe, is responsible for the environmental monitoring of the Caspian Sea and the river basins of the Ural and Emba Rivers flowing into the Caspian Sea. The results of environmental monitoring obtained in these Centers are compiled in the Environmental

Monitoring Center in Almaty (in Almaty oblast the Hydro-meteorological Station is named the Environmental Monitoring Center).

The primary equipment for the analysis of water quality includes spectrophotometers introduced in the era of the former Soviet Union. Thus, some target substances for the environmental quality standards are difficult to measure. Table 6.11 provides a list of items that may be analyzed.

Table 6.11 Available items for measurement in the Almaty Analysis Center

Item measured		Item measured		Item measured	
Odor	○	Nitrite ion	○	Cadmium	−
Transparency	○	Nitrate ion	○	Silver	−
Color	○	Total nitrogen	○	Tin	−
Temperature	○	Phosphate	○	Aluminum	−
Suspended solids (SS)	○	Silica	○	Arsenic	○
pH	○	Transparency	○	Titanium	−
Dissolved oxygen (DO)	○	Oxidation-reduction potential	○	Bismuth (Bi)	−
Oxygen saturation	○	Total phosphorus	○	Volatile Phenol	○
Carbon dioxide	○	Total iron	○	Resin	
Hydrogen sulfide	○	Iron (Bivalent)	○	Petroleum content	○
Magnesium	○	Iron (Trivalent)	−	Oil content	−
Chlorine	○	Copper	○	Surface active agent	○
Sulfate	○	Zinc	○	Fluorine	○
Total ion	○	Nickel	−	Cyanogen	−
Hardness	○	Total chrome	○	Thiocyanic acid	−
Hydrogen carbonate	○	Chrome (Hexavalent)	−	Boron	−
Carbonate	○	Chrome (Trivalent)	−	Total Phenol	○
Na + K	○	Lead	○	Xanthogenic acid	−
Potassium (K)	−	Vanadium	−	Carbohydrate	−
Calcium (Ca)	○	Molybdenum	−	Chlorine-based agrichemicals	−
COD	○	Iron (Trivalent)	−		
BOD_5	○	Cobalt	−		
Ammonium ion	○	Mercury (Hg)	−		

6.3.4. Water Pollution

Despite the declined industrial production due to the economic slump, the water quality of rivers, lakes and marshes does not meet the environmental quality standards. The pollution sources include the untreated wastewater from chemical plants, oil refineries, non-ferrous metal mines, smelters, and sewage treatment plants in the urban areas.

The most seriously polluted river is Irytish River which originates in the Xinjiang Uyghur Autonomous Region of the People's Republic of China and flows into Russia across the eastern part of Kazakhstan. In eastern Kazakhstan, there are non-ferrous metal mines and refineries, and a total volume of 120 million m^3 of wastewater containing heavy metals from the mines and tailing dams reportedly flows into the Irytish River every year.

According to the Water Quality Monitoring Report in the first half of 2005, a 51 times higher concentration of zinc and a 15 times higher concentration of manganese than the environmental quality standards were detected in the Breska River, which flows through the mine district into the Irytish River. In the Xinjiang Uyghur Autonomous Region, petroleum resources development and agricultural development are actively carried forward in line with China's Western Development. For this reason, the flow of the Irytish River decreased to about 2/3 in 2001 and the river suffered increasingly serious river water pollution due to the pollutants produced by the development activities. The communities in the river basin using the Irytish River as the drinking water source are asking the local governments for proper solutions for water pollution in fear of possible damage to health, though specific corrective actions have not yet been taken.

Table 6.12 Mean water quality in the first half of 2005

River	Pollutants involved	Mean concentration (mg/L)	MPC exceeding times of water quality standards
Breksa River	Nitrate nitrogen	0.096	4.8
	Copper	0.0067	6.7
	Zinc	0.510	51.0
	Manganese	0.150	15.0
Tikhaya River	Nitrate nitrogen	0.052	2.6
	Copper	0.0053	5.3
	Zinc	0.310	31.0
	Manganese	0.086	8.6
Glubochanka River	Nitrate nitrogen	0.114	5.7
	Copper	0.0054	5.4
	Zinc	0.153	15.3
	Manganese	0.056	5.6
Krasnoyarka River	Copper	0.0031	3.1
	Zinc	0.720	72.0
	Manganese	0.187	18.7

Source: Environmental Monitoring Report in the First Half of 2005

In addition, in Pavlodar, near the border with Russia, there remains a large quantity of mercury in the wastewater reservoirs and within the premises of chemical plants that were engaged in the production of sodium hydroxide using mercury in the era of the former Soviet Union. Therefore, there is apprehension that the mercury might flow into the Irytish River through ground water. For this issue, the Ministry of Environmental Protection (MEP) has constructed walls with water-impermeable clay under the ground surrounding the sites that used mercury to prevent possible migration of the mercury-contaminated groundwater, though the plants have been privatized and thus thorough solutions have not been implemented. Regarding the mercury contamination in the Irytish River, the Government of RK is urged by the Russian Government to strengthen the environmental management of the river.

Irytish River

Mercury in the location of a chemical plant

The Nura River, which flows through the central part of Kazakhstan, is also suffering mercury contamination down to its 25 km-distant lower reaches due to the inflow of approximately 3,000 tons of mercury contained in the industrial effluents from the chemical plants through drain outlets which were operating in the city of Temirtau in Karaganda Oblast during the era of the former Soviet Union. At present, taking in water from the Nura River is prohibited, though the river water is utilized for farming and livestock feeding in the villages within the river basin where there is no alternative water source available. The Ministry of Agriculture launched projects for dredging the river and withdrawing the contaminated soils from the river basin in FY 2005 with the financial assistance from the World Bank in order to use the Nura River flowing in the suburb of Astana as the water source for the capital Astana where available drinking water sources are limited. According to the Environmental Monitoring Report in the First Half of 2005, copper concentrations 6 times higher and mercury concentrations 2.3 times higher than the water quality standards were detected in the Nura River.

Mercury coagulated on the floor of a chemical plant

Mercury coa Nura River

One of the causes of water pollution includes the discharge of untreated wastewater from the sewage treatment plants. Of the annual total volume of treated wastewater of 0.14 km^3 discharged from the sewage treatment plants, approximately 36% reportedly meets the effluent standards. In Kazakhstan, industrial wastewater and domestic wastewater are fed to the sewage treatment plants, though the sewage treatment plants are designed on the assumption that the industrial wastewater is properly treated within the plants. Therefore, a large volume of untreated industrial wastewater may be discharged if fed into the sewage

treatment plants.

The major rivers in the country are classified into the following 8 river basins, Aral-Syrdarya Basin, Ili-Balkhash Basin, Irytish Basin, Ural-Caspian Basin, Ishim Basin, Nura-Sarysu Basin, Chu-Taraz Basin, and Tobol-Torgai Basin, which are controlled in terms of flow discharge, volume of water drawn, and water quality by the individual Basin Committees under the jurisdiction of the Water Resources Committee of the Ministry of Agriculture (See Fig.6.4). Water pollution in individual river basins is the responsibility of the Ministry of Environmental Protection (MEP), and the Basin Committees take charge of only the management. In addition, groundwater is under the control of the Committee for Geology and Protection of Resources (Kaznedra) of the Ministry of Agriculture, and the water quality of groundwater used as drinking water sources is inspected by the Health and Quarantine Center, the external bureau of the Ministry of Health in individual oblasts.

Drain outlet of wastewater treatment plant in the suburb of Astana City (Treated water to be discharged to reservoir)

As indicated by the changes in pollution of major rivers in Table 6.13, improvement of water quality has not been achieved in most rivers. This may be attributed to the fact that the punitive measures applicable to the business entities discharging pollutants exceeding the emission standards is limited to penalty charges and no other actions, such as suspension of operation and lawsuits, are imposed. In addition, the extremely low amount of fines compared to the investment in the environmental protection equipment and facilities may be another reason for continuing polluted water discharges.

In 2002, the individual Basin Committees carried out the inspection of effluents from plants and sewage disposal plants. One marine products processing enterprise was accused of discharging wastewater containing organic substances significantly exceeding the effluent standards into the Ural River, but the fine imposed was 1,100 US$. In another case, a zinc refinery was accused of 7 breaches of the law involving discharging of illegally stored poisonous substances into the Irytish River, but the fine incurred was only 22,900 US$.

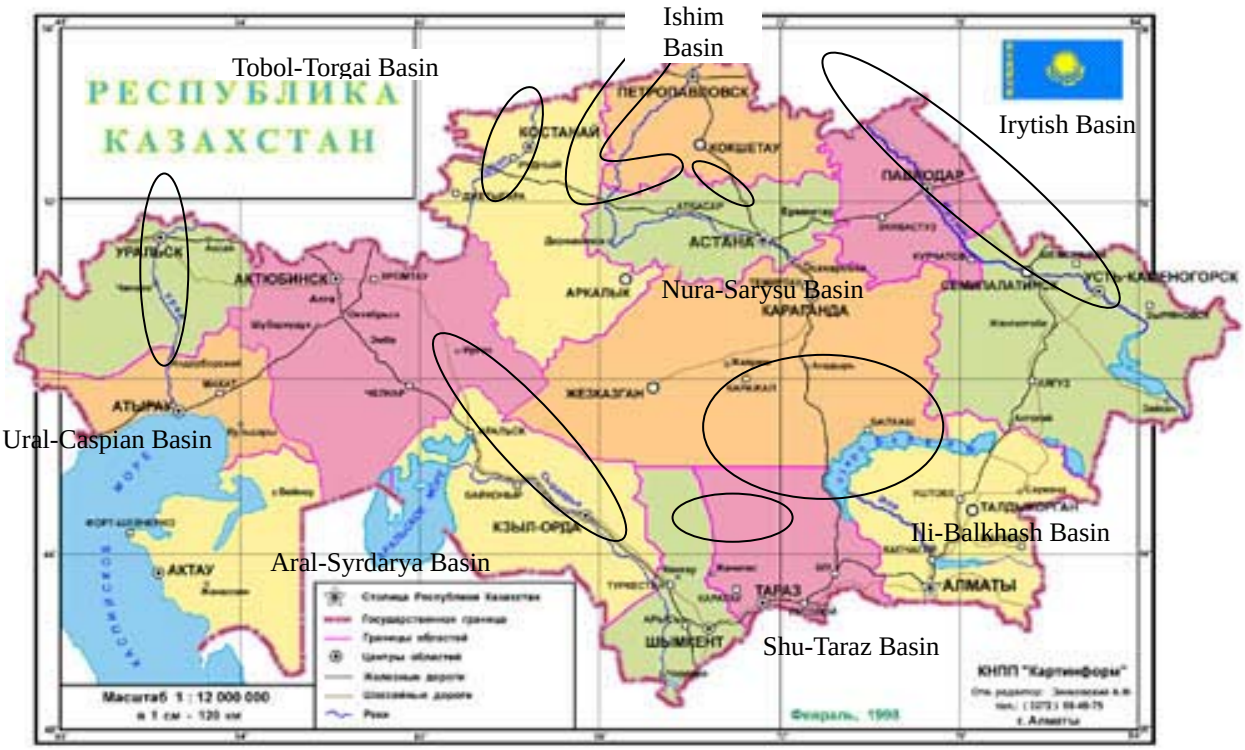


Fig.6.4 Major rivers and basins in Kazakhstan

Table 6.13 Changes in water pollution of major rivers by river basin

River basin	Water Pollution Index (WPI)						Pollution class[NOTE]	Major pollutants involved
Rivers, Lakes and marshes	1997	2000	2001	2002	2003	2004		
Ural-Caspian Basin	-	-	-	-	-	-	-	
Ural River	3.0	1.3	0.8	0.8	0.7	0.7	2	Phenol
Tobol-Torgai Basin	-	-	-	-	-	-	-	
Tobol River	0.5	2.2	0.6	0.5	0.6	0.6	2	Surface active agent, BOD
Ilek River	7.4	4.2	4.4	6.3	5.6	3.6	4	Boron, Chrome
Aral-Syrdarya Basin	-	-	-	-	-	-	-	
Badam River	2.7	2.2	2.0	1.6	2.1	1.9	3	Sulfate, Copper
Shardary Water Reservoir	2.9	1.9	2.1	2.0	2.0	1.9	3	Sulfate, Copper
Chu-Taraz Basin	-	-	-	-	-	-	-	
Taraz River	1.4	0.9	0.8	0.5	0.6	0.7	2	
Balkhash-Alakol Basin	-	-	-	-	-	-	-	
Small Almaty River	2.9	1.7	2.1	2.6	1.9	1.5	3	Copper, Phenol
Large Almaty River	2.0	0.8	0.8	0.9	1.5	1.6	3	Copper
Balkhash Lake	2.4	3.7	4.0	3.4	2.6	2.2	3	Copper
Nura-Sarysu Basin	-	-	-	-	-	-	-	
Samarkand Water Reservoir	3.4	2.6	3.7	2.1	1.9	1.6	3	Copper, Phenol
Nura River	4.4	4.1	3.1	2.1	2.0	1.9	3	Copper, Mercury
Kara-Kengir River	-	6.0	6.4	4.8	3.9	3.7	4	Copper, Ammonia nitrogen
Kengil Water Reservoir	-	4.5	2.7	4.8	3.8	2.4	3	Copper, Sulfate
Irytish Basin	-	-	-	-	-	-	-	
Irytish River	1.4	1.6	1.9	1.2	1.1	1.7	3	Copper, Oil content
Ulba River	8.6	4.7	3.5	4.0	4.4	5.5	5	Zinc, Copper
Tikhaya River	9.5	5.8	6.0	6.8	5.7	9.1	6	Zinc, Copper
Breksa River	12.6	4.1	7.1	5.8	7.8	28.2	7	Copper, Zinc
Krasnoyarka River	3.3	7.6	6.5	5.3	4.4	10.2	7	Zinc, Copper
Ishim Basin	-	-	-	-	-	-	-	
Ishim River	1.3	1.2	1.0	0.9	0.9	0.9	2	Sulfate, Oil content

Source: Environmental Monitoring Report 1999-2001, First half of 2005

Note: Pollution Indicator

The degree of water pollution is assessed by the pollution class. The pollution class is determined based on the numerical value (Water Pollution Index: WPI) which is calculated by adding the proportions of BOD and acidity against the values of their environmental quality standards to the values of the 4 top-ranked proportions of the substances measured against their environmental quality standards and then dividing the sum of the addition by 6.

Water pollution class

Class	Water Pollution Index	Water quality
1	< 0.3	Very clean
2	0.3 - 1.0	Clean
3	1.0 - 2.5	Almost clean
4	2.5 – 4.0	Mildly polluted
5	4.0 – 6.0	Moderately polluted
6	6.0 – 10.0	Heavily polluted
7	10.0 <	Very severely polluted

6.4. Soil Pollution

The total area occupied by plants and industrial waste disposal facilities is reportedly 184,000 hectares and the area of land in which development of underground resources and construction of plants are underway is 176,000 hectares. Existing plants and waste disposal centers are mostly owned by the state enterprises or state-run business entities that are under the jurisdiction of the Ministry of Energy and Mineral Resources, though some plants and waste disposal centers are left uncontrolled due to the bankruptcy of the involved state enterprises. As discussed in Section 6.5, development of underground resources and the resultant industrial wastes may have caused soil pollution, though the actual conditions cannot be identified because of the lack of monitoring of soils.

At Baikonur enclosed with the steppes in Kzyl-Orda Oblast, there is a space rocket launching site of approximately 670,000 hectares. Over the period 1957 to 2001, space rockets were launched from the site to put into orbit 1,237 space ships. The rockets launched break off the first stage at a height of 50-120 km, and the chemical substances contained in the fuel are scattered, causing the pollution of soils. From the soils around the rocket launching site, highly toxic heptyl contained in the rocket fuel has been detected in high concentrations. If a rocket launch fails, a large quantity of fuel can be released. In fact, in the failure of the launching of the “Proton” rocket in 1999, approximately 395,000 hectares in Atasy Village in Karaganda Oblast were polluted. The launches of rockets in the period up to 2001 reportedly scattered approximately 2,000 tons of heptyl.

There is a possibility that wastes produced within the rocket launching site could pollute the surrounding environments, though the methodology for Environmental Impact Assessment (EIA) including the method of environmental monitoring has not been established and thus the actual conditions have not been identified.

Soil pollution in farm lands includes the pollution of soils caused by industrial wastewater and/or wastes from irrigated farm lands adjacent to the factory districts as well as the pollution of soils by agrichemicals. The imports of herbicides and agrichemicals in 2000 were approximately 5,300 tons. The consumption of these chemicals was decreased by approximately 1/4 over the past 20 years. The Government of RK has placed limitations on the types of agrichemicals and herbicides for domestic use, though DDT and other chemicals are smuggled into the country from Russia, Kyrgyzstan, and Uzbekistan. In addition, those agrichemicals that were supplied to the state-run farms or sovkhoz in the era of the former Soviet Union and then became prohibited from use are dumped and left out in the open in some farm lands, though no survey has been carried out by the Ministry of Agriculture.

The environmental quality standards for soil are defined in terms of many items as listed in Table 6.14, and the analytical procedures in the era of the former Soviet Union are inherited. However, there are no gas chromatographs or liquid chromatographs for measurement of residual agrichemicals, nor shaking apparatus for elution. Therefore, the actual conditions of soil pollution have not been identified.

Table 6.14 Environmental quality standards for soil

Item	Standards (mg/kg)	Item	Standards (mg/kg)
α-methylstyrene	0.5	Xylene (o-,m-,p-)	0.3
Styrene	0.1	Manganese	1,500
Toluene	0.3	Copper	3.0
Formaldehyde	7.0	Arsenic	2.0
Acetaldehyde	10.0	Nickel	4.0
Benzpyrene	0.02	Nitrate	130.0
Benzene	0.3	Mercury (Hg)	2.1
Vanadium	150.0	Total chrome	6.0
Isopropyl benzene	0.5	Hexavalent chrome	0.05
Cobalt	5.0	Lead	32.0
Fluorine	10.0	Sulfate	160
Manganese chloride	1.0	Phosphate	200.0
Potassium chloride	560.0		

Source: Soil pollution standards (established November 29, 1997)

6.5. Waste Management

According to the government's statistics, within the territory of Kazakhstan, approximately 20 billion tons or more of industrial wastes and general wastes are accumulated, approximately 6.7 billion tons of which are reportedly harmful wastes. The government's survey in 1999 estimated the annual production of general wastes as 4.6 million tons (14 to 15 million m^3). In practice, in the big cities such as Almaty and Astana, the waste collection services cannot keep up with the increasing amount of waste with the explosion of population in urban areas. Since 1996, the general waste collection business has been privatized, though the collection fees are kept at low levels by the Antimonopoly Committee and non-payment for services by pensioners and the unemployed as well as the steep rise in labor costs and vehicle maintenance costs caused by inflation make spending on plants and equipment and increases in the number of personnel impossible. Consequently, illegal dumping of uncollected wastes on construction sites or vacant lots is occurring. In addition, in response to the recent economic development, packaging materials used for imported products account for a higher proportion of the general wastes. At present, in Almaty, daily emissions of general wastes amount to 930 tons, though they are estimated to reach 1,000 tons a day in 2010. The general wastes are simply accumulated in the disposal sites in the suburbs without being covered with soil, and used fluorescent lamps, medical equipment, and other hazardous wastes are left standing, this causing rising concerns about the effects on the environment. In 2001 in Karaganda Oblast, the towns were invaded by rodents breaking out of the waste disposal centers, and a budget of approximately 20 million tenge [KZT] (approximately 19 million yen) was spent over two years for extermination.

Refuge disposal site in the suburb of Almaty City

Refuge collection site in Temirtau City in Karaganda Oblast

In order to keep up with the increase in general wastes, Almaty City has permitted a raise in waste collection fees and launched a project to minimize garbage aiming at collection of separated garbage and a 10% recycling rate based on the master plan proposed in the "Survey on Waste Management Project in Almaty City" conducted between 1999 and 2000 by JICA. In Almaty City, previously unseen garbage cans for garbage separation have emerged.

Garbage cans in Astana City

Garbage can for source separation in Almaty City

The problem of industrial waste is also serious. Especially in the eastern non-ferrous metal mining area, 1.5 billion tons of waste slag and residues of refining in the era of the former Soviet Union are left out in the open and it is feared that the heavy metals contained in the wastes are being dissolved into the rain water, causing pollution of ground water and/or the wastes are scattered, leading to air pollution. During the privatization of mines and refineries after the independence of Kazakhstan, no definite agreement has been concluded between the government and the privatized enterprises about disposal of the wastes, and the wastes are still left uncontrolled. Regarding the problem, the government has secured a budget for a three-year program starting in 2005 for preparation of inventories of mine wastes, though there is no discussion about the specific solutions. In addition, also for the uranium ore, similar to the case of non-ferrous metal mines, the waste slag in the mines of currently discontinued mining operations is left standing, and in the former state-run processing enterprises not in operation at present, possibly radioactive-contaminated production facilities are left uncontrolled. Also for this problem, the government is to prepare inventories of

wastes in the uranium mines, survey the health conditions of the residents, and check the surrounding environments for any residual radiation dose in FY 2005. In addition to the mine wastes, the wastes stored in the state-run plants in the era of the former Soviet Union are also left uninvestigated.

6.6. Countermeasures Against Global Warming

6.6.1. Greenhouse Gas Emissions

Kazakhstan ratified the UN Framework Convention on Climate Change (for prevention of global warming) in 1995 and signed the Kyoto Protocol in 1999. In 1994, the first inventory of greenhouse gas (GHG) emissions and absorption rates was prepared. This inventory was, however, found later to contain data of questionable reliability. The results of re-surveys of GHG emissions in 1990 and 1994 showed 350 million tons and 230 million tons of CO_2 equivalent respectively. The greatest GHG emission source is the energy sector, which accounts for 90% of the total emissions. Table 6.15 provides the GHG Emissions by Main Sources over the period up to 2002. The per capita greenhouse gas emission in 2002 was 12.6 tons.

Table 6.15 GHG Emissions by Main Sources

Unit: million tons (CO_2 equivalent)

Class	1990	1992	1994	1999	2000	2001	2002
CO_2	238.4	274.7	179.4	102.9	120.3	128.5	142.6
Energy production	218.3	257.8	171.9	94.0	108.5	115.6	128.3
(Fuel combustion)	213.5	252.9	168.1	88.4	102.1	107.8	119.4
(Fuel leakage)	4.8	4.9	3.8	5.6	6.4	7.8	8.9
Production process	20.0	16.9	7.5	8.9	11.8	12.9	14.4
Land use changes and Forestry	-10.5	-10.4	-10.0	-8.9	-8.3	-8.3	-8.3
CH_4	62.9	60.2	49.6	28.6	33.7	31.8	34.1
Energy production	43.6	41.4	33.7	18.5	22.8	20.4	21.6
(Fuel combustion)	1.5	1.9	1.0	0.2	0.3	0.4	0.4
(Fuel leakage)	42.0	39.5	32.7	18.3	22.5	19.9	21.2
Production process	0.04	0.03	0.02	0.03	0.02	0.03	0.03
Land use changes and Forestry	16.5	16.1	13.4	7.0	7.3	7.5	7.9
Waste	2.7	2.7	2.5	2.9	3.6	3.8	4.6
N_2O	26.9	24.9	17.2	8.6	8.9	9.8	10.2
Energy production	0.8	0.9	0.6	0.3	0.4	0.4	0.4
(Fuel combustion)	0.8	0.9	0.6	0.3	0.4	0.4	0.4
Agriculture	25.6	23.6	16.1	7.9	8.3	9.0	9.4
Waste	0.5	0.4	0.5	0.3	0.3	0.3	0.4
Total emissions	328.2	359.8	246.2	140.1	162.9	170.1	186.9

Source: Climate Change Office HP

The inventory of GHG emissions is prepared on an annual basis by the Climate Change Office established in 2000 with the aid of the United States. Though US considers the JI (Joint Implementation), CDM (Clean Development Mechanism) as effective means for reduction of GHG in the countries undergoing transition to a market economy (countries with economies in transition: EIT countries), since the EIT countries have not yet fully established the intra-country monitoring of GHG emissions and a system for promoting environmental protection which are required for the application of the Kyoto Mechanisms, the US is supporting the eligible countries based on its own Climate Change Action Plan in the attempt to establish the organization for achieving the goals for reduction of GHG emissions and promoting environmental protection. The Climate Change Office was also established based on this strategy.

The primary functions of the Climate Change Office include (1) selecting and coordinating priority national-level projects related to reduction of GHG emissions, (2) promoting overseas investment and overseas corporation, (3) implementing and controlling the projects involved, (4) supporting institutional reforms.

6.6.2. Reduction of Greenhouse Gas Emissions

(1) Energy conservation programs

In Kazakhstan, because of the availability of abundant and inexpensive energy resources, energy conservation has not been promoted, but, in order to suppress a future increase in energy consumption, the Ministry of Energy and Mineral Resources developed the energy conservation program for 2006 to 2015. As specific measures, development of a proper energy resource utilization program suited for individual regions, construction of hydraulic power plants, and adoption of wind power generation are under consideration. The master plan for the period up to 2015 will be developed based on the results of the first three-year program (2006 to 2008). The three-year program has planned the following goals: (1) establishing basic standards for energy conservation, (2) developing oblast-level energy conservation programs, (3) issuing national statistical reports on input energies for all involved activities, and (4) reducing energy consumption from the 11% of GDP in FY 2004.

(2) Joint Implementation (JI)

The Government of the Republic of Kazakhstan is promoting the implementation of the JI/CDM project as one of the means for the economic development. In October 2002, an existing cogeneration system composed of a low-efficiency boiler and steam turbine in West-Kazakhstan Oblast cogeneration station was replaced by a higher-efficiency gas turbine cogeneration system in which it was implemented as part of the JI model project[1] of a NEDO energy conservation model project. The Government of the Republic of Kazakhstan has scheduled the occurrence of credit for the period from 2008 to 2012 and the transfer to credit for 62,000 tons per year (of CO_2 equivalent) on the assumption that the Kyoto Protocol will be ratified.

[1] As one of the prerequisites for JI, the host party must comply with the obligation to reduce its GHG emissions to the quantified amount assigned, i.e. also equivalent to being listed in Annex B of the Kyoto Protocol. This project has been considered as JI since Kazakhstan declared its intension to be listed in Annex B at COP7 in 2001, and also, based on the premise that Kazakhstan will voluntarily comply with the same commitments of other Annex I Parties under the UN Framework Convention on Climate Change.

(3) Millennium Development Goals

In September 2000, the 189 Member States of the United Nations met at the United Nations Millennium Summit held in New York and ratified the UN Millennium Declaration defining peace, security and disarmament, development and poverty eradication, protecting our common environment, human rights, democracy and good governance, meeting the special needs of Africa, and other principles as the fundamental values essential to internal relations in the twenty-first century. The Millennium Development Goals, established as a common framework based on the consolidation of the UN Millennium Declaration and the international development goals adopted in the major international conferences and summits held in the 1990s, contain eight goals to be achieved by 2015, and the 7th goal is "Ensure environmental sustainability." The "Ensure environmental sustainability" goal is composed of three specific numerical goals: Target 9 "Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources," Target 10 "Halve, by 2015, the proportion of people without sustainable access to safe drinking water," and Target 11 "Achieve, by 2020, a significant improvement in the lives of at least 100 million slum dwellers."

Kazakhstan has set up the numerical goals for Target 9 as listed below, and reported that the goals would be "almost achievable."

Goals for Target 9

1. Forests occupation 4%
2. Protected territories to preserve biodiversity 3%
3. CO_2 emissions per capita 12.2 tons (1992)
4. Wastes (1999)

    - Solid waste 20 billion tons
    - Municipal waste 14 million m^3
    - Low-level radioactive waste 230 million tons
    - Medium-level radioactive waste 2 million tons