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Central Asia: Background Paper on Climate Change

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Central Asia: Background Paper on Climate Change

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Summary

Central Asia (CA), encompassing the newly independent countries - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan - is rich in natural resources, most still untapped. Water is the most precious and conflict-prone natural resource in the regions. In Kyrgyzstan and Tajikistan, large quantities of water are stored in the mountain glaciers. Kazakhstan, Turkmenistan and Uzbekistan have huge and mostly unexplored oil and gas deposits. At the same time, almost half of the population of these countries live in poverty and lack access to sufficient natural resources to sustain their livelihoods, while the countries' wealth is unevenly distributed.

Global climate change poses serious threats to the region's environment, ecological and socio-economic systems. Agricultural production has already decreased in some commodity groups and quantities and qualities of water resources are at risk of severe effects of climate change.

Climate change considerations call for such major policies as the reduction of GHG emissions, including lowering carbon intensity of economies with less fossil fuel (such as oil and coal) mined, burned, traded, introducing cleaner technologies, climate change mitigation and adaptation. Climate change issues are closely interwoven in the issues of water availability and energy security severely affecting the livelihood in the CA region.

As a climate change response policy, all the five countries have already established an environmental legal and regulatory framework for meeting their commitments under the UNFCCC. Central Asian countries are non-Annex I countries to UNFCCC and their commitments are to carry out a GHG emissions inventory periodically, as well as vulnerability and mitigation studies. Kyoto Protocol has opened up new opportunities for participating in GHG mitigation projects through the flexible mechanisms.

To alleviate the situation in the years to come, the CA countries, with the assistance of the international community, undertake activities primarily in two directions. Firstly, they amend their national legislation to take into account climate change in their socio-economic and environmental policies and, secondly, this legislation opens up possibilities of designing and implementing national climate change policies and practical actions in compliance with the Kyoto Protocol. They carry out greenhouse gas (GHG) emission inventories and participate in Clean Development Mechanism (CDM).

It is against this background that this ***Regional Study Paper*** considers:

- how the climate change is viewed to affect *water and energy security* as the key issues in the CA region,
- what GHG emissions are generated by the region and its individual countries, including their specific economy sectors,
- what components of the region's environment are expected to be most vulnerable under climate change, and, finally,
- what response policies are designed or envisaged. It concludes with some recommendations for future actions as they are considered in the CA region.

List of Acronyms

CA - Central Asia

CDM - Clean Development Mechanism.

GDP - Gross Domestic Product

GHG - Greenhouse gases

IPCC - Intergovernmental Panel on Climate Change

NAP - National adaptation plan

NC - National Communication

PIN - Project Idea Notes

PDD - Project Design Documents

UNFCCC - UN Framework Convention on Climate Change

GHG - Greenhouse Gas

IPCC - Intergovernmental Panel on Climate Change

LUCF - Land Use Change and Forestry

NMVOC - Non-Methane Volatile Organic Components

NGO - Non-Governmental Organization

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Introduction: the context of climate change threats in Central Asia

Central Asia (CA), encompassing the newly independent countries - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan (Fig. 1) - is rich in natural resources, most still untapped. Water is the most precious and conflict-prone natural resource in the regions. In Kyrgyzstan and Tajikistan, large quantities of water are stored in the mountain glaciers. Kazakhstan, Turkmenistan and Uzbekistan have huge and mostly unexplored oil and gas deposits. At the same time, almost half of the population of these countries live in poverty and lack access to sufficient natural resources to sustain their livelihoods, while the countries' wealth is unevenly distributed.

Global climate change poses serious threats to the region's environment, ecological and socio-economic systems. In this region, agricultural production has already decreased in some commodity groups and quantities and qualities of water resources are at risk of severe effects of climate change.

Figure 1 Map of Central Asia

Source: http://www.sofreco.com/projets/c886/index.htm)

The socio-economic transition of the CA countries to market economies under new political systems has therefore been since recently aggravated by another transition, namely climate change. On the other hand, Central Asia significantly contributes to global warming by generating large volumes of GHG emissions. Kazakhstan is the 30th largest emitter of carbon dioxide worldwide and Uzbekistan is the most carbon intensive economy globally. (WRI, 2005)

These emissions are partly a legacy of the past economic and, in particular, industrial policies. Energy resources were allocated among CA countries as far back as the USSR times in such a way that Kazakhstan was responsible for the supply of coal, Uzbekistan – for natural gas, while Turkmenistan – for oil. These industries are the largest contributors to Central Asian's GHG emissions. The concern over climate change is especially growing because climate change affects the CA region's water and energy security and can lead to political tension among the countries unless carefully managed by all of them.

Climate change considerations call for such major policies as the reduction of GHG emissions, including lowering carbon intensity of economies with less fossil fuel (such as oil and coal) mined, burned, traded, introducing cleaner technologies, climate change mitigation and adaptation. Climate change issues are closely interwoven in the issues of water availability and energy security severely affecting the livelihood in the CA region.

As a climate change response policy, all the five countries have already established an environmental legal and regulatory framework (specifically air protection laws) for meeting their commitments under the UNFCCC. Central Asian countries are non-Annex countries and their commitments are to carry out a GHG emissions inventory periodically, as well as vulnerability and mitigation studies. However, any GHG reductions by CA countries would contribute to the ease of the global warming issue especially when we consider that mitigation of climate change issue should be a joint international effort. Moreover, the Kyoto Protocol has opened up new opportunities for participating of CA countries in GHG mitigation projects.

To alleviate the situation in the years to come, the CA countries, with the assistance of the international community, undertake activities primarily in two directions. Firstly, they

amend their national legislation to take into account climate change in their socio-economic and environmental policies and, secondly, this legislation opens up possibilities of designing and implementing national climate change policies and practical actions in compliance with the Kyoto Protocol. They carry out greenhouse gas (GHG) emission inventories and participate in the Clean Development Mechanism (CDM) efforts.

Their CDM/JI institutional capacity building varies, but generally requires additional support. In particular, substantial progress on CDM institutional capacity development has been recently achieved in Uzbekistan over the last year and a half. However, no CDM project from CA had been registered by the CDM Executive Board until 2007. There are some stand alone projects that tend to evolve into CDM projects but affected by unavailability of approved baseline methodologies.

It is against this background this ***Regional Study Paper*** will consider:

- how the climate change is viewed to affect *water and energy security* as the key issues in the CA region,
- what GHG emissions are generated by the region and its individual countries, including their specific economy sectors,
- what components of the region's environment are expected to be most vulnerable under climate change, and, finally,
- what response policies are designed or envisaged. It concludes with some recommendations for future actions as they are considered in the CA region.

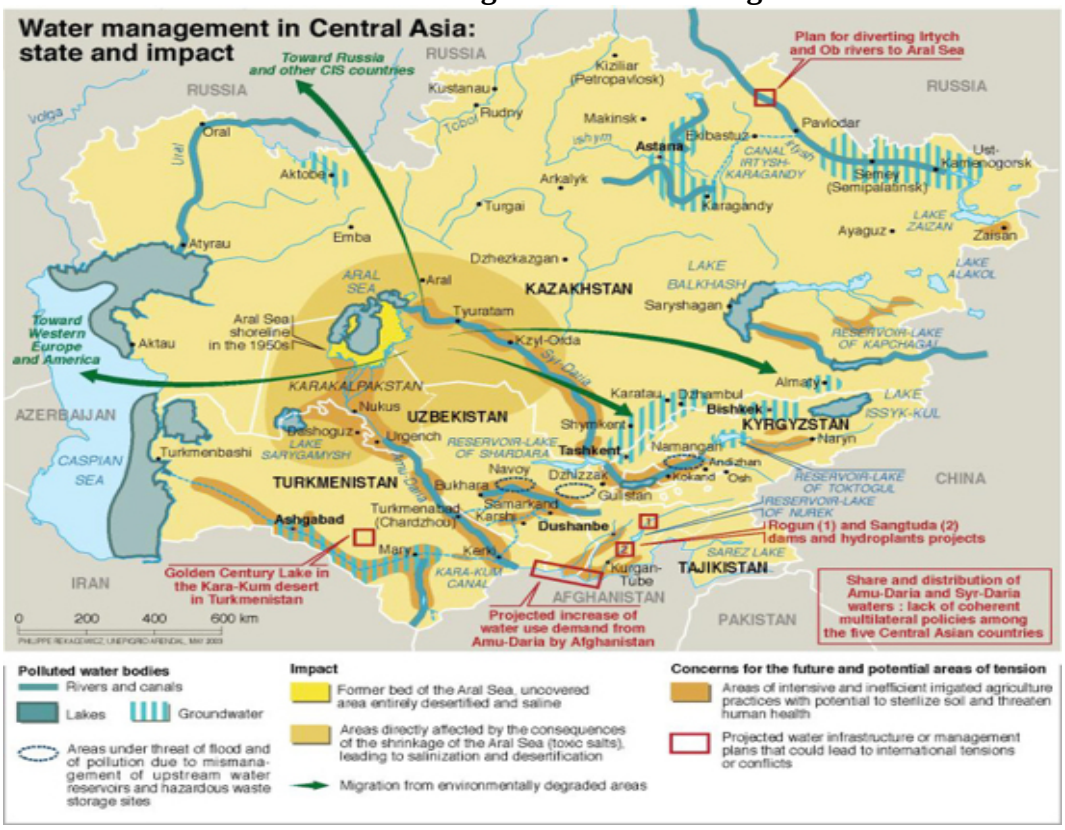
1. Climate change and water availability in Central Asia

Water availability is one of the major concerns for the Central Asia region. Water management policies and their harmonisation are crucial because of water interdependence of countries in the region as it is shown in Fig. 2. Climate change is anticipated to alter the hydrological cycle, and is unlikely to relieve the limitations placed by water scarcity upon the region. Water is an important limiting factor for ecosystems, food and fibre production, human settlements, and human health in this arid region of the world. Climate change and human activities may further influence the levels of the Caspian and Aral Seas, which will affect associated ecosystems, agriculture, and human

health in the surrounding areas. Win-win opportunities exist which offer the potential to reduce current pressures on resources and improve the human welfare in the region and also offer the potential to reduce their vulnerability to adverse impacts from climate change.

The CA countries are undergoing radical economic transitions, with great impacts on many sectors likely to be affected by climate change. Much of the agriculture of this arid region developed in response to the agricultural plans of the former Soviet Union the legacy of which is still there. Irrigated cotton production, for example, expanded from the 1960s through the 1980s, with significant impacts on water resources, the environment, and human health. Water resources were overcommitted to agriculture and were transferred unsustainably from several river systems.

Figure 2 Water management in Central Asia

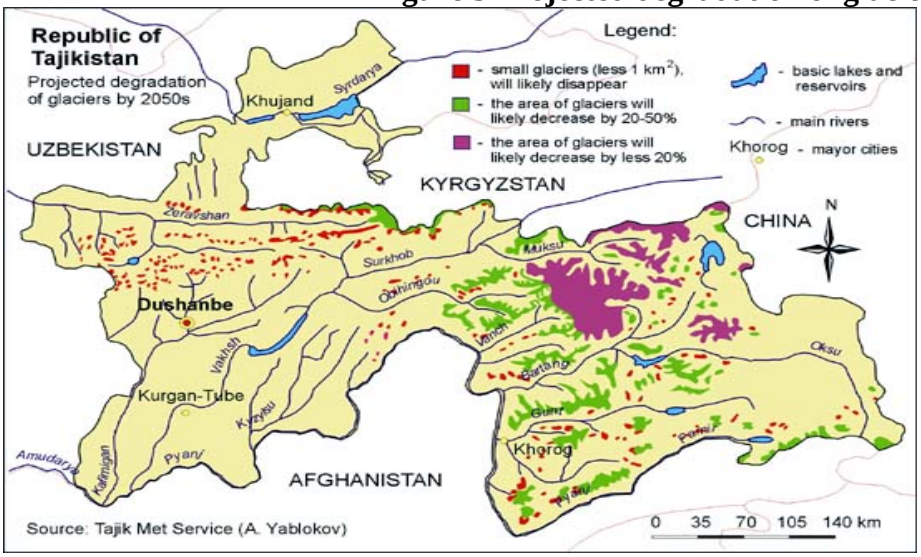


Source: UNEP, 2003

Many experts believe that the Central Asian climate will significantly warm up, resulting in major environmental, economic and social disruptions. 46 Glaciers are already shrinking, which may eventually decrease water flows (Fig. 3). From the 1950s to the 1990s, the Pamir-Alai glaciers lost 19 per cent of their ice, with the process now gaining

in intensity. For several decades, the area of glaciers in different regions of Tien Shan, Gissaro-Alai, Pamirs and Dzhungarskiy and Zailiyskiy Alatau has decreased at the average rate of about 1 per cent per year. According to some model predictions, the availability of water in Syr Darya may decrease by up to 30 per cent and in Amu Darya by up to 40 per cent. Some other models do not predict such dramatic declines, but no scenario shows an increase in water flow; in all models, the demand for water grows faster than the natural supply. Increasing occurrence of droughts and decreased grain productivity are also widely predicted. Given high uncertainties over these projections and the potentially serious consequences for human security and development in the region, it is necessary to constantly update and improve the knowledge (and its use in policy decisions) of natural processes in glaciers and mountain areas (UNDP 2005).

Figure 3 Projected degradation of glaciers by 2050



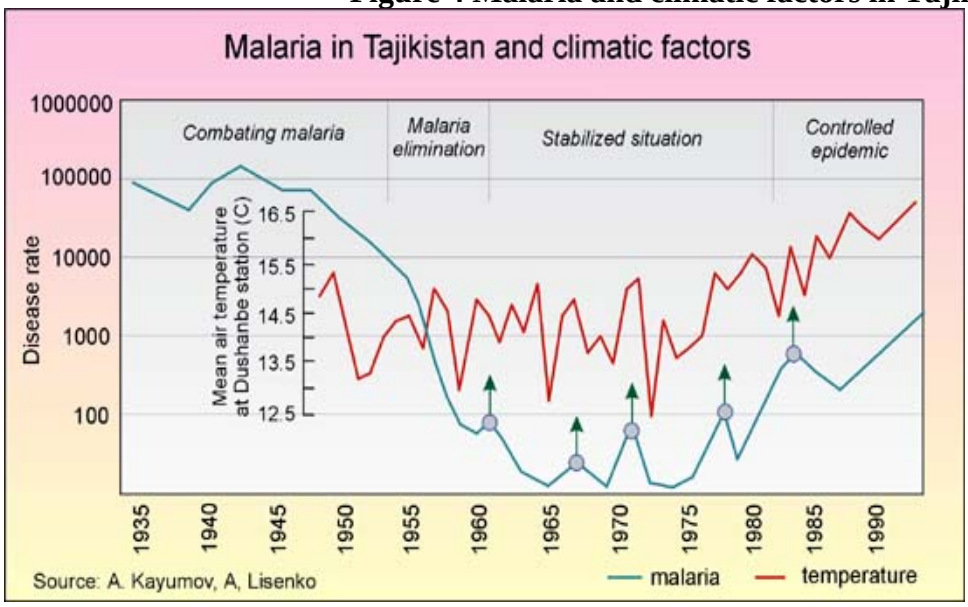
Source: Tajikistan 2002: State of the Environment Report

While climate variations and changes in the mountain ecosystems seriously affect water quantity, environmental pollution reduces its quality, often making it unsuitable for irrigation, drinking or commercial purposes. Since the 1960s, the water quality in Central Asia has drastically deteriorated. The main reason for this has been the discharge of heavily polluted water through drainage systems currently making up to 15 per cent of the river flow volume of the Aral Sea basin. Since the 1960s, mineralization of water in the lower reaches of the Amu Darya and Syr Darya has at least doubled, and water has also become unacceptable for drinking. (Central Asia HDR 2005, UNDP).

Targets for improved efficiency in irrigation as a complementary **climate change adaptation** strategy could lead to savings in water use, which would be more important than any changes likely to result from climate change over the next few decades. Throughout the CA states, options to reduce water use include lining more irrigation canals to reduce seepage losses (up to 40% of diverted water is lost in arterial channels) and reducing the area of crop and pasture irrigated by inefficient flooding methods while increasing the area of more-valuable fruit and vegetable crops irrigated by efficient drip and below-ground irrigation systems. In Turkmenistan, for example, cotton irrigation required 12,000 m^3 water/ha in the mid1990s; more modern techniques would require only 7,000 m^3/ha. More than one-third of all water used in Turkmenistan is applied to irrigated cotton; thus, modernizing techniques could save 20% of the country's current water use. Uzbekistan plans to reduce water consumption in agriculture and similar opportunities for such large savings probably could also apply in Tajikistan. Turkmenistan features the extremely uneven location of water resources: 95% is the share of Amudarya, the other 5% is the share of all rivers, springs and discovered reserves of the underground water in the south and southwest of Turkmenistan. The water scarcity has an immediate influence on the natural environment and human living conditions and a secondary impact on agricultural productivity. Turkmenistan has experienced tensions with Uzbekistan over water allocations from one of the most important water sources in the region, the Amu Darya, flowing through the eastern part of the country (UNEP, 2003). At the same time, this crucial water source has been regularly listed among the most polluted water bodies in Central Asia.

Climate change impact on ecosystems brings along changes in genetic, species, and ecosystem biodiversity. Such changes affect, in particular, human health increasing, for example, incidences of diseases, such as malaria (Fig. 4)

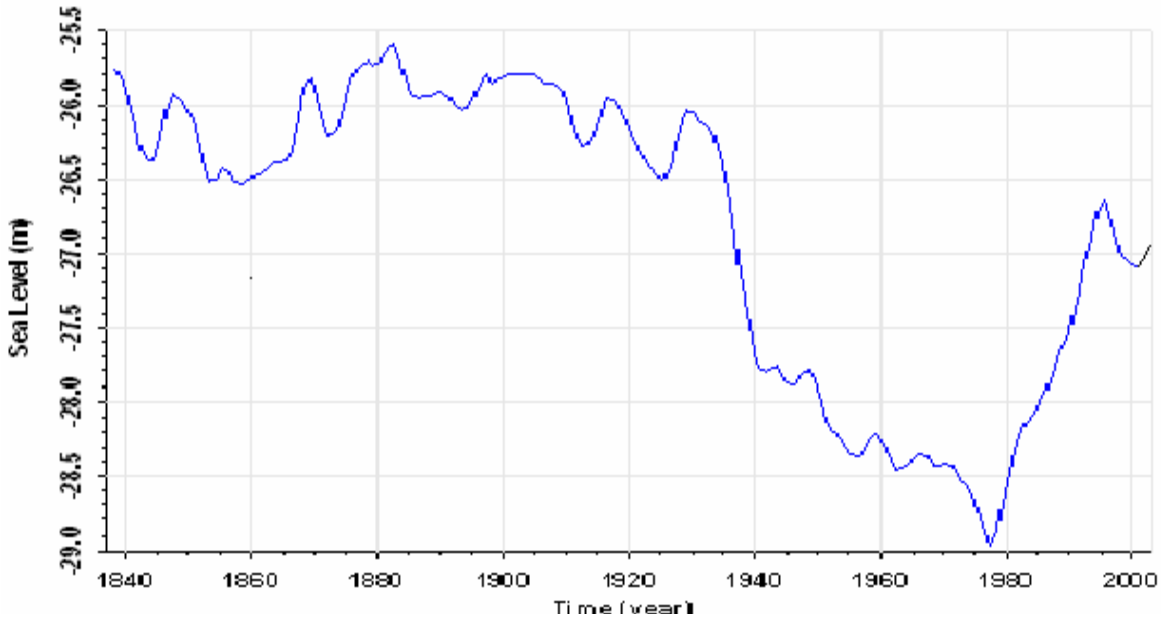
Figure 4 Malaria and climatic factors in Tajikistan



Source: Tajikistan 2002: State of the Environment Report

The top-priority issue in a large part of the Central Asia is the understanding of the Caspian sea level changes causes and possibility of its long-term fluctuations prediction. Fluctuations of the Caspian Sea level are also a point of interest as an index of a regional climate change, which is connected with its global change (Fig.5). Present changes of the Caspian Sea level are caused by certain variance of the water balance components and mainly by river runoff and visible evaporation. Different approaches have been used to forecast long-term variations of the Caspian Sea level and water balance components. However, successful forecast that explain long-term changes (tendencies) in the Caspian Sea level is still absent.

Figure 5 Annual levels of the Caspian Sea measured in the Baku post (the Azerbaijan western coast)



Source: PANIN 2006

2. Central Asia contribution to global climate change

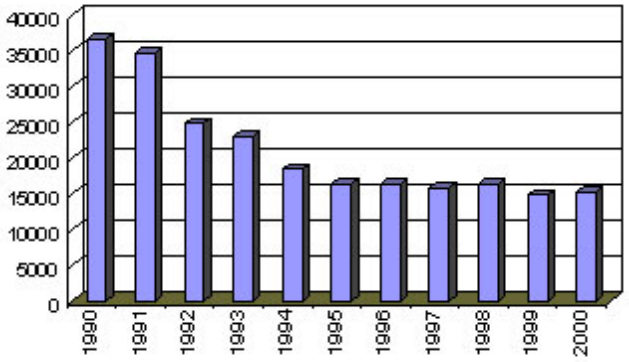
Carbon intensity of economic activity is determined by the past and current economic development policies, especially by the amount of fossil fuels, such as coal and oil, burned in energy, transport, and industry, and other sectors. Energy resources were allocated among CA countries as far back as the USSR times in such a way that Kazakhstan was responsible for the supply of coal, Uzbekistan – for natural gas, while Turkmenistan – for oil. These industries are the largest contributors to Central Asian GHG emissions.

Kyrghyzstan

Industrial recession during the past 10 years has led to reduction in GHG emissions from stationary sources (See Figure 6). Due to a lack of mineral accessible fuels and finances, the country has considerably increased electricity production from hydropower, in particular in winter. This keeps GHG emissions at a low level but requires water savings for irrigation purposes during winter time (in particular, for the downstream states lacking

water but rich in energy resources). Still, energy sector accounts for the largest share of total GHG emissions (74%) even that its total share decreased from 80% in 1990. Since recently, transport pollution has significantly increased and now is a major source of air pollution in the country, as well as significant contributor of GHG emissions (Environment and sustainable development in Central Asia, 2005). Despiote recebnt decline associated with overall economic recession in the coutry, current GHG emissions are on the rise and are expected to increase by 25% up to 25 MtCO2e/yr already by 2010.

Figure 6 Kyrgyzstan: GHG emissions in Gg of CO2 equivalent



Source: First National Communication of the Kyrgyz Republic on Climate Change under the UNFCCC, Bishkek, 2003

After the collapse of the Soviet Union, Kyrgyzstan had to import natural gas and oil products at much higher prices than before and which were previously subsidized. The country depends on foreign energy suppliers, such as Russia and other CA states that meet 60% of its energy demand. Therefore, energy security and energy dependence have a top political and economic priority. As such measures to reduce GHG emissions through increased energy efficiency and use of renewable energy could bring double development dividend, i.e. lead to reduction of GHG emission and improve situation with energy security in the country.

Kazakhstan

With annual GHG emissions of more than 200 MtCO2e/yr, Kazakhstan is by far the largest GHG emitter in Central Asia. Its energy sector generates about 80% of total emissions, out of which about 90 % refer to emissions due to fuel combustion and about

10 % - to fugitive emissions related to extraction, transportation and processing of fuel (see Figure 7). The GHG inventory in Kazakhstan shows that the 2005 GHG emissions with a direct greenhouse effect amounted to 240.7 mln.t of CO_2 equivalent, including 187.7 million t from the energy sector, 16.1 million t from the industrial sector, 20.2 million t from agriculture and 16.6 million t from waste. For the 1990-1995 period, mid-annual increase rates of GHG emissions in the atmosphere were 6.7 %. The CO_2 sequestration by the forestry sector and land use amounted to 5.9 million t in 2005 as shown in table 3. Thus, GHG net emissions were 234.8 million t in the CO_2 equivalent. Total CO_2 emissions were 186.3 million t without carbon sequestration by forests and 180.4 million t with it in 2005.

Figure 7 GHG emissions in Kazakhstan, mln t of CO2 equivalent

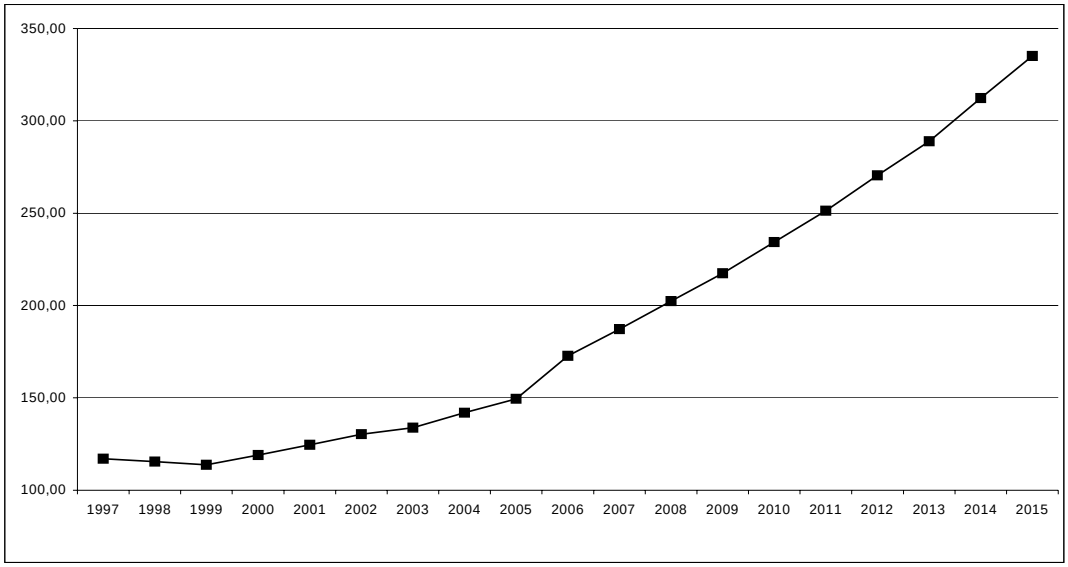
GHG categories	1990	1992	1994	2000	2005
CO_2	**238.3**	**261.2**	**243.7**	**137.3**	**186.3**
Energy activity	220.1	246.3	236.5	126.6	170.2
Fuel combustion	216.8	243.0	233.9	120.3	163.7
Fugitive emissions	3.3	3.3	2.6	6.3	6.5
Industrial processes	18.3	14.9	7.2	10.7	16.1
Land use changes and forestry (sinks)	-8.1	-7.1	-4.8	-7.1	-5.9
CH_4	**64.0**	**57.8**	**46.3**	**33.9**	**42.7**
Energy activity	39.0	32.8	23.9	13.1	17.0
Fuel combustion	1.6	1.9	1.2	0.4	0.6
Fugitive emissions	37.4	31.0	22.7	12.7	16.4
Industrial processes	0.05	0.04	0.02	0.03	0.03
Agriculture	16.9	16.5	13.6	7.4	9.5
Waste	8.0	8.5	8.7	13.4	16.2
N_2O	**27.0**	**25.1**	**17.6**	**9.0**	**11.7**
Energy activity	0.8	0.9	0.9	0.4	0.5
Fuel combustion	0.8	0.9	0.9	0.4	0.5
Agriculture	25.8	23.8	16.2	8.3	10.7
Waste	0.4	0.4	0.5	0.3	0.4
Total emissions	**329.3**	**344.1**	**307.6**	**180.2**	**240.7**
Net emissions (sources – sinks)	321.2	336.9	302.7	173.1	234.8

Source: Greenhouse gas emissions inventory, 2004. Republican state enterprise "Kazakh research institute of ecology and climate » (KAZNIIEK).Astana, 2006

Since 1990 is the base year for the majority of countries for the Kyoto Protocol purposes Kazakhstan's current total GHG emissions are now well below its 1990 level (i.e. emission in 2005 accounted to 73% of 2005 emissions). However given high rates of economic growth and accelerated development in fuel and energy as well as mining sectors, it is projected that average annual GHG emission will grow and could reach

the 1990 level (or around 300.9-344.8 mln. t CO_2 equivalent) already by the end of first Kyoto period (2008-2012) and increase further up to 340-390 mln. t by 2015 (Fig.8).

Figure 8 Forecasts of CO2 emissions of Kazakhstan's energy sector, in mln. t.



Key factors determining high energy and consequently carbon intensity in Kazakhstan are the following:

- High concentration of energy-producing facilities;
- Location of large energy plants mostly near fuel-extraction sites;
- a well developed network of electricity transmission lines of high voltage lines (500 and 1150 kilowatts);
- a system of relay-type safeguards and anti-damage automated mechanisms, assuring stability of the power grid in emergency and post-emergency situations;
- an integrated vertical system of operational control management consisted of the central dispatcher's unit, regional dispatcher centers, dispatcher centers of electrical energy consumers.

Kazakhstan has not yet ratified the Kyoto Protocol, but has already decided on joining Annex 1 after the ratification of the Kyoto Protocol. Therefore, Kazakhstan has different objectives than other CA countries focusing in particular on defining its quantitative emission reduction targets, creating a JI infrastructure and setting up an internal emission

trading scheme. This maybe possible given that overall level of technical, human and institutional development is viewed substantially higher in Kazakhstan than in the other four countries. In addition it should be taken into account that Kazakhstan is pursuing a different approach with regard to Kyoto Protocol implementation.

Uzbekistan

According to the first National Communication of the Republic of Uzbekistan under the UN FCCC (2001), total GHG emissions reached 160.5 million tons of CO_2-equivalent and made up 0.7% of global GHG emissions in 1999. Major sources of GHG emissions are enterprises of the fuel and energy sector, construction industry, metallurgical and chemical industry, automobile and railway transport, agriculture, mining and transportation of minerals as well as waste storage and processing.

A share of industrial processes related to extraction, transportation and combustion of fossil fuels amounts to over 73% (117.8 million tons of the CO_2-equivalent, 1999). A note should be made that for the ten years' period of 1990-1999 GHG emissions continue to grow by 11% (110 million tons CO_2 equivalent, 1990). It is expected that the rate of GHG emissions growth will increase by 16% by 2010 in comparison to he 1990 level. The major GHG is carbon dioxide, which makes 67% of all GHG emissions. Its main source is the energy sector of country, notable energy production and use.

The second significant GHG is methane (about 27%) which is generated by mining, transportation of natural gas, production of oil and coal. Agricultural part of methane emissions is also significant. The most part of it is released by rice cultivation and intestinal fermentations of ruminants.

The main directions of GHG emissions change are as follows: GHG emissions fall in the fuel-energy sector; energy efficiency rise in the housing-municipal sector; lowering the methane leakage in the oil-gas sector; growing use of renewable energy resources (UNEP Climate School – Uzbekistan, 2006)

Turkmenistan

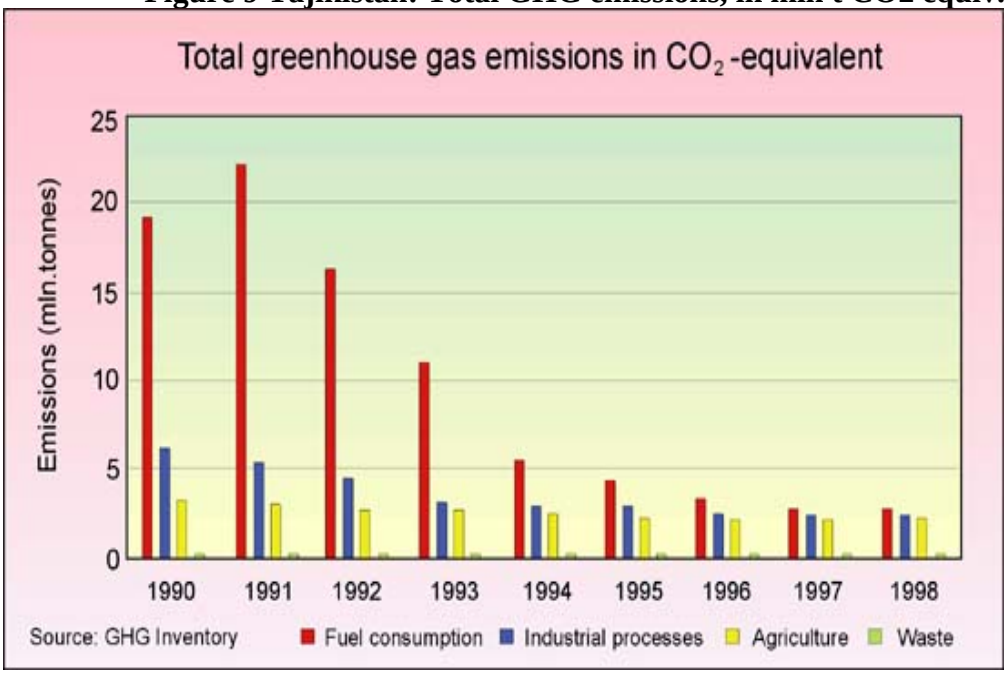
In 1994 Turkenistan's GHG emissions were 52 MtCO2eq/yr with energy sector contributing about 93.5% of the total amount. It is expected that the total GHG emissions will increase by 62% by 2010, mainly as a result of the planned increased in oil and gas production activities. Nevertheless, Turkmenistan is interested in developing its abundant renewable energy potential (wind and solar) and would like to explore the use of carbon financing for implementation of projects in this area. Since 1995, Turkmenistan is a non-Annex I party to UNFCCC and since 1999 is a party to the Kyoto Protocol.

Tadjikistan

GHG emissions are insignificant and do not influence the climatic system. The main sources of GHGs in Tajikistan are cement and aluminum production, fossil fuel combustion in transport, industrial and communal sectors, agriculture and land use change, including the reduction of timber biomass in forests. Household and industrial wastes contribute a small part of greenhouse gas emissions. (National State of the Environment Report. Tadjikistan, 2002)

According to experts' assessments, contribution of Tajikistan to the global warming during 1970-2000 totaled 300 million tonnes of CO_2, including emissions from fossil fuel combustion and cement production. The results of GHG inventory show that largest emissions in Tajikistan were registered in 1991 and amounted to 31 million tonnes of CO_2-equivalent without consideration of their removal by natural sinks. The least emissions were observed in 1998 and amounted to 6.3 million tones (Fig.9).

Figure 9 Tajikistan: Total GHG emissions, in mln t CO2 equiv.



Source: Tajikistan 2002: State of the Environment Report

CO_2 emissions. The biggest reduction is observed in CO_2 emissions and a small reduction in emissions of CH_4, PFCs and N_2O. CO_2 emissions per capita in the period under review have reduced from 3.8 to 0.5 tonnes; they are the lowest in Central Asia. Tajikistan takes the 100th place in the world as regards the volume of GHG emissions.

High capacity of hydropower plants explain a low level of CO_2 emissions nowadays and in the future. In the period of 1990-1998, the biggest CO_2 emissions were observed in 1991 (22.6 million tonnes), mainly because of fossil fuels combustion. The size of CO_2 emissions in the period under review decreased by more than 10 times, mainly because of the decline in energy-related activities. CO_2 emissions are mainly produced by: fossil fuel combustion in industry, transport and residential sector (82-92 %); production of cement, lime, aluminum, ferrous metals and ammonia (8-18 %).

Because of illegal tree cuttings, the CO_2 sequestration by forests and other forest biomass decreased by 35% to become 588 thousand tones in 1990 and only 447 thousand tones in 1994. As a result of changes in land use and reclamation of new lands, CO_2 absorption by soils increased from 932 thousand tonnes in 1990 to 1.4 million tonnes in 1998. CO_2 emission due to intensively used soils increased from 19 thousand tonnes in 1992 to 84 thousand tonnes in 1998. However, there are significant uncertainties in the category

"Land use change and forestry" due to inaccuracy of data in this activity.

3. Climate change response policies

Climate Change adaptation: Scientific data confirms, that at present, development and implementation of measures on greenhouse gas emissions reduction, called a climate change mitigation strategy, is not sufficient for the prevention of human-made impacts on the climate system. Adaptation to climate change is as important task in solving climate change problem as reduction of GHG emissions. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

The results of vulnerability assessment in CA countries of natural resources, national economy and public health to climate change confirm that influence of climate factors sometimes is very high, and appropriate adaptation measures could decrease or prevent severe effects of climate change and provide common preparedness. The present stage of adaptation strategy includes primary possible adaptation measures, which might be implemented in order to cope with climate change effects and support the sustainable development of the republic. Next stages of adaptation strategy development are expansion, probation and detalization of adaptation measures.

Human and natural systems will to some degree adapt autonomously to climate change. Planned adaptation can supplement autonomous adaptation, though options and incentives are greater for adaptation of human systems than for adaptation to protect natural systems. Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts. However, experience also demonstrates that here are constraints to achieving the full measure of potential adaptation. In addition, maladaptation, such as promoting development in risk-prone locations can occur due to decisions based on short-term considerations, neglect of known climatic variability, imperfect foresight, insufficient information, and over-reliance on insurance mechanisms. (IPPC, 2001)

Important directions of national adaptation policy (NAP) measures on adaptation to climate change in the CA region include:

- In-depth research on climate change, its impacts on natural resources, national economy, public health and development of specific adaptation measures;
- Improvement of the systematic observation networks and environmental monitoring to revise and renew adaptation measures;
- Improvement of the system of data collection, interpretation and dissemination;
- Enhancement of weather forecasting, climate modeling and early warning systems for minimization of natural disasters risk and preparedness to extreme phenomena;
- Capacity building to strengthen institutional, technical and human resources to promote adaptation and research in fields of climate and hydrological investigations, geographical information systems, environmental impact assessment, protection and re-cultivation of lands, rational use of water resources, conservation of ecosystems, sustainable agriculture, infrastructure
- Development and health protection;
- Implementation of specific projects on adaptation in priority areas related to rational use of natural resources, development of national economy and human health protection.

Conclusions

Data shows that CO_2 emissions were reduced substantially in Tajikistan, Kazakhstan and Kyrgyzstan after 1992. It is argued that main decrease in CO_2 emissions in these countries is due to a serious economic contraction after the collapse of Soviet Union. Other factors contributing to this result are improvements in energy intensities and decline in energy related activities in general. Even though other two Central Asian countries, Turkmenistan and Uzbekistan, also experienced similar economic contraction for the same period, their CO_2 emissions have increased. This could be explained by their energy use patterns and energy market structures. Energy intensities have increased significantly for these countries. It is suggested that liberalization of energy sectors improves energy intensities. It can be argued that, with the liberalization, Turkmenistan and Uzbekistan can find possibilities to improve energy intensity effects and in return to reduce CO_2 emission levels. The Central Asian countries have been experiencing a

recovery since the beginning of 2000. Therefore, it is possible that CO_2 emissions will begin to increase in the future unless energy intensities and carbon content of energy can be decreased via policy changes and/or behavioral adaptation.

Research over a decade of 1992-2001 demonstrated that:

- Population effect on GHG emissions is mainly stable in Central Asian countries.
- The observed reduction of overall CO2 emissions in Central Asia is largely due to the crisis that these countries experiences after gaining their independence from the Soviet Union.
- Fuel shift among fossil fuels took place mainly in Uzbekistan. Fuel switch from fossil fuels to non-fossil fuels took place in all countries except Uzbekistan.
- Energy intensities are key elements of energy-saving and carbon-reduction plans.

While Tajikistan, Kazakhstan, Kyrgyzstan and Turkmenistan (only recently) improved their energy intensities, Uzbekistan has problems in reducing their energy efficiencies. It is argued that liberalization of energy sectors improves energy intensities. Therefore, it can be argued that, with liberalization, especially Uzbekistan and Turkmenistan can find possibilities to improve energy intensity effects and in return reduce CO2 emission levels.

The framework of the Kyoto Protocol opens up the opportunity for making use of the international community to reduce GHG emissions, introduce cleaner technologies, climate change mitigation and adaptation policies. Since climate change issues are closely interwoven in the issues of water availability and energy security severely affecting the livelihood in the CA region addressing climate change will contribute to alleviating these problems as well as quell potential inter-country conflicts in the region. CDM and JI are a potentially efficient way of mitigating climate change impact.

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