KAZAKHSTAN

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Concise report and summary of national publications on climate change dimensions and impacts

Initial climate change studies in Kazakhstan (1995–2000)

Climate change studies in Kazakhstan have been conducted regularly since 1995, following ratification of the UN Framework Convention on Climate Change (UNFCCC) by the Republic of Kazakhstan. The first climate change projects were implemented with the support of international programmes, including the US Country Studies Program (1995–1997) (US CSP) and the Netherlands Climate Change Studies Assistance Programme (1998–2000) (NCCSAP). For these projects, implementation groups were organized comprising specialists and scientists from various scientific research institutes and other organizations. The Kazakh Research Institute of Environmental Monitoring and Climate (now the Kazakh Ecology and Climate Research Institute, KazNIIEK) was responsible for all activities in climate change studies. KazNIIEK is a scientific subdivision of the Ministry of Environmental Protection of the Republic of Kazakhstan (MEP).

Research under the US CSP project had five central themes:
- climate dimensions and regional climate change scenarios;
- vulnerability and adaptation of natural resources and economic sectors to climate change impacts;
- GHG inventories in the Republic of Kazakhstan;
- climate change mitigation assessments; and
- national climate change action plan development.

In April 1997, the results of the US CSP project were discussed at a national climate change seminar coupled with an international conference. The project results were published in the journal *Hydrometeorology and Ecology*, No. 3, 1997, and other publications. They included articles on long-range climate changes and their consequences for grain productivity, climate global warming contribution to the development of desertification processes in Kazakhstan, assessment of climate change impact and adaptation of spring wheat, pastures, glaciers, geocryological conditions and mudflow-forming factors in the mountains of the country. A National Climate Change Action Plan (NCCAP) was developed in the second phase of the project. It was considered as part of the National Action Plan on Environment Protection of the Republic of Kazakhstan. Forests in Kazakhstan were considered a carbon sink and three categories of forest management activities were identified as potentially decreasing CO_2 emissions: management for conservation, management for storage, and management for substitutions. Possible mitigation measures considered for the forest sector in Kazakhstan, included:
- promoting improved logging practices to reduce the damage to residual trees and the soil;
- encouraging agroforestry activities to contribute to sustainable development;
- promoting forest expansion through tax policy to encourage forest management that reflects the long-term nature of forest investment;
- promoting an improved legal and policy framework to control deforestation, encourage development and climate change mitigation, including technical exchange programmes on environmental impact assessment and mitigation, and improved environmental planning;
- encouraging the use of long-lived forest products;
- providing financial incentives for new afforestation activities on private lands; and
- controlling air pollution effects on forests.

A list of climate change adaptation and mitigation measures in the forest sector were included in the National Climate Change Action Plan as priority actions. However, it was not possible to implement the action plan at that time because of a lack of financing.

During the Kazakhstan-Netherlands project *Climate Change Studies in Kazakhstan* under the NCCSAP support there were three research subprojects implemented which covering the gaps of the previous climate change studies. The First National Communication of the Republic of Kazakhstan summarized past studies, which were compiled and published. The second subproject related to GHG inventory emissions for 1994 and 1990. The third subproject was an assessment of impact and adaptation to climate changes for Kazakhstan's part of the Caspian Sea coastal zone, and the southeastern mountain regions of the country, with a focus on strategies for prevention of snow avalanches and mudflows.

Climate change studies in Kazakhstan are very important because its natural resources and economy are significantly vulnerable to climatic changes due to limited water resources, a large territory and peculiarities deriving from its geographical location at the centre the huge Eurasian continent. The sectors and regions in Kazakhstan most vulnerable to climate change were identified as water resources, agriculture (wheat production), grasslands, mountain ecosystems, and the Caspian Sea coastal zone. The main scientific results from these studies are that:

- the mountain areas of the south and southeast of Kazakhstan are vulnerable to climate change impact;
- the frequency and intensity of debris flows and snow avalanches can be expected to increase as a result of potential climate change;
- the expected rise in level of the Caspian Sea, in combination with storm surges, will cause high sea water levels;
- the Caspian Sea level rise will cause an elevation in groundwater level in the coastal zone; and
- the estimated economic and social damage caused by climate change in these areas is significant.

The contribution of the project conducted under the NCCSAP to the national climate change policy in Kazakhstan is important. The FNC was distributed among the key Ministries and other interested organizations, with a summary for policy-makers on climate change impacts and adaptation assessments, with enhanced public awareness and concern about climate change. The increase of public awareness fostered policy decisions on institutional strengthening on climate change. That is why the study on climate change adaptation strategies for mountain regions was continued under a one-year project on "Mudflows, snow avalanches and climate change in Kazakhstan" (2002). This project was supported by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) and the Swiss Federal Institute for Snow and Avalanche Research (SLF). As a result, a system of snow avalanche forecasting at Zailiyskiy Alatau range was developed based on Swiss experience and introduced into the Kazhydromet warning system.

Climate change studies in Kazakhstan from 2000 to date

Since 2000, activities on climate change have been implemented at the request of MEP within the Programme on scientific research in the area of environment protection, and the UNDP/GEF project "Enabling activities for the preparation of Kazakhstan's Second National Communication to the UN Framework Convention on Climate Change" (2006–2008). Climate change studies are very important in Kazakhstan and have been continued for MEP within the limits of budgetary financing after 2000. Since then, a GHG inventory has been prepared annually by KazNIIEK, including a national CO_2 emission-absorption balance estimated for the forestry sector. GHG inventory data obtained by KazNIIEK for Kazakhstan can be found on the Web site of the Coordinated Centre on Climate Change.

Table 1. Distribution of forest areas (State Forestry Fund) as of 01 January 2009.

Administrative area	General area of the State Forest Fund ($\times 10^6$ ha)	Forests lands ($\times 10^6$ ha)	General wood store on root[1] ($\times 10^6$ m^3)	Land cover (%)
Akmolinskaya oblast	1.0	0.4	42.7	2.6
Aktobe oblast	1.0	0.1	1.0	0.2
Almaty oblast	5.0	1.8	38.7	8.0
Atyrau oblast	0.1	0.01	0.5	0.1
West-Kazakhstan oblast	0.2	0.1	8.0	0.7
Zambyl oblast	4.2	2.2	3.4	15.3
Karagandy oblast	0.3	0.2	4.6	0.3
Kostanai oblast	0.6	0.2	16.5	1.1
Kyzylorda oblast	6.7	3.1	6.0	13.6
Mangystau oblast	0.5	0.1	0.1	0.7
South-Kazakhstan oblast	3.4	1.6	3.1	13.6
Pavlodar oblast	0.5	0.2	26.6	1.9
North-Kazakhstan oblast	0.7	0.5	54.4	5.4
East-Kazakhstan oblast	3.6	1.8	175.1	6.4
Republic of Kazakhstan (total)	27.8	12.3	380.7	4.5

Notes: (1) Standing timber stock as of 01 July 2003.

The territory of Kazakhstan is poorly forested, covering only 4.5% of the country. The forests in Kazakhstan unevenly distributed, with about 80% of the wood stock in the northern and north-eastern areas. Forest area distribution by administrative unit is shown in Table 1, based on data from the State Agency for Statistics.

Figure 1 illustrates that *Haloxylon* spp. occupies more than 60% in the general forest area in Kazakhstan. The general standing wood stock amounts to 375.8 million cubic metres, including 140 million m^3 of mature and over-mature wood. Despite considerable volumes of mature and over-mature wood (38%), which built up because of limited cutting of deciduous trees and an interdiction on coniferous tree cutting and logging for industrial processing is not a main objective. Since 1991, the official annual wood cutting volume has been reduced from 2.5 million m^3 to 1.2 million m^3. Forestry activities in Kazakhstan should stress the resource increase and ecological potential of woods. The contribution of woodworking activities to the economy of Kazakhstan was only 2.7% of the gross national product in 1990, and that was several times greater than now. Insufficiently effective reproduction and operation of woodlands demands the introduction of more modern approaches to forest restoration and management.

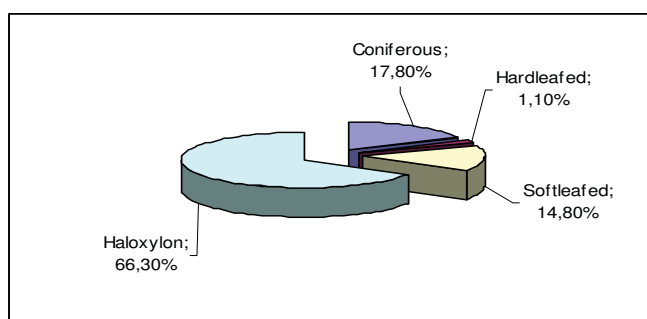**Figure 1. Shares of various tree types in the forest area of Kazakhstan in 2008.**

Table 2. GHG absorption by the forests in Kazakhstan.

Year	Stock (Gg CO_2)
2000	1961.1
2001	1951.7
2002	1929.4
2003	1373.5
2004	1884.8
2005	1708.2
2006	1557.6
2007	1842.4
2008	1961.3

The data in Table 2 show that forests in Kazakhstan represent a positive carbon stock. According to the IPCC Good Practice Guidance (GPG) on GHG inventory in LULUCF (IPCC, 2003) the estimations of GHG emissions and stocks were conducted for two categories: Forest Land Remaining Forest Land (FF); and Land Converted to Forest Land (LF).

In addition, emissions from wildfires were calculated, although most of the fires in Kazakhstan are not a result of human activities, but they are taken into account by the RK Statistics Agency. Also, in the GHG inventory calculations for the LULUCF sector in Kazakhstan, it was considered that all forests in the country are managed.

According to GHG Guidance for LULUCF, the approach of "a change of a carbon stock" for calculation of GHG emission or absorption was chosen. The tree groups are:
- Coniferous – pine, fir, cedar, juniper and similar species
- Softwood deciduous – birch, aspen, alder and poplar
- Hardwood deciduous – oak, ash, maple and elm
- Haloxylon (saxaul) forests – black saxaul and white saxaul
- Other wood – apricot, skeleton, plum, apple-tree, etc
- Bushes – dwarf birch, hawthorn and other bushes.

The basic source of the data on change in wood biomass stocks are results of the inventory of woods in RK conducted every five years (data of the accounts as of January, 1 for 1988, 1993, 1998, 2003 and 2008). During the forest inventory, the area and stock of growing wood of the basic tree groups by age group (Table 3) is determined. Although *Haloxylon* spp. occupies more than 66% of the forest area (Figure 1), they represent only 14.9 million cubic metres, or 3.8% of the whole standing wood stock in Kazakhstan in 2008 (Table 3), while coniferous and softwood deciduous trees formed more than 91% of the total standing wood stock. This is explained by the greater wood and space density, and forest stock height of the latter two categories. Experts from the Kazakh Forest Management Enterprise calculated a coefficient for the average annual gain of woody biomass equal to 1.6 m^3/ha, depending on the share of each tree group in the total wood stock.

Table 3. The area ('000 ha) and standing wood stock (million m^3) of the main woodland classes in the Republic Kazakhstan.

	Tree group											
Year	Coniferous		Deciduous softwood		Deciduous hardwood		*Haloxylon* spp.		Other wood		Bushes	
	area	stock	area	stock	area	stock	area	stock	area	stock	area	stock
1988	1737.5	221.1	1303.3	115.6	86.5	2.3	481.2	9.7	43.9	1.0	1410.0	6.5
1993	1800.2	240.4	1406.1	123.3	95.3	2.8	5091.4	10.7	80.8	1.4	2068.8	7.0
1998	1719.0	236.6	1430.5	126.0	98.1	2.9	5421.4	10.2	82.5	1.5	2675.6	9.3
2003	1650.8	228.6	1415.6	131.1	100.0	3.1	6252.8	15.2	137.0	2.6	3094.5	11.0
2008	1606.0	235.4	1378.0	127.2	98.9	3.23	6088.0	14.9	140.1	2.7	2963.2	10.9

*Data source: Kazakh Forest Management Enterprise*

For the GHG emissions inventory in the forestry sector, forest fires were also taken into account. GHG emissions from forest fires are calculated as fire area multiplied by the weight of the burnt wood and application of corresponding emission factors for each gas.

In 2007 the quantity of carbon absorbed by the forests of Kazakhstan were estimated to be 2335 Gg CO_2. GHG emissions from forest fires and wood cutting were 493.1 Gg CO_2. Thus, there was 1842.4 Gg CO_2 absorption in the forestry sector. In 2008, these values were estimated to 1961.3 Gg CO_2 absorption, 39.8 Gg CO_2 emission and a net gain of 1961 3 Gg CO_2 (Table 2).

Figure 2 shows the dynamics of absorption and emission of CO_2 in the forestry sector for 1990–2008. Emissions are basically attributed to forest fires and decomposition of detritus associated with logging. Stocks are connected with change in absorption of carbon by elevated parts of live biomass ("FF" category). Thus the contribution of the coniferous and softwood deciduous trees to carbon uptake is about 80%.

The Law on "About woods and wood plantings", and "The Wood Code", etc., ban the cutting down of coniferous and *Haloxylon* spp. plantings, which is positive for preservation and restoration of woods. In the "Wood Code" and the associated programme "Woods of Kazakhstan", confirmed by governmental order No. 542 of 14 May 2004, emphasis is placed on the implementation of a complex of actions for protection and reproduction of woods, and their rational use. The given measures, undoubtedly, will lead to stabilization and improvement of the condition of woods in Kazakhstan, especially during the upcoming global climate change. At the same time, the issue of climate change is not directly taken into account in these documents.

Figure 2. CO$_2$ absorption(1) and emission(2) from the forestry sector in Kazakhstan.
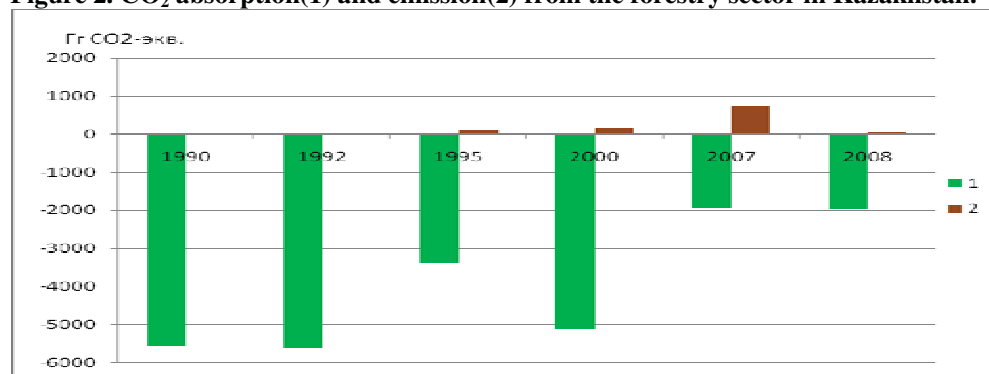
Further climate change studies in Kazakhstan

During 2004–2007 further climate change studies were conducted within the research programme of MEP. The research theme was "Estimation of regional climate change, climate change vulnerability and adaptation of ecosystems and climate-dependent branches of the economy, as well as climate change scenarios development under GHG concentration increase in the atmosphere." Additional studies on climate change were conducted within the UNDP/GEF project on the preparation of the Second National Communication (SNC) of the Republic of Kazakhstan to UNFCCC.

Briefly the results of these works are as follows. The observed annual temperature trends for the last 50 years in Kazakhstan were positive, increasing by 1.5°C. Taking into account that the greater part of the territory of Kazakhstan is occupied by deserts and semi-deserts, their ecosystems and many economic sectors, especially agriculture and water resources, are very vulnerable to climate change. According to climate change scenarios based on global climate modelling, further temperature increases with no significant gain in atmospheric precipitation may lead to a drier climate. In parallel, the climate zone boundaries may shift northward, and wheat yields may be reduced more than by 25%, grassland productivity may be reduced by 30–90%, and sheep breeding is expected to be unfavourable.

Some attention was given to research into climate change influences on the forests of Kazakhstan. The uncontrollable cutting of wood; forest fires, caused by both weather conditions and humans; less tree planting and forest rehabilitation works; and damage by insect pests—all these may led to a reduction in the wood resources of Kazakhstan. Shifting climatic zones can lead to the destruction of wood ecological systems. Areas of particular forest communities could be reduced or even disappear.

As a whole, research into the effects of possible climate change in Kazakhstan has revealed a high degree of vulnerability of the economy to the expected anthropogenic climate change. Moreover, the expected negative consequences of these changes for Kazakhstan far outweigh the positive.

Surface air temperature trends in Kazakhstan

Between 1936 and 2005, based on observation data from over 90 meteorological stations in Kazakhstan, the calculated linear trends in the mean air temperature time series and the sum atmospheric precipitation show that the climate of Kazakhstan in the period became significantly warmer. Winters in Kazakhstan are getting warmer, on average by 0.5°C per decade, while warming less in summer, at 0.2°C per decade, implying in general an overall warming of 0.3°C per decade.

Comparison of seasonal trends in different regions shows the east shore of the Caspian Sea increasing by 0.7°C per decade, while the positive tendency in winter is less, at 0.2°C per decade). The number of hot days is rising considerably in the regions of Kazakh hummocky topography (2.4 days per decade), but only 2.0 days per decade in the district of Mangyshlak. The number of cold days is decreasing in all regions of Kazakhstan, especially in the west and southwest of Kazakhstan, from minus 4.6 days to minus 7.7 days per decade in the district of Mangyshlak.

In all regions of Kazakhstan there is a reduction in the number of cold days, while the number of hot days in desert regions is increasing. A temporary tendency of extremely high daily temperature has a positive character in all Kazakhstan. Night temperatures are increasing considerably more than day temperatures. There are exceptions to this, such as in the higher areas Kazakh hummocky topography, Gorny Altai and the district near the Dzungaria Gates. It shows that nights (also in winter) in most parts of Kazakhstan are warming, and accordingly the daily and annual amplitude of air temperature is decreasing. In turn, it indicates decreasing continentality of the climate of Kazakhstan.

Climate change scenario constructions in Kazakhstan

While developing climate change scenarios, five double models of common atmospheric and ocean circulation were used, and five scenarios of atmospheric exhaust fumes concentration, as given in IPCC. The 1961 to 1990 period was accepted as the base period.

From the information in Table 3, the worst precipitation conditions derive from the "hard" scenario, where by 2085 there may be a northward zonal shift of 250–300 km. In this situation, all the northern districts of Kazakhstan will be in the semi-arid zone and the semi-arid zone will cover a very wide area. Other scenarios indicate much less of a northward zonal shift.

Research into regional climate change scenarios for use in the research on the assessment of influences on southern and eastern Kazakhstan pastures indicated air temperatures rising in all seasons of the year in this region.

Table 3. Changes in average annual surface air temperature and annual total precipitation according to "hard", "medium" and "soft" scenarios of GHG concentrations.

Scenario	Climate characteristics	2030	2050	2085
Medium	Change in average annual air temperature	1.4°C	2.7°C	4.6°C
	Change in total annual precipitation	+2%	+4%	+5%
Extremely high (hard)	Change in average annual air temperature	1.2–1.9°C (1.3°C)	2.5–4.0°C (3.0°C)	5.7–8.0°C (6.2°C)
	Change in total annual precipitation	-2– +8% (2.2%)	-4– +15% (3.7%)	8–28% (6.5%)
Extremely low (soft)	Change in average annual air temperature	1.5–2.2°C (1.7°C)	1.6–2.6°C (2.0°C)	3.1–3.4°C (3.3°C)
	Change in total annual precipitation	0-8% (3.0%)	-3– +9% (1.7%)	-2– +13% (4.1%)

Climate Change Vulnerability Assessment

While SNC was being prepared, additional research considered vulnerability and adaptation to climate change.

Spring wheat. The main districts for sown cereals are located in the north of Kazakhstan, an area of marginal agriculture. Even under the medium scenario of climate change, there will be worsening of the climate conditions for cultivation of spring wheat, that could cause a sharp decrease in crop yield: some 25–60% in Kostanay, Akmola and Pavlodar regions; and 70–90% in north Kazakhstan. Increased air temperatures will have a negative influence on plant development, which will cause a considerable decrease in crop yields.

*Grassland. U*nder the medium scenario of climate change, the condition of the pasture area of Kazakhstan will change for the worse due to reduced precipitation. The future of pasture under the influence of climate change will be evaluated in terms of loss and increase of fodder crops on sown areas. To 2030, reduction will be of the order of 40 t/ha, and 80 t/ha by 2085. For submontane pastureland, under the medium and hard scenarios for climate change, an increase of fodder units from 61 to 115 t/ha could occur annually, with the main increases (60–90%) in spring and early summer periods.

Sheep breeding. Sheep breeding is the main livestock sector in Kazakhstan. Economic reasons led to the number of sheep and goats in the republic decreasing from 36.7 head in 1987 to 9.5 million head in 1998, although by 2007 they had increased to 17.7 million head. For the last 40 years, the

average number of non-pastoral days in the cold half of the year fell to 6 days from 11, showing the easing of sheep pastoral conditions in the south of Kazakhstan. Also, the combination of a warming climate and systematic organized sheep breeding may avoid significant decrease in sheep production.

Water resources. As a result of climate change there will be increased requirement for water, nationally in order to support needs of the population and industries of Kazakhstan, and regionally for neighbouring countries that depend heavily on water resources that originate in Kazakhstan. Under the influence of anthropogenic change of climate the water resources will increase in the mountain districts, while decreasing in agronomic districts.

Forestry. In terms of percentage of forest land, Kazakhstan stands low in the global list, although the area per person in Kazakhstan, at 0.77 ha) is the same as the United States of America and Malaysia, and more than in several East European countries. With a possible move to the south in mountain regions, the resistance of forest ecosystems implies eco-climatic zone boundary disturbances. The temperature and humidity changes may cause unsuitable conditions for pine, fir, larch and cedar, and thus lead to changes in species compositions, with an increase in less valuable deciduous trees and shrubs. In mountain regions, the lower limit of spruce moving upward by 100–120 m will give way to deciduous softwood species and fruit trees. Fir plantings may disappear from the territory of Zhetisuiskiy Alatay, and they will remain only in a small area of East Kazakhstan.

This high vulnerability of forestry to climate change is explained by the circumstances that the main species, such as pine, fir, cedar and juniper, are at the southernmost border of their area, and are very sensitive to temperature and humidity regimes. Junipers grow on the northern border of their area and also are capable of reacting to changed climatic conditions.

Climate change adaptation and mitigation policies in Kazakhstan
The Republic of Kazakhstan ratified the Kyoto Protocol in September 2009, and started actively participating in the international negotiation process on climate change mitigation and further GHG reduction. Climate Change issues are considered a very serious problem in the Concept of Ecological Security for 2004–2015. It implies further climate change studies of climate tendencies and assessments of climate change impacts. The Ecological Code of the Republic of Kazakhstan, which was accepted in January 2007, introduced accounting and control of GHG emissions both at the country level and at an enterprise level, with the goal of mitigating climate change impacts. The necessity of adaptation to climate change is still not included in governmental legislation. However, the development of the Adaptation Strategy of the Republic of Kazakhstan is one important part of the Plan of Action of the Ministry of Environmental Protection - Road Map for 2010. Since 2009, Kazakhstan has been developing a strategy on low carbon economic development.

The percentage of wooded land in Kazakhstan, including *Haloxylon* spp. and bushes, is 4.5%, while forests are only 1.2%. Nevertheless, despite their small size, the forests play an important role in soil protection, in climate and water regulation, water protection and in recreation. The forming of a propitious environment for stable forest regulation takes on an important significance in climate change conditions. Aiming at realization of the governmental regulation of the Republic of Kazakhstan, No. 319 of 20 April 2007, the programme "Zhasyl El" for 2008–2010 was developed and ratified, No. 958 of 16 October 2007. It plans to create forests on 145 180 ha, and set the pattern for future work on forest protection and expansion. The problem of protecting, restoring and sustainably using the biological and landscape diversity has been made difficult in the absence of scientifically grounded recommendations and measures to protect and reclaim of bio- and landscape diversities, and the limited resources in terms of plantations and genebanks.

Review of status and work by national research institutions on research for assessment of climate change

Currently, research on climate change in Kazakhstan is provided in The Kazakh State Climate and Ecology Research Institute, in the State Republican Enterprise "Kazhydromet", and in the Coordinating Centre on Climate Change, which is a non-governmental organization (NGO). By order of the Ministry of Environmental Protection, between 2004 and 2007 there was research into the influence of global climate change on the economy and natural resources.

The Ministry of Environmental Protection is the national authorized body of the government, accomplishing regulation and inter-sectoral coordination in terms of developing and realizing state policy in the sphere of environmental protection and nature management regulation. National projects in the sphere of climate research are coordinated by the Ministry, including institutional and real sector projects, projects of societal access to ecological information on adaptation to climate change and on GHG emission reduction. The Ministry also develops legislation for realization of its obligations under the UNFCCC and the Kyoto Protocol.

Currently the Ministry of Environmental Protection has a programme «Zhasyl Damu» (Green development) for 2010–2014, the main purpose being to improve environmental quality and to support sustainable ecological development of society. One of the three elements of the programme, "Protection and restoration of natural ecosystems", addresses transition to sustainable development, climate change, biodiversity saving, coping with land degradation, areas of ecological disaster and polluted territories.

State Republican Enterprise "The Kazakh State Climate and Ecology Research Institute" (KazNIIEK)

One of the main tasks of SRE KazNIIEK is to satisfy international obligations taken under UNFCCC and other international agreements, as well as to form and implement government ecological policy in the sphere of hydrometeorology and environmental monitoring. Since 2000, KazNIIEK, by the order of the Ministry of Environmental Protection, has worked on GHG inventory in Kazakhstan. The resulting GHG inventory is presented to the government annually, and adds to the national reports on environmental conditions in the Republic of Kazakhstan.

In the frame of climate change for 2010, the Ministry of Environmental Protection entrusted to KazNIIEK to develop the concept of low-carbon development and a strategy on climate change adaptation. KazNIIEK is working of this with the support of the UNDP/MEP project "Strengthening capacity in the field of sustainable development through integration of climate change issues into strategic planning in the Republic of Kazakhstan".

State Republican Enterprise "Kazhydromet"

Kazhydromet activities related to climate change problems include:
- hydrometeorological monitoring;
- assessment and climate forecasting;
- hydrometeorological mechanisms and climate change studies;
- long- and short-term weather forecast methods development and improvement;
- research into climatic, hydrological, agricultural and meteorological resources and changes under natural and anthropogenic factors; and
- complex studying of natural meteorological phenomena and meteorological regime of the Caspian Sea, Aral and Balkhash Lakes, the Baikonyr spaceport, and adjoining territories.

Kazhydromet provides systematic observations from 251 meteorological stations, which form the basis for climatic monitoring. There is a scientific branch that provides climate research and its assessment, and also is working on scenarios of climate change. The scientists of Kazhydromet work on climate change vulnerability and adaptation assessment, and took part in the SNC preparation.

Non-governmental organization "Coordination Centre on Climate Change"

The NGO Coordination Centre on Climate Change (C4) is active in climate change works and is the first NGO working in the sphere of UNFCCC and the Kyoto Protocol. C4 was established in 2002. Specialists of C4 formed working groups on project realization in the sphere of GHG reduction. It allowed a demonstration to the community of Kazakhstan of the possibility for realizing such projects, their benefits both for the individual citizen and for the national economy. C4 operates as an independent organization attracting financial resources in order to address Kazakhstan's global ecological problems. Environmental protection decisions are impossible without a corresponding legislative basis, and the Centre participates in improving and harmonization of the legislative basis of Kazakhstan to implement obligations under international ecological conventions.

C4 supplies expert support to realization of the Kyoto Protocol mechanisms. National partners of C4 are KazNIIEK, Kazhydromet, the public association "Karaganda Oblast Ecological Museum", and others. It has held many seminars and meetings on environmental problems, particularly in the area of protection of the ozone layer and global climate change.

Public Association "Karaganda oblast Ecological Museum" (Ecomuzei)

The NGO "Ecomuzei" supports the collection and dissemination of ecological information in the territory of central Kazakhstan in order to improve the role of society in decisions on topical ecological problems, and democratic processes in development of society. One of the main objects of Ecomuzei is adoption of new effective ecological technology, including building of biogas installations. In 2006, "Ecomuzei" organized the first Central Asian conference on sustainable energy.

Institute of Botany and Phytointroduction of the Ministry of Education and Science

In accordance with global climate change, the Institute of Botany and Phytointroduction works actively on protection of biodiversity and further planning to provide research on conformity and dynamic conditions of vegetative cover. There is a need for long-term biosphere stationary monitoring, realization of permanent monitoring conditions of vegetative cover coupled with observation of climate change effects on vegetation. The Institute of Botany and Phytointroduction in Kazakhstan developed a project for ecology-based monitoring of vegetative cover in global climate change.

The necessary control database for analyses of anthropogenic changes in vegetative cover and changes associated with climate change, could be developed on the basis of earlier surveys of the biological properties of the types of plants and vegetative cover in nature and cultivation. In this context, the main value of the research is the amalgamation of data from other teams of researchers, including the Institute of Botany, forestry, agricultural afforestation, agriculture, grassland agriculture, pedology, plant physiology, Kazakh Agriculture Institute, Institute of Phytophysiology, Institute of Soil Science, Kazakh Al-Farabi National University, botanic gardens and nature reserves. Unfortunately, today we have no reliable methodology to assess climate change influences on the vegetative cover. Accordingly, the primary task is to elaborate methodical approaches to the assessment of climate factor influences on the dynamics of vegetative cover and to the biota as a whole.

The trend in natural resources and vegetative cover changes in Kazakhstan may be considered as a fast-growing disaster. But Kazakhstan is not ready to assume the measures to protect it, because mechanisms of changes are not sufficiently understood and there is little or no monitoring. It depends on a number of reasons, including human resources, economic conditions and financial provisions for research activities and their support by the State. Also there is no State scientific policy identifying the direction and work strategies concerned with global climate change. Global climate change requires that monitoring of vegetative cover be a main priority in the sphere of botanical and ecological research.

The Kazakh Forest Management Enterprise

The Kazakh Forest Management Enterprise is a state institution under the Committee of Forestry and Hunting of the Ministry of Agriculture. The main object of its activity, defined by the Wood Code of the Republic of Kazakhstan, is working out a complex of measures on maintenance and rational use of forestry and wood resources, optimal reproduction, protection and protection of woods based on reliable information regarding wood resources. Realization of an electronic databank on the forest fund will promote creation of a state wood cadastre and monitoring of woods; to define volumes for sustainable forest use; actions for reproduction of forests; and control of activities by establishments in forest management projects.

The enterprise conducts the state accounting of the forest fund, the purpose of which is to provide state bodies and interested legal and physical persons with the operative information on condition and dynamics of the national forest fund. The documentation is updated every fifth year. Between each five-year accounting, annual accounts of the wood fund are maintained under a special form (areal data).

The enterprise plays an important role in forest management. However no activity related to climate change impact and adaptation has so far been undertaken, and there is a lack of information in this area. Carbon sequestration by the forests of Kazakhstan may be significant because huge territories with trees are outside the system of forest accounting. There is a need to improve the inventory of the forests in Kazakhstan.

International projects

Among current international projects concerning to a certain degree climate change impact issues, there is a UNDP/GEF project "Conservation and Sustainable Use of Biodiversity in the Kazakhstani Sector of the Altai-Sayan Ecoregion". The main objective of the project is to enhance the sustainability and conservation effectiveness of Kazakhstan's national protected areas system by demonstrating sustainable and replicable approaches to conservation management. It focuses on several important economic sectors, including agriculture (livestock production, farming, fishery) and forestry in the region. Although there are no direct indications of climate change adaptation issues, it will undoubtedly also promote adaptation of these sectors to climate change impacts.

Another climate change-related project is being implemented in the frame of the UN Convention to Combat Desertification. Since 2005, the Central Asia countries have collaborated in a complex regional programme "Central Asian Countries Initiative on Land Management" (CACILM). The purpose of the programme is strengthening the potential for sustainable management of land resources; mobilization of investments for project realization on rational use, restoration and prevention of land degradation, especially for rural territories; increase in standard of life and their attraction to programme realization.

Projects on adaptation to climate change are implemented currently only in the framework of the UNDP/GEF Small Grant Programme. Since 2009, several small projects have been realized at the level of rural communities, on water resources savings, rational irrigation and horse breeding.

Less attention has been paid to issues of climate change impact on forestry and its adaptation to the expected climate. There are no projects on carbon accounting in the LULUCF sector.

Summary list of proposals to identify possibilities for collaboration between FAO and national institutions and specialists

Below is a list of proposals identifying possibilities for collaboration between FAO and national institutions and specialists:

- Elaborating methodological approaches to the assessment of climate change influence on dynamics of vegetative cover and the whole biota. (Institute of Botany and Phytointroduction, with KazNIIEK)
- To develop a modern agro-climatic informational scheme to support food safety and to decrease desertification processes on the arable lands of Kazakhstan. (KazNIIEK as coordinator)
- Assessment of potential carbon uptake of forests in the Republic of Kazakhstan as a result of reforestation and forest recreation on the land of the forest fund.
- Improvement in the system of care of protective forest belts and protection of woods against fire.
- Creation of plantation timber to increase the wooded areas in operated boreal and moderate woods.
- Assistance to natural forest recreation for the increasing of forest care areas.
- Actions for care of wood culture with a gain in the areas of forests.
- Reforestation and creation of protection planting in desertification areas.
- Preventive maintenance in forests.
- Preservation of pine forests in the east of Kazakhstan under threat from potential climate change.
- Improving forest exploitation under conditions of global climate change.
- Introduction of a carbon accounting system in the forestry sector of Kazakhstan on the basis of the state account of the forest fund.

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