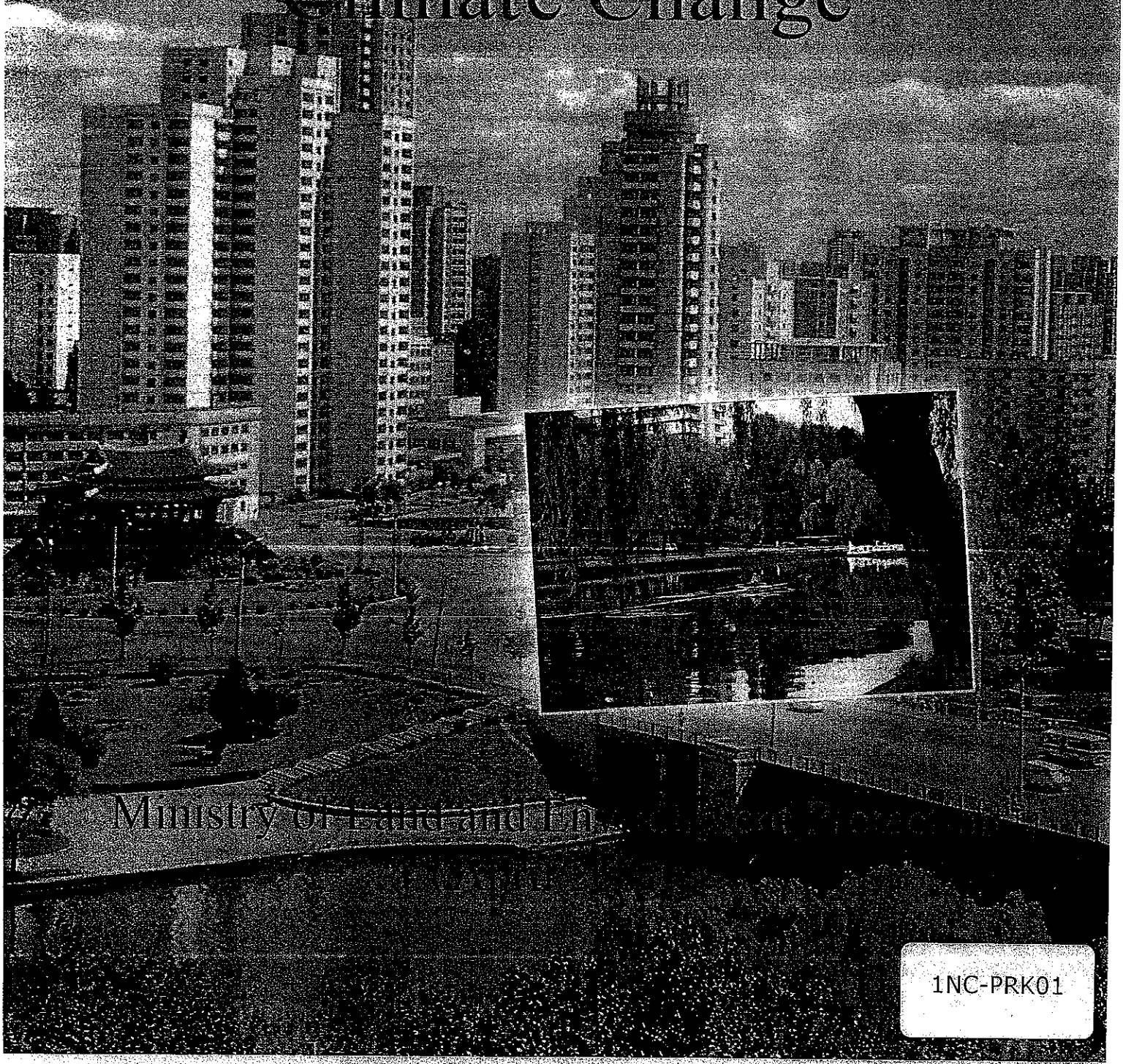
DPRK's First National Communication under the Framework Convention on Climate Change



Ministry of Land and En

DPRK's First National Communication under the Framework Convention on Climate Change

Ministry of Land and Environment Protection

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Executive Summary

1. Introduction

The Democratic People's Republic of Korea signed the United Nation Framework Convention on Climate Change at the United Nation Conference on the Environment and Development in June 1992, with more than 150 countries, and ratified it on 5 December 1994. The Convention has been entered into force for DPRK on 5 March 1995.

The preparation of the national communication was a first step in the actual implementation of the UNFCCC in DPRK.

As a developing country DPRK is lacking financial resources to start the implementation of the Convention and to prepare its first national communication to the CoP. So, the preparation of this report was supported by the project "Enabling DPR of Korea to Prepare its first National Communication in Response to Its Commitment to the UNFCCC", which is funded by UNDP/GEF.

This National Communication is a part of the DPRK Government's efforts not only to abide by Article 12 of the UNFCCC, but also to successfully implement its commitments under the Convention so as to prevent global warming and reduce greenhouse gas emissions.

This report describes and summarizes 1990's national GHG inventory and the main measures and responding strategies addressed to GHG emission reduction and adaptation to climate change anticipated.

DPRK has participated in the UNDP/GEF "Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS)" project, which intends to develop and improve regional and national capacity to prepare an inventory of anthropogenic emissions of GHG, to evaluate the cost effectiveness of the technically feasible measures to reduce GHG emissions and to develop strategies, policies and programmes that will be required to implement the identified measures.

This document compiled the results of the enabling activity project and ALGAS project.

The work is coordinated by the National Coordinating Committee for Environment and the Ministry of Land and Environment Protection. The Ministries, Committees, Departments and other Institutions as well as experts and officials concerned to climate change supported the preparation of this document.

2. National Circumstance

The DPR of Korea lies in Northeast Asia of Eurasian continent.

Land area of DPR of Korean, bordered by China and Russia to the north, is 122,762 square kilometers.

Korean peninsula, being surrounded by three seas; East, West and South Seas, is continental and oceanic in climate. Annual average temperature is 9°C~10°C, 24°C in summer (June~August) and –5.5¤ in winter (November~Febrary). The annual average precipitation is 1000~1200 mm, and drought conditions exist from April to June and flooding during July to August.

Climate change issues are considered important in DPR of Korea. The activities related to climate change is in line with the policy of the government for national and global environmental protection and benefits as well as country's sustainable development and management of natural resources.

The population of DPR of Korea was 20.960 million in 1990 and average life expectancy reached to 74 years.

The DPR of Korea is a socialist industrialized state with advanced industry and agriculture.

The DPR of Korea's mountainous forest area occupies 74.2% of total territory, which accounted for 9.02 million ha in 1990.

Agriculture in DPR of Korea, which is one of two basic constitutions of national economy, is very important sector in developing the national economy and people's livelihood. The main crops cultivated in the country are rice and maize.

In 1990, the total agricultural crops production were 9.1 million tones, of which 4.5 million tones were rice and 3.9 million tones were maize.

Livestock is also the important agricultural activity in DPR of Korea, as well.

3. Overview of DPR of Korea's Economy

The DPR of Korea is an socialist industrial state with independent national economy mainly relying on its own raw materials. Industry is basically dominated by electricity, iron and steel, metal, mining, processing, manufacturing, chemical and etc. that are largely geared to exploiting the rich natural resources.

DPR of Korea's GDP was US$ 20,875 million 1n 1992, which, in 1996, decreased to US$ 10,588 million due to the recent temporary economic constraints.

The GDP portion of industry sector, comprising of steel, chemical, cement, magnesite, machine manufacturing, electricity, electronics, construction etc, became from 37.6 percent in 1990 to 45.1 percent in 1996.

Agricultural sector decreased in its share in the GDP, from 21.8 percent in 1990 to 14.7 percent in 1996, owing to the continued natural disasters such as drought, flooding and tidal wave.

Primary source of energy in DPR of Korea consist mainly of coal.

Above 80% of necessary energy is provided with the fossil fuels such as coal and oil.

Coal, abundant in DPR of Korea, is mainly related to energy activities and widely used in all sectors of national economy as the main fuel and raw material. The amount of imported oil accounted for 3 million tons in 1990.

Coal produced in 1990 was 60 million tons, and in 2020, it will be 120 million tons.

The total amount of electricity generated in 1990 accounted for 56.4 billion KWh.

The DPR of Korea abounds in hydro and renewable energy resources. The potential hydro resources in 1998, has been estimated to be 48.8 billion KWh, of which 16.6 billion KWh were already developed.

4. Potential Climate Change and Its Impact on Natural Ecosystems and the Economy

Prevention of global warming should be of common concern to be solved by all the countries and nations in the world, as potential warming seriously threatens environment for production and lives of the people by changing climatic zone as well as causing sea level rise to influence eco-environment.

Considering the annual average temperature, its trend in the DPR of Korea coincides basically with Northern Hemisphere's and shows the rising. According to the variation character in temperature by years, the cold period lasted until 1940's and warm period started from 1950's.

The trend of air temperature variation in DPRK, especially the northern inland region, is very similar to the one of Northern Hemisphere. There are some differences between the trend of variation of summer and winter in air temperature. The variation of air temperature in summer is late in phase as compared with Northern Hemisphere. Regarding to the temperature variation of decades in winter and summer, the temperature has risen systematically and radically in winter.

Precipitation in the DPR of Korea is characterized by big change with season. In most areas, more than 50% of the annual precipitation was recorded in July and August, and 5-10% in winter. Annual precipitation ranges from 500 mm to 1500 mm by regions.

A significant increase in mean air temperature is projected as the result of increasing CO_2 concentrations in the global atmosphere. General Circulation Models (GCMs) suggest increase in temperatures from 1°C to 3.5°C with the doubling CO_2 which is expected to occur between 2050 to 2075, depending on the CO_2 emissions scenario used. Maximum temperature increase is expected to be in summer and winter. In summer, the spatial pattern of projected change in precipitation is not uniform over the region. GCMs simulations predict that precipitation would increase slightly (0.5-1.0mm/day) in the northern part of the northern region of Asia, and by more than 1mm/day over the Korean Peninsula.

So, the concerns should be focused on the fact that climate change would influence the economy and natural resources as well as ecosystem of the country to a considerable degree. In general, the studies showed that agriculture, forest, coast, and water resources would be highly vulnerable to possible climate change.

In recent years, annual average temperature was 1.6°C higher than the one of the last years, and average temperature in January was –6.4°C, which is 2.6°C higher than the one of the last years. Particulaly, heavy rain of 758 mm fell down for 5 days from 24 to 28, July 1997, reduced crop production in many areas and resulted in soil erosion in some areas. Furthermore, large hectares of tideland were seriously damaged by tidal wave, causing yield reduction of crops in 1997. In 1995 and 1996, several spells of heavy rain brought by abnormal climate damaged several hundreds of thousands hectares of forest.

In recent years, severe drought and heavy flood have caused many harmful forest insects in some regions, resulting in decrease of seedling production and afforestation to bring about eco-environment destruction and tremendous economic loss.

The study on the vulnerability assessment of coastal zones showed that sea level rise (SLR) is the one of serious problems in DPR of Korea.

According to IPCC publications, it is projected that sea level would rise to 29cm in 2030 and 1.00m in 2100. If so, there would be happened the retreat of coastline, damages of tidal lands (arable) and salt-fields, and beach erosion, resulting in negative impact on not only the coastal ecosystem and fishery activities but the industry, agriculture and residents in the coastal areas.

5. Inventory of Greenhouse Gas Emissions and Removals

The DPR of Korea has developed national inventory of its targeted year emissions and sinks for the most significant greenhouse gases. The inventory of greenhouse gas (GHG) emissions by sources and removals was compiled for the year 1990, which is recommended as a base year by IPCC Guidelines for National Greenhouse Gas Inventories.

The IPCC Guidelines of 1996 were taken as the methodological basis for estimating GHG emissions and sinks. In some cases, the IPCC methodology was complemented to reflect national circumstances and /or data availability. Most of sectors considered by IPCC are covered in the DPR of Korea's inventory.

In accordance with the IPCC Guidelines, the DPR of Korea's inventory is divided into five main categories: Energy Activities, Industrial Processes, Agriculture, Land Use Change and Forestry, and Waste Management. The national GHG inventory represents emission data on three gases with direct greenhouse effect: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); and on three gases with indirect greenhouse effect-carbon monoxide (CO), oxides of nitrogen (NOx), and non-methane volatile organic compounds (NMVOC).

The total CO_2 emissions in DPRK in 1990, amounts to 169,445 Gg, with 975Gg of methane emissions.

Most of the emissions come from the combustion of fossil fuels in energy sector. Total CO_2 emissions from energy sector in 1990, reached to 159,942Gg, accounting for 94.1% of total national CO_2 emissions.

CO_2 emissions from coal combustion was 137,267 Gg, being 92.6 % of total CO_2 emissions from fossil fuel combustion. The share of emissions from liquid fuel combustion to the total CO_2 emissions from fossil fuel combustion was 6.7 %, being 9,875 Gg of CO_2.

Emissions of carbon dioxide from biomass fuel consumption amounted to 20,258 Gg, which indicated biomass as important energy sources in DPRK.

The energy sector emitted 159,942 Gg of CO_2, 649 Gg of CH_4, 17 Gg of N_2O, 425 Gg of NO_x, 475 Gg of CO and 61 Gg of NMVOC in 1990.

The energy and transformation subsectors had the highest emissions. Manufacturing industry and construction subsectors came in second with 20% share, followed by the energy industry. In the Manufacturing subsector, lime, cement and steel manufacturing industries were the main sources of greenhouse gases with the amount of 1,146 Gg, 6,929 Gg and 833 Gg respectively.

Traditional biomass burning refers to traditional use of biomass fuel in cooking and space heating. Although the CO_2 emissions from biomass burning were not included in the total emissions, the trace gases from biomass burning were considered as net emissions and included in the total calculations. The residential and commercial/institutional subsectors have 6.26 % and 1.67 % share respectively.

An important source of trace gases come from the burning of traditional biomass fuels that are mainly used for cooking in household.

The forestry sector, as a sink of GHGs, sequestrated 14,631Gg of CO_2.

Agriculture and coal mining were the main sources of CH_4 emissions.

Table 0-1 Short Summary Report for National Greenhouse Gas Inventory of DPRK in 1990 (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Total National Emissions and Removals		169,444.6	-14,631.1	975.19	38.73	432.02	478.10	60.50	4,170.00
1 Energy	Reference Approach	159,923.6							
	Sectoral Approach	159,941.9		649.43	17.31	425.14	474.53	60.50	0.00
A Fuel Combustion		159,941.9		43.58	17.31	425.14	474.53	60.50	
B Fugitive Emissions from Fuels		0.0		605.85		0.00	0.00	0.00	0.00
2 Industrial Processes		9,502.7		0.10	1.13	6.78	0.00	0.00	4,170.00
3. Agriculture				254.71	20.29	0.00	0.00		
4.Land-Use Change & Forestry		0.0	-14,631.1	0.41	0.00	0.10	3.57		
5. Waste				70.54	0.00				

Baseline Scenario Projection of GHG Emissions to 2020

A. GHG Projection to 2020 in Energy Sector

The projected CO_2 emission from 1990 to 2020, resulting in the baseline scenario, is presented in Figure 0-1.

In Figure 0-1, the baseline scenario is compared with the projected CO_2 emissions in the Long-term Development Plan of DPRK (LDPK or BAU).

Projection of CO_2 emissions involves intrinsic uncertainty. Thus projection results can change significantly depending on models and assumptions.

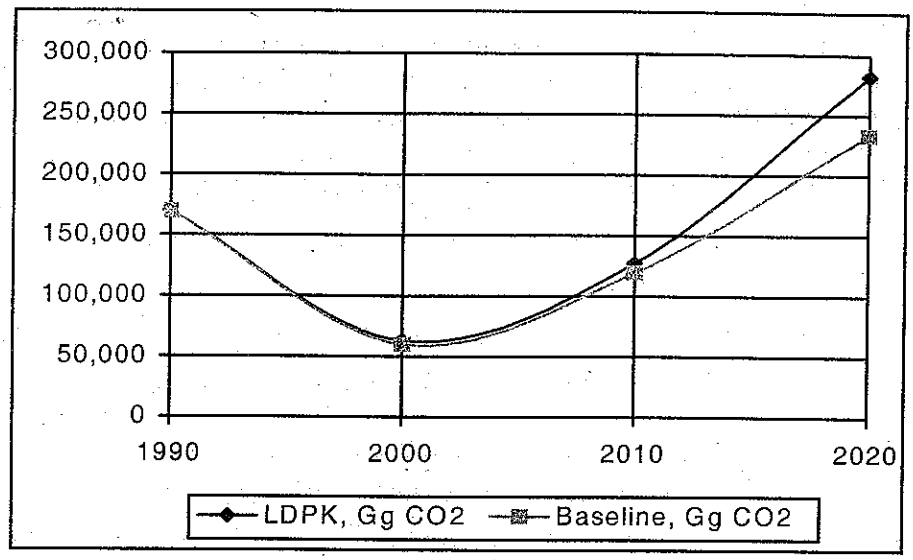


Figure 0-1 Projected CO_2 Emissions (Gg) – Baseline Scenario

B. GHG Projection to 2020 of Forestry Sector

For the projection of CO_2 emissions in forestry and land use sector for the period 1990-2020, the assumptions in the National Plantation Forests Establishment Plan up to 2020 were considered. In the assumptions, it is envisaged that the current area of forestland will be reduced by 1.9 percent during projected period due to the demand for lands in other sectors. Likewise, existing policies that promote the expansion of grassland for livestock grazing were also considered.

The estimated CO_2 emission/uptake for forestry sector is presented in Table 0-2.

As shown in the Table, the net uptake of CO_2 will continue to 2020.

Table 0-2: Projection of CO_2 Emission/Uptake from Forestry Sector to the year 2020

YEAR	Emission(+)/Uptake(-) (Kt CO_2)
1990	-14,631
2000	-14,007
2010	-13,119
2020	-12,291

6. Adaptation Measures to Climate Change

In DPR of Korea, the programs on GHG emissions reduction and adaptation to climate change should be integrated with other national and sectoral development for environmental protection.

In developing and assessing the adaptation measures, flexibility and cost-effectiveness were taken as the main criteria, using EFOM, COMAP and AHP model.

A. Adaptation measures of Agricultural Sector

Agricultural technologies to adapt to climate change might include the introduction of new crop varieties and changes in planting times.

a) Suitable modification at transplanting time and seeding time

Suitable selection of transplanting time and seeding time, considering the climatic conditions by regions, is very important for crops to resist drought and high temperature.

And, it is important to prevent losses of crop yield caused by the cold weather, typhoon and heavy rain.

b) Irrigation

The proper irrigation to compensate for losses of moisture by evapotranspiration may bring a significant increase in crop production.

In particular, to establish irrigation system for corn-fields is very important to increase its production.

c) Fertilization

An increase in amount of fertilizer applied in some certain areas can compensate the crop yield losses caused by climate change.

d) Seed improvement

It is important to develop and introduce crop variety for currently cultivating crop, considering the increase of temperature.

e) Crop rotation

An important way to increase crop production is to convert some corn fields with low production vulnerable to the climate change into potato or sweet potato fields.

Double cultivating system, as well should be introduced into the regions suitable to temperature condition.

B. Adaptation Measures of Forestry

On the assessment of forestry, adaptation measures in DPR of Korea are considered as follows;

a) Forest seeding

- Plant and seed good breeds, which grow fast, have a good quality and stand the disease, drought and cold
- Introduce imported species of the best quality by converting them to acclimatize to the country's climate.
- Promote vegetative reproduction method to produce new breeds, and plant many pine-nut trees of economic value using the method of engrafting pine-nut trees upon pine, on a large scale.

- Intensify the research for developing the first hybrid and good breeds that can increase the production by 1.5 times more with better endurance from diseases, and new oil trees and fruit trees which yield high harvests.

b) Forest management

- Well manage existing planted forest and cultivate crops including beans and wild herbs including bellflowers under trees in planted forest to enhance the ability to absorb carbon dioxide per unit area of forest.
- Assimilate the experience and success of others to suit to our specific conditions in preventing damages from harmful forest insects so that we can completely remove all harmful insects at full speed.

  Develop and research into attractant and evader as effective control of harmful insects.
- Build monitoring posts in some regions that are severely damaged to proceed survey and forecast fire and harmful forest insects, and equip with modern monitoring facilities.

C. Adaptation Measures of Coastal Zone

Assessment is also focused on sea level rise over the Korean West Sea in DPR of Korea. The sea level rise would be seriously affected to Korean West Sea coastal area as well as its ecosystem.

West Sea coastal area of DPR of Korea , given its historical formation process and its geography / meteomorphology, is characterized as much more sensitive one over sea level rise (SLR) than any other places.

Adaptation measures in Korean West Sea are considered as follows;

a) Tideland protection measures

A rise in sea level would lead to the inundation of low coastal and coastal marshes, especially tidelands.

- **Damage to bank of tidelands**

  The height and thickness of breakwater constructed in tideland should be reconsidered, expecting the sea level rise.

  The study on sea level rise should be conducted in order to protect breakwater and seawall already constructed.

- **Damage by flooding**

  At present, the banks, dams and drainage system to prevent flood have been constructed in all rivers and streams in DPRK, but the impact of climate change expected were not considered in design.

  There should be some problems in the standard design level of the bank in downstream.

  Not only new drainage systems should be established in downstream but its capacity be increased in place where it has been done.

Over the flooding, there should be established a projecting service system as well as alarm system.

b) Ecosystem protection

Sea level rise could cause changes in the population sizes and distributions of species, and alter the species composition and geographical extent of habitats and ecosystems.

To protect ecosystem in coastal areas, it is important to establish integrated coastal zone management system for conserving and managing the habitats of fauna and flora, while new development in coastal areas should be considered on its impacts to ecosystem in related areas.

c) Facilities protection

Infrastructure including ports, wharf, drainage system and water breaks should be reinforced above present design level, responding to expected sea level rise.

d) Prevention of soil inundation

Based on vulnerability assessment to more sensitive areas over sea level rise, seawalls should be constructed in specific sites along the coastline.

It is considered that such areas would be estuaries of Amnok, Chongchon and Daedong River.

Furthermore, in order to reduce the expansion of soil inundation by land sinking, underground water should be not exceedingly extracted in coastal areas.

7. Education, Training, and Public Awareness

DPR of Korea recognizes that some of the greatest contribution to global environment conservation could be made by public participation. To encourage people to address the problem of climate change in their daily lives, opportunities for people to learn about environmental issues should be provided in homes, schools, regions, companies and other situations.

Therefore, development of educational and public awareness programs on climate change, providing public access to information on climate change issues and public participation (including NGOs) are important parts for implementation of the general obligations of UNFCCC and development of the National Action Plan.

It is possible to obtain basic professional knowledge on the scientific aspects of the global climate change issues at all universities in DPR of Korea. A program for public participation on different aspects of climate change is also currently being developed.

Climate change issues and study results are presented in quarterly science and technical journals, newspapers, and on radio and TV.

Both the national and local governments engage in various campaign for environmental conservation. These programs are often conducted in June, which is World Environment Day, and particularly March and November, which are DPRK's Land and Environment Protection Campaign Period. The government will increase the support to environmental NGOs, which plays a positive role in public environment campaign.

8. Climate Change Research and Technology Development

Climate is traditionally one of the main fields of research interest in DPRK and a lots of studies on its genesis and characteristics have been carried out.

A major part of these studies has been performed by the institutes of the Meteorology and Hydrology Commission, Universities and Sciences of Academy in DPR of Korea.

The government has initiated the implementation of the National Action Plan for Implementation of Agenda 21 (NAP) developed in 1994, and Ministry of Land and Environment Protection is a coordinator of that progrmme.

NAP sets long-term objectives for the establishment of an environmentally sound socioeconomic system. The plan is designed to promote comprehensively and systematically policies for environmental conservation. It includes improvement of scientific research, monitoring and observation, development of appropriate technology, and international cooperation for research, monitoring and observation.

9. Follow-up Activities

Formulating, implementing and regularly updating national programs containing measures to mitigate climate change and facilitate adequate adaptation to climate change impacts are the general commitments of all Parties in accordance with Article 4 (1b) UNFCCC.

Basic State Policies for Environmental Protection

In the 1980s, the DPRK Government made environmental protection a Basic State Policy. Since then, progress has been achieved in environmental protection. But there still exists comparatively severe natural resources waste and environmental pollution, caused by the economic development, population growth, increased resource consumption, and inefficiencies of production and use. In protecting the environment, a series of measures and strategies may be undertaken.

(i) Formulate and implement a sustainable development strategy, which should be reflected in social and economic development plans and programs of the State, and enhance the coordination of environmental protection and resources conservation. This is consistent with the goals of economic growth pattern that the DPRK is making efforts to realize.

(ii) Establish a law and regulation system for environment protection. Some laws, regulations and a preliminary legal system of environmental protection suitable for DPRK's own situation is set up. It plays an important role in reducing harmful substances and GHG, and in protecting the global and regional environment. However, environmental protection legislation needs further enhancement.

(iv)Increase funds for environmental protection through various channels. Environmental protection funds are certainly necessary, and more input and earlier input can bring out obvious and better social, economic, and environmental benefits.

Improve Energy Efficiency and Reduce Energy Consumption

Energy efficiency improvement is considered one of the most important strategies for abating GHG emissions in the DPRK.

In DPR of Korea, there still exists significant potential for further energy saving in each sector. The cost of GHGs abatement from energy saving is the lowest among all other abatement measures.

Energy saving is not only a key measure for GHG abatement, but consistent with the State's sustainable development goal. Therefore, it is clear that measures need to be adopted to promote energy saving because of its significance and effects.

The long-term energy saving strategy should be reflected in social and economic development plans of the future.

Technical improvements should be accelerated, and the development of research, the adoption and dissemination of advanced technologies have to be promoted.

Cogeneration should be considered where possible. In the industry sector, average energy efficiency of widely used equipment, especially industrial boilers and kilns, should be improved by means of technical innovation and installation of new models.

In the commercial and residential sectors, coal and firewood-saving stoves should be widely popularized all over the country.

Finally, adoption of clean coal technologies such as briquetting, gasification and advanced combustion, etc., should be expanded. This is a very important strategy for abating GHG emissions, as coal will be the major energy source in the DPRK for a long time in the future.

At the same time, it is also important to raise people's consciousness of energy conservation, resources conservation and environmental protection through information, dissemination and education.

Accelerate and Expand Energy Substitution

Given the fact that fossil fuels account for a major proportion of primary energy in the DPRK, the other major option for large-scale abatement of GHGs emissions is the substitution of low and non-carbon energy for fossil fuels, especially coal. Long-term alternative energy development programs should be formulated early for this long run strategy.

Hydropower, nuclear power and renewable energy are the main fields of non-carbon energy development. Hydropower generation in 1990 provided 50 percent of total electricity.

Solar and wind energy are the major fields of renewable energy development, especially in the rural areas and remote regions of the DPRK. These sources can improve local energy supply shortages and protect the global and regional environments.

Strengthen Development and Protection of Forestry Resources

Forests are the major part of the land ecological system, which absorb and sequester large amounts of CO_2.

To advance the very significant functions of forests in addressing global climate change, the following key measures should be carried out.

(i) Strengthen the management and protection of existing forest resources, control the forest resources expenditure and strictly prohibit the activities that destroy forest resources.

(ii) Simultaneously promote afforestation along with forest protection. Encourage and organise "all inclusive mass movement for tree planting" according to various afforestation plans and programs. Planting of fast-growing firewood with high productivity should be introduced in the areas with a serious firewood shortage. Although firewood planting itself do not contribute greatly to carbon sequestration, it protect forest resources by limiting the destructive cut of natural forests and providing rural areas with firewood in a regular way.

(iii) Develop appropriate policies that will accelerate forestry development and protection.

Develop Techniques for Abating GHG Emissions in Agriculture Production

Rice production, nitrogen fertilizer, and animal husbandry are the three major sources of GHG emissions in the agriculture sector. While increasing production of grain and livestock, great efforts should be made to abate GHG in agriculture sector.

The rice production practices for abating methane emissions from paddy fields should be further developed.

Upgrade of Forecasting Service and Alarm Systems in Vulnerable Areas along West and East Coastal Zones over Sea-Level Rise

Responding to the flooding due to sea level rise, there should be upgraded existing projecting service system and alarm system for emergency as well as established new ones in areas much sensitive to flooding. Since the Korean West Sea coastal zone is much sensitive to flooding, it is considered as most proper option responding for SLR to reinforce and strengthen existing banks and seawalls much higher and thicker than present design, while introducing advanced construction technology to new banks and seawalls.

Both comprehensive and integrated management over Eastern and Western Coastal Regions of DPR of Korea should be established, responding to climate change.

Join and Expand International Cooperation on Protecting Global Environment and Climate

The DPRK will continue to join international activities related to global climate change and will exert its new and earnest efforts to realise the UNFCCC goals.

Solving the problems of environment and climate change will require identifying funding inputs and a set of priority projects in key fields. Settlement of the DPRK's environmental problems emerging in social and economic development depends on its efforts in policy research, organization, management, technology progress, and fund raising. It is necessary to expand the input of funds in protecting the environment.

DPRK Government has paid much attention to raising funds for environmental protection. DPR of Korea is a developing country. Hence, apart from domestic funds, the other important channel for raising environmental protection funds is to further expand the external financial inputs. Foreign funds can act as catalysts to accelerate the steps for environmental protection in DPR of Korea.

Resolution of the environmental problems in DPRK will also make a contribution to addressing global environmental issues. International technical and financial assistance is helpful for capacity building to abate GHG emissions in DPRK.

CHAPTER 1. National circumstances

Redistribution of precipitation and heavy rain, and frequency and intensity of droughts with rising of temperature will entail negative consequences, particularly in agriculture, forest, water management and coastal zones of east and west of the country. Climate change can also bring about negative influence on human health.

On the other hand, DPR of Korea is one of the largest emitters in Northeast Asia and has a considerable GHG reduction potential.

Therefore, climate change issues are considered important in the country. In DPR of Korea, the climate change is a priority only to the extent that it is related to the main national objectives - protection of the environment and sustainable development.

Actions related to climate change must meet a long-term national development strategy and fit into other development programs.

The DPR of Korea's long-term national priorities are to improve people's living standards, ensure the economic self-reliance, increase economic growth, promote rural development, and preserve the environment.

Table 1-1 presents information on the national circumstances.

Table 1-1: National circumstances

Indicators	1990	1996
Population (million)	20,960	22.114
Land Area (000 square kilometers)	12.2,762	
- Urban, %	2.68	
- Forest, %	74.2	
- Agricultural, %	16.76	
- Other, %	6.36	
Urban Population as % of total population	60.9	60.2
Livestock Population (000)		
Cattle	858	567
Swine	6,080	2,290
Sheep	568	185
Goat	660	713
Poultry	24,972	11,137
Unemployed Rate %	0	0
Illiteracy Rate %	0	0

Source: Central Bureau for Statistics

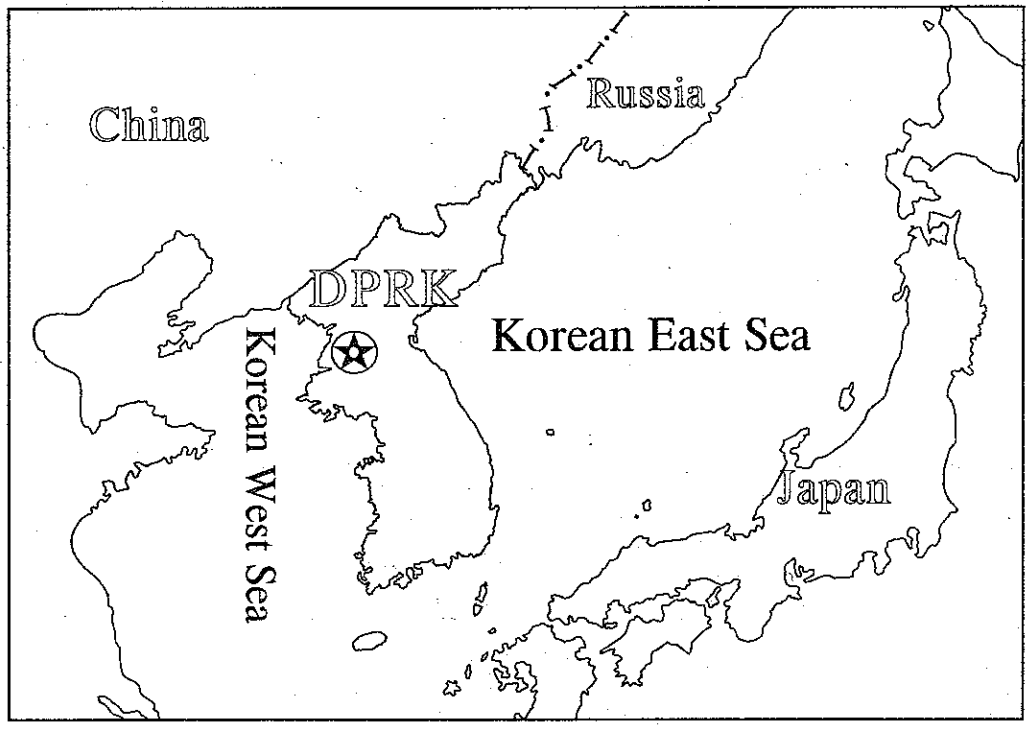
In DPRK, all people have received the compulsory education, particularly universal 11 year compulsory education since 1970s, so there was no illiteracy.

Also, there was no the unemployed as the State provide jobs for all the employable people.

1.1 The Geography, Climate and Natural Resources

The Democratic People's Republic of Korea is located in Far East in Asian continent. It is bounded by 2 large bodies of waters: the Korean East Sea on the East and the Korean West Sea on the West, and neighboring China and Russia to the North with Amnok river and Tumen river as the frontiers. (Figure 1.1)

Figure 1-1. The location of DPRK



The land area of DPR of Korea was 122,762 square kilometers.

As DPR of Korea is located in the middle latitudes, its climate is temperate with four distinct seasons; spring, summer, autumn and winter.

Influenced by the Asian continent and surrounding oceans, it is hot and humid in summer while cold and dry in winter.

Annual average temperatures is 9°~10°C, with average temperature in summer (June~August) being 24°C and –5.5 in winter (November~Febrary) respectively.

Annual precipitation varies from less than 1000 mm to more than 1,200 mm, though it differs slightly by regions.

The DPR of Korea is richly endowed with natural and energy resources. It has the great reserves such as coal, iron, zinc, magnesite, and limestone, etc.

Crud oil and natural gas are not yet exploited.

1.2 Population

The total population of DPR of Korea was 20.960 million in 1990 and 22.114 million in 1996.

Table 1-2. Population size

	1979	1986	1990	1993	1996	1999
Total Population (000)	17,000	19,060	20,960	21,213	22,114	22,754
Average life expectancy (year)	-	-	74.0	72.7	70.1	66.8

Source: Central Bureau for Statistics

The urban population predominates; its share was 60.9 % in 1990 and 60.2 % in 1996. Average life expectancy is 74 years, which is similar to the average in developed countries, but it decreased to 66.8 in 1999.

The population of the Democratic people's Republic of Korea will reach 22.996 million by 2000 and 29.164 million by 2020.

Table 1-3. Projected population growth

	2000	2005	2010	2020
Total population (000)	22,996	24,404	25,897	29,164
Population growth rate (%)	0.950	1.196	1.195	1.196

Source: Central Bureau for Statistics

1.3 Land Use Patterns

Table 1-4. Land use categories

	1990	1993	1996
Total area (million ha)	12.157		
Agricultural area (m.h)	2.038	2.087	2.103
Forest area (m.h)	9.020	8.879	8.906
Industrial area (m.h)	0.189	0.196	0.199
Water shed area (m.h)	0.710	0.720	0.727
Residential area (m.h)	0.137	0.152	0.157

Source: Central Bureau for Statistics

DPR of Korea has mountainous terrain, of which forestry areas account for 8.906 million ha in 1996.

Agricultural land is about 2.013 million ha in 1996. However, with the economic development, the amount of land for agriculture and forest is diminishing and is expected to continue to fall with further development.

Meanwhile, the land for residential and commercial use such as homes, roads, factories and parks, is anticipated to expand.

1.4 Overview of DPR of Korea's Economy

The economy of DPRK is the independent socialist national economy depending on its own technology and natural resources.

Table 1-5 shows the status of the economy.

The total industrial output increased by 196 times in 1977 as against 1946, 431times in 1984 as compared with 1946, and 1.5 times in 1993 compared with 1986. The high rate of economic growth led to the rapid growth of energy demand.

The total GDP was US$ 20,875 million in 1992 and it decreased to US$ 10,588 million in 1996.

The GDP portion of industry sector, comprising of steel, chemical, cement, magnesite, machine manufacturing, electricity, electron, construction etc, increased from 37.6 percent in 1990 to 45.1 percent in 1996.

Agricultural sector decreased in its share in the GDP, from 21.8 percent to 14.7 percent, owing to the continued natural disasters such as dry, flooding and tidal wave. The most important agricultural crops include rice and maize. In 1990, the total agricultural crops production were 9.10 million tones, of which 4.50 million tones were rice and 3.90 million tones were maize.

The Service sector, including transportation, communication and commerce; trade; finance; and government services decreased from 34.3 percent in 1992 to 35.4 percent in 1996.

In recent years, there have been some economical difficulties in DPRK, but the economy will be stabilized in near future to continue its sustainable development.

Table 1-5. Economic statistics of DPRK

	1992	1994	1996	1998	2000
GDP (US$, million)	20,875	15,421	10,588	10,273	11,156
Share of industry (%)	37.6	41.7	45.1	-	-
Share of agriculture (%)	21.8	20.9	14.7	-	-
Share of construction (%)	6.3	5.9	4.8	-	-
Share of others (%)	34.3	31.5	35.4	-	-
Industrial output (US$, million)	-	-	-	4,448	4,493
Agricultural output (US$, million)	-	-	-	1,706	2,470
Volume of freight by train (million tones)	120	-	-	-	60
Volume of freight by road (million tones)	175	-	-	-	-
Electricity (KWh, billion)	-	-	-	25.6	25.9
Coal (million tones)	-	-	-	22.07	22.29
Steel (000 tones)	-	-	-	1,110	1,112
Fertilizer (000 tone)	-	-	-	730	740
Cement (000 tones)	-	-	-	1,700	1,720
Fish (000 tones)	-	-	-	160	160
Foreign debt	-	-	-	-	-
- US$, million	2,984	-	-	4,162	-
- Rouble, millio	2,829	-	-	2,829	-
GDP per capita (US$)	990	722	482	458	485
Total amount of export (US$, million)	962	896	756	-	-
Total amount of import (US$, million)	1,207	1,060	998	-	-
Total crop production (000 ton)	8,800	7,083	2,502	-	-
Rice (000 ton)	4,500	3,177	1,426	-	-
Maize (000 ton)	3,718	3,547	825	-	-

Source: Central Bureau for Statistics

1.5 Overview of the Energy Sector

1.5.1 Resources

With the growth of population, economic development, and improvement of living standard, the energy demand will continue to grow for decades in spite of improvements in the efficiency of energy use. In recent years, there have been some efforts to improve energy efficiency in supply and end use sector, for example introduction of circulated fluidized boiling combustion, high efficiency cooking stoves, and far infrared radiator etc.

In DPR of Korea, primary source of energy is coal.

Coal, which is abundant in DPR of Korea, is mainly related to energy activities and widely used in all sectors of national economy as the main fuel and raw material.

In 1990, 3 million tones of crude oil were imported.

The amount of coal production accounted for 27.5 million tones in 1970, 65 million tones in 1980 and 60 million tones in 1990, and in near future, it will reach to 120 million tones.

The total amount of electricity generated in 1990 accounted for 56.4 billion KWh. At present, DPRK depends mainly on coal for generating electricity. The DPR of Korea has rich hydro and renewable energy resources. The potential hydro resources in 1998, has been estimated to be 48.8 billion KWh/yr, of which 16.6 billion KWh/yr were already developed.

The potential wind and wave/ tidal power resources were estimated to be 7 billion KW/yr and 19 billion KW/yr respectively.

1.5.2 Energy Transformation and Distribution

Energy sector plays a significant role in the future economic development of the country.

However, despite the large energy resources, DPR of Korea suffers from acute shortage of electricity due to some economical difficulties and increased energy demand in end-use and other sectors. Many of old power plants are very inefficient. For instance, the electricity generating efficiency in Pyongyang Thermal Power Plant is about 25 %. It is important to install units with large generating capacity, high efficiency, and good performance, to promote cogeneration (of heat and electricity), and to renovate old equipment. Furthermore, the size of the country's territory and its geographical condition together with the concentration of coal deposits in the country require high investments to power transmission systems, considering its high losses and low reliability. The power sector needs considerable rehabilitation and serious upgrading to meet the intrinsic demand of electricity.

The management structure and forms of the power transmission system have been radically developed since independence of the country. In line with the Government's policy for power system, all the power plants, the networks of power transmission and electric power substations have been properly distributed throughout the country.

1.5.3 Energy Consumption

End-user energy consumption continued to increase with the DPRK economy's growth during last decades.

In DPRK, energy consumption per capita is very high as compared with GDP per capita.

Table 1-6 shows how DPRK compares with several other countries in the amount of CO_2 emissions per capita from fuel combustion, based a recent report by the International Energy Agency.

Table 1-6. CO_2 emissions per capita from fuel combustion of selected countries (1996)

Country	Tonnes CO_2/Capita
Philippines	0.91
Indonesia	1.21
Thailand	2.92
Malaysia	5.13
DPR of Korea	8.08 (1990)
Japan	9.36
United Kingdom	9.91
Australia	10.57
Canada	15.67
United States	20.05
Singapore	21.45
Brunei	27.92

Energy consumption by sector and fuel type in 1990 is shown in table 1-7.

Table 1-7. Primary energy consumption in 1990 (Unit : 000 ton)

	Industry	Household	transport	Agriculture	other	Total
Anthracite	34,614	2,178	1,820	1,886	4,911	45,409
Lignite	7,995	1,918	740		1,281	12,226
Gasoline	90		215.6	7	62.4	375
Diesel oil			420	-	263	683
Fuel oil	1,015				885	1,900
LPG	45	6			24	75
Naphtha	220				8	228
Kerosene		150			40	190
Coke	4,020					4,020

Source: Central Bureau for Statistics

According to the result of MEDEE/S model (Model for Energy Demand Evaluation), primary energy consumption will be increased from 47.974 Mtoe in 1990 to 95.948 Mtoe in 2020.

It must be noted that any long-term projections baseed on some key assumptions should only used as a reference for discussion of trends. Many special factors make the modeling of energy trends, and hence energy demands, especially difficult and derived projections uncertain.

1.5.4 Energy Strategy

Energy policies of DPRK have set the goal to meet increasing energy demand, while ensuring energy security, so as to encourage economic productivity as well as enhancing the general well-being of the people. The fundamental long-term strategies for the implementation of the energy policies are;

a) to insure supply reliability by promoting self sufficiency through development of indigenous resources, particularly coal, and providing adequate and viable systems for the delivery of energy supply to the end-users

b) to raise usage efficiency by promoting the efficient use of energy

c) to ensure environmental sustainability by minimizing environmental effects of energy production and use, promoting conversion and end-use efficiency and shifting to renewable energy forms.

Table 1-8. Main economic targets in the Long-term Development Plan of DPRK

	2005	2010	2015	2020
GDP (US$, million)	12,309	23,787	39,365	63,618
GDP growth rate (%)	2	14.1	10.6	10.1
Industrial output (US$, million)	4,960	14,118	24,377	35,802
Industry growth rate (%)	2	23.3	11.6	8
Agricultural output (US$, million)	2,719	3,473	5,009	7,745
Agricultural output growth rate (%)	2	5	7.6	9.1
Electricity (KWh, billion)	28.6	50.0	70.0	100.0
Coal (million tones)	24.61	45.00	68.00	120.00
Steel (000 tones)	1,240	5,000	10,000	15,000
Fertilizer (000 tone)	810	4,000	5,500	7,000
Cement (million tones)	1.90	11.0	15.0	20.0
Fish (000 tones)	180	500	1,000	1,500
GDP per capita (US$)	504	904	1,405	2,117
Total crop production (million tones)	5.5	6.0	8.0	10.0

Source: State Planning Committee

The long range programs and institutional reforms in energy sector were based on the economic targets set forth under the Long-term Development Plan of DPRK.

Some economic targets set forth under the Long-term Development Plan of DPRK are shown Table 1-8.

The DPRK's energy supply mix from 1990 to 2020 is summarized in Table 1-9.

Table 1-9. Energy Supply Plan in DPRK

	1990	1998	2000	2005	2010	2015	2020
GDP (million US$)		10,273	11,156	12,309	23,789	39,365	63,618
Coal (000 ton)	60,000	22,070	22,290	24,610	45,000	68,000	120,000
Electricity (billion KWh)	56.4	25.6	25.9	28.6	50.0	70.0	100.0

Source: State Planning Committee

The highest priority of the energy strategy is increase of energy efficiency and energy-saving improvement.

1.6 National Organisations for Co-ordinating Climate Change Studies and UNFCCC Activities in DPRK

At present, a national leading agency for co-ordinating activities both on the UNFCCC and the other ratified environmental conventions in DPRK is the Ministry of Land and Environment Protection.

Recognizing the need to keep in step with the international community to address the environmental problems such as climate change, the government established National Coordinating Committee for Environment (NCCE) in 1994.

The primary objective of the NCCE is to promote the organisation and coordination of activities relating to global environmental problems such as climate change, biodiversity and international water.

The NCCE has become the principal national organisation presiding over activities concerning GEF's objective.

Since 1994, the works on global environmental issues including climate change, biodiversity, international water and ozone layer protection have been carried out by Environment and Development Centre under the Ministry of Land and Environment Protection.

Experts from different sectors, ministries, and institutions including State Planning Committee, Ministry of Land and Environment Protection, Ministry of Electricity and coal Industry, Ministry of Agriculture, Hydrometeorological Bureau, State Academy of Sciences and Central Buereau for Statistics were involved into the climate change study team organised in Environment and Development Centre.

The Initial National Communication of the DPR of Korea is based on the results obtained by this team, including GHG emission inventory, vulnerability and adaptation assessment and mitigation analysis.

CHAPTER 2. Inventory of Greenhouse Gas Emissions and Sinks

GHG emissions from sources and removal by sinks from anthropogenic activities have been estimated and included in the inventory.

The preparation of GHG inventory has made good foundation for the development of a more comprehensive and detailed national inventory in the future.

There were many difficulties in collecting data necessary for inventory. Lack of data, misunderstanding on categories, the inexperienced in inventory development etc. has possibly affected the accuracy of the inventory.

In inventory, all the emission factors were adopted from the IPCC guidelines, as local emission factors not available.

Also, emissions from bunker fuel were not estimated due to lack of data available.

2.1 Inventory for the Energy sector

The energy sector is one of the highest sources of greenhouse gases, accounting for 159,942 Gg or 94.1 % of the national total CO_2 emissions. The energy sector is subdivided into two categories of fuel combustion and fugitive activities. The other gases such as CH_4, NO_2, NOx, CO and NMVOCs are released but in much smaller quantities.

To identify which sources emit significant GHG, the energy activities are further subdivided into subcategories of energy industry, manufacturing industries and construction, transportation, commercial/institutional sector, residential sector, agriculture/forestry/fishing and others, following the standard subcategories recommended by the Intergovernmental Panel on Climate Change (IPCC).

Fugitive emission sources include coal mining and coal handling emitting CH_4.

For DPR of Korea, fugitive emissions from coal mining and coal handling are minimal compared with GHG emissions from combustion activities.

In developing the national GHG inventory of DPRK, the base year was selected as 1990.

The largest part of the emissions is a consequence of the combustion of coal, oil, and biomass fuel, and most of the carbon is released immediately as $C0_2$. Some of the carbon is released as carbon monoxide (CO), methane (CH_4), or as non-methane hydrocarbons to the atmosphere.

Since energy is a crucial factor in DPRK's modernisation, the government has given the top priority on the full production of coal necessary for economy. Using the reference approach, the total CO_2 emissions from fossil fuel combustion in 1990 was 147,143 Gg.

The CO_2 emission from coal combustion was 137,267 Gg or 93.3 % of the total CO_2 emissions from fossil fuel combustion. The share of emissions from liquid fuel consumption to the total CO_2 emissions from fossil fuel combustion was 6.7 %, being 9,875 Gg of CO_2

Emissions of carbon dioxide from biomass fuel consumption amounted to 20,258 Gg, which indicated biomass as important energy sources in DPRK. The figure was not

included in the total CO_2 emissions because there would be no net emissions of CO_2 as the same amount of gas is absorbed from the atmosphere in the next growth cycle of the plant through photosynthesis.

The energy sector GHG inventory in tabular form is listed in table 2-1.

Table 2-1. 1990 Greenhouse Gas Emissions for the Energy Sector, Gg

Greenhouse gas source and sink categories	CO_2 Emissions	CO_2 Removals	CH_4	N_2O	NO_x	CO	NMVOC	CO_2 equivalent
Total National Emissions and Removals	169,444.6	-14,631	975.2	38.7	432.0	478.1	60.5	186,515
Energy Sector	159,941.9	0.0	649.4	17.3	425.1	474.5	60.5	178,596
A Fuel Combustion (Sectoral Approach)	159,941.9		43.6	17.3	425.1	474.5	60.5	165,875
1 Energy Industries	90,775.3		1.1	12.5	279.5	18.7	4.8	94,635
2. Manufacturing industries and construction	34,272.8		3.4	4.7	104.5	50.3	6.8	35,707
3 Transport	3,472.7		0.4	0.1	24.1	93.6	17.7	3,510
4 Other Sectors	15,685.7		38.8	0.0	17.0	312.0	31.3	16,501
5 Other	15,735.4		0.0	0.0	0.0	0.0	0.0	15,735.4
B Fugitive Emissions from Fuels	0.0		605.8		0.0	0.0	0.0	12,721.8
1 Solid Fuels			605.8					12,721.8
2 Oil and Natural Gas			0.0		0.0	0.0	0.0	

* CO_2 equivalent refers to the 3 direct gases of $C0_2$, CH_4, and N_20.

In order to compare the sectors and/or subsectors, emissions in terms of CO_2 equivalent is applied using the global warming potential (GWP) factors. The global warming potential for methane and N_2O are 21 and 290, respectively for a time horizon of 100 years.

The energy sector emitted 159,942 Gg of CO_2, 649 Gg of CH_4, 17 Gg of N_2O, 425 Gg of NO_x, 475 Gg of CO and 61 Gg of NMVOC in 1990.

The energy and transformation subsector had the highest emission with 56.7 % of the total national carbon dioxide emission.

Manufacturing industries and construction subsector came in second with 20.2 % share, followed by the energy industry. In the Manufacturing subsector, lime, cement, and steel manufacturing industries were the largest emitters of greenhouse gas giving off 1,146 Gg, 6,929 Gg and 833 Gg of CO_2, respectively.

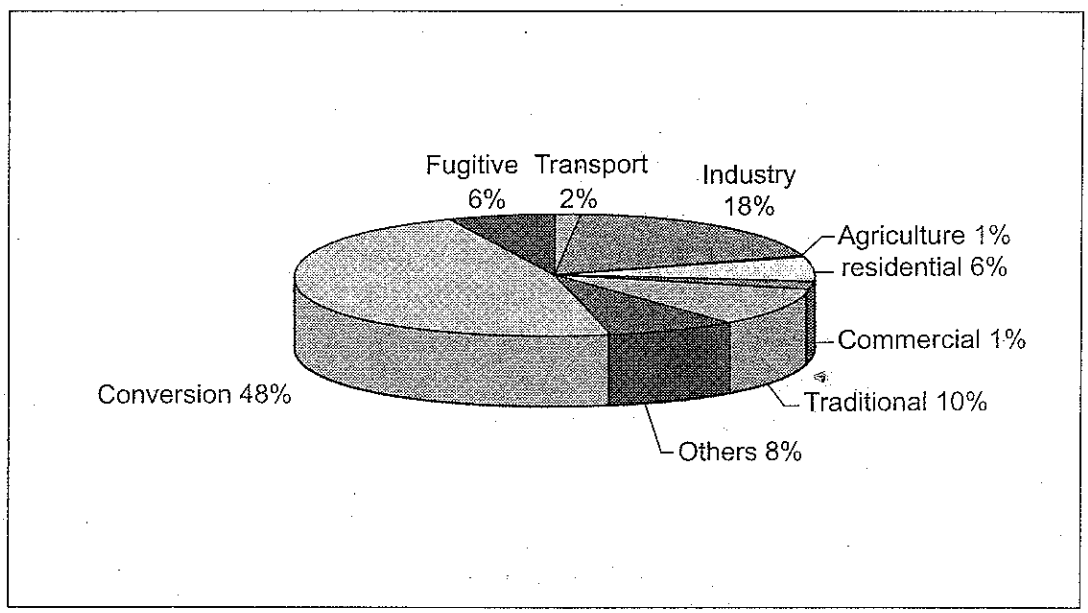
Traditional biomass burning refers to traditional use of biomass fuel in cooking and space heating. Although the CO_2 emissions from biomass burning were not included in the total emissions, the trace gases from biomass burning are considered as net

emissions and must be considered in the total calculations. The residential and commercial/institutional subsectors have 6.2 % and 1.67 % in CO_2 emission share respectively.

An important source of trace gases come from burning of traditional biomass fuels which are mainly used for cooking in household.

Fugitive emissions include methane emissions from mining, handling, transmission and distribution of coal. DPR of Korea produced 60 million tones of coal in 1990, reflecting 97.4 percent of the total fossil fuels consumed in 1990. For the great production of coal, CH_4 emissions from this source amounted to 606 Gg, resulting in 12,767 Gg of CO_2 equivalent emissions. In DPRK, there was no production of natural gas or crude oil. The relative share of each subsector is illustrated in Figure 2-1.

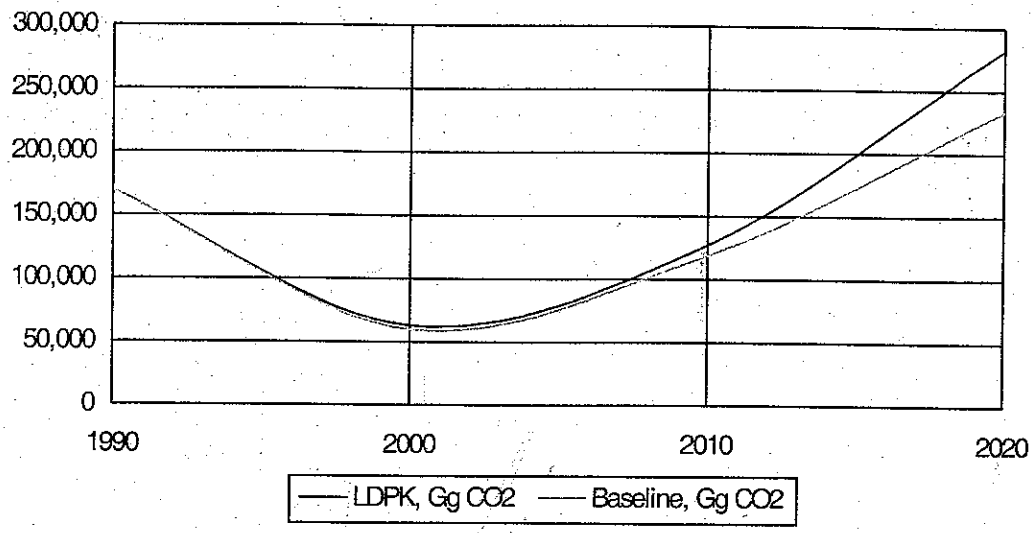
Figure 2-1. Energy Sector GHG Inventory by Subsector, 1990



When the greenhouse gas emissions from the energy and transformation subsector were allocated to the other sectors in proportion to its share of electricity allocation, the industrial sector became the largest emitter.

Baseline Scenario for CO_2 emissions from the energy sector was based on the actual energy data from 1980 to 1990 and the projected energy profile from 2000 to 2020 based on the Long-term Development Plan of DPRK.

The projected CO_2 emission from 1990 to 2020 resulting the baseline scenario is presented in Figure 2-2. In the Figure 2-2, the baseline scenario is compared with the projected CO_2 emissions in the Long-term Development Plan of DPRK (LDPK) which used the IPCC methodology.



	1990	2000	2010	2020
LDPK, Gg CO_2	169,445	62,948	127,083	282,408
Baseline, Gg CO_2	169,445	59,920	119,009	233,450

Figure 2-2. Projected CO_2 Emissions (Gg) – Baseline Scenario

2.2 Inventory for the Forestry and Land Use Change Sector

The forestry is valuable natural resource of the country and an important pillar supporting the country's economic development. About 75% of total terrestrial area are mountainous area with forestlands representing abundance of biological diversity and different ecosystems.

Every year, the amount of timber and firewood are extracted from forests for the use to economy, local communities and industries. Forestlands are also the main watersheds of rivers, which provide water for irrigation, hydropower, industries and households. As the forests provide many beneficiaries with their economic and environmental values, it is quite significant to develop the forestry in sustainable manner for achieving the general national development goals.

Due to the geographical condition, the country's forests are distributed throughout the country, with large proportion in northern areas of the country. As mentioned above, all the forests are mountainous and over 70% of the forests have more than 20° slope.

In 1990, the forest area of the country was 9.02 million hectares or 74.2% of terrestrial area. It shows that forestry sector is of importance in national GHG inventory, for large carbon sink capacity.

Areas by different forest types are outlined in Table 2-2.

The DPR of Korea has used the standard IPCC methodology in calculation of emissions and sinks in forestry sector, which was provided during the implementation of the ALGS project.

Table 2-2. Area by different Forest categories

Category	Area (thousand hectares)
Natural Forest	6,510
- productive	3,000
- degraded	1,800
- Non-forest	800
- Protected Forest	910
Plantations	2,510
- well established	1,000
- juvenile	1,090
- degraded	420
Total	9,020

The followings were considered as important source/sinks of greenhouse gases.

a) Changes in forest and other woody biomass stocks – This includes plantations and natural forests of economic value, production and use of wood commodities, trees planted along the roads and dams.

b) Forest and grassland conversion – Due to the lack of data, it was assumed that all the converted areas from the forests during the past decade have been used for arable land.

c) Burning of forests - (for trace gases)

d) Abandonment of managed lands – Land abandonment generally does not happen in the DPR of Korea. Therefore, this category was excluded in the calculation of emissions inventory.

In estimation of forestry sector GHG inventory, it is necessary to reclassify the existing forest types for the inventory estimation, and to identify the areas by forest types and their growth rates. According to the statistics, the forest lands covered 9.02 million hectares in 1990. Of it, 6.51 million hectares were natural forests and 2.51 million hectares were plantation forests. Each forest type has again divided them into evergreen and deciduous forests respectively to gain annual growth rates.

The emissions from natural forests were also included in GHG inventory because they are continuously influenced by human intervention and most of the timber production activities are generally undertaken in natural forests.

The annual biomass increase by different forest types is given in Table 2-3.

As shown in that table, it was assumed that all the plantation forests consist of evergreen tree species, considering the fact that the most of tree planting activities of the country in the past were mainly to plant superior needle-leaf tree species such as Larch or pine-

nut tree that are fast-growing and of economic value. Based on areas and annual growth rates by forest type, the total carbon uptake was estimated to be 8096.4 kt-C in 1990.

Table 2-3. Areas and Annual Biomass Uptake by Forest Type

Forest Type			Area (thousand ha.)	Annual Increment in Biomass (t dm/ha/yr.)
Plantations	Well established	Evergreen	1000	5.56
		Deciduous	-	-
	Degraded	1	420	1.88
		2	-	-
Juvenile forests			1090	0.4
Natural Forests	Productive commercial	1	1770	2.6
		2	1230	1.75
	Degraded	1	1190	0.5
		2	610	0.32
Other			-	-

According to the national statistics, 6.5 million cubic meters of timber products were harvested for industrial use and 3 million cubic meters of forest products were removed as traditional firewood in 1990 in the DPR of Korea.

Applying a general conversion factor of 0.95 t dm/m^3, the harvested products in terms of thousand tons of dry matter were 6,175 roundwood and 2,850 firewood.

The total biomass consumption from forest stocks was 8888.5 kt dm, which is equivalent to 3999.8 kilotons of carbon (0.45 was used as default carbon fraction).

Subtracting this consumption from total carbon uptake, the difference is about 4,096. 6 kt C which indicates the net carbon uptake or net removal of 15,020 kt CO_2.

Based on the statistics over last 10 years, it was assumed that about 10 thousand hectares of forest lands are cleared annually for agricultural uses in the DPR of Korea and the evergreen and deciduous forests share the equal proportion of them as 50% respectively. Assumptions were also applied for biomass densities, which are 52t dm/ha and 40t dm/ha before conversion and 25t dm/ha after conversion for coniferous and broadleaf forests respectively. With regards to the biomass density assumptions, it has been considered that most of the conversion practices were taken place in the areas where the forest stands were poor and weak, thus have low biomass density.

It is the predominant case in the DPR of Korea, that, when the forest are cleared, the biomass are usually removed from forests and used off-site as firewood to meet the rural demand for fuel. Therefore, it is assumed that about 30% of the biomass cleared are burnt in the fields and about 65% are removed from forest and burnt off-site, while the rest (5%), consisting of leaves and small twigs/branches are left to decay.

Using the default values of the IPCC Guidelines such as fractions of biomass oxidized on-site and off-site, the total carbon released from burning was estimated to be 80.8

kilotons. Adding this figure with the amount released from decay, the total emissions from forest and grassland conversion was 81.27 kt C or about 298 kt CO_2.

Table 2-4. Emissions from forest and grassland conversion in 1990

Immediate Release from Burning (kt C)	Delayed Emissions From Decay (kt C)	Total Annual Carbon Release (kt C)	Total Annual CO_2 Release (kt CO_2)
80.80	0.47	81.27	297.99

Due to the limitation of data available, the estimation is confined to the emissions from forest conversion. Based on the assumption that about 10 thousand hectares of forest lands are converted annually, and on the default values provided by IPCC Guidelines, the estimated emissions from soil was 25 kt C (about 92 kt CO_2) in 1990.

Based on the CO_2 emissions from burning and using the conversion ratios, the calculation for the trace gases such as CH4, CO, N_2O, NO_x was also conducted. Trace gas emissions are given in Table 2-5.

Table 2-5. Trace gas emissions from burning in 1990.

Gases	Emissions Ratio	Emissions (kt)
Carbon Emissions from on-site burning	100	25.5
CH_4	1.2	0.4
CO	6	3.57
N_2O	0.7	0.003
NO_X	12.1	0.1

The summaries of the C uptake/emission from the four categories of sources are presented in Table 2-6.

Table 2-6. Total Forestry and Land Use Sector CO2 Emission/Uptake in 1990.

Land Use Changes	Total Emission/Uptake (kt C)	Total Emission/Uptake (kt CO_2)
Changes in Forest and Biomass Stocks	-4,096.6	-15,021
Forest and Grassland Conversion	81.27	298
Emission from Soil	25	92
Net Emission	-3,990.3	-14,631

Note: + = Emission, - = Removal

For the projection of CO_2 emissions in forestry and land use sector for the period 1990-2020, the data in the National Long Term Plan for Forest Planting and Seedling up to 2020 based on current trend were considered.

The estimated CO_2 emission/uptake for forestry sector is presented in Table 2-7. As shown in the Table, the net uptake of CO_2 will continue upto 2020.

Table 2-7. Projection of CO2 Emission/Uptake from Forestry and Land Use upto the year 2020

YEAR	Emission(+)/Uptake(-) (kt CO_2)
1990	-14,631
2000	-14,007
2010	-13,119
2020	-12,291

There are a number of uncertainties and limitations in development of forestry sector inventory.

As the most of data used to develop the emission inventory in forest sector are based on survey and studies before 10 to 20 years, it is necessary to launch new forest resource survey to improve the GHG inventory. It should include the studies on the land use change and soil carbon for different forest types.

2.3 Inventory for the Agriculture Sector

In national GHG inventory, agriculture sector is the main source of methane emissions. Agricultural land is about 2.013 million ha in 1996.

Large amounts of methane are emitted from husbandry and rice cultivation.

A) Methane Emission from Livestock

The methane emissions from livestock were estimated to be 90.2 Gg in 1990. Of them, about 57.4% came from enteric fermentation and 42.6 % from manure management.

Table 2-8. Livestock population in DPRK

Livestock Population (000)	1990	1996
Cattle	858	567
Swine	6,080	2,290
Sheep	568	185
Goat	660	713
Poultry	24,972	11,137

Source: CBS

In 1990, 0.02 Gg of N_2O were emitted from animal waste management.

B) Methane emissions from rice fields

Rice is the predominantly cultivated grain crop in the DPR of Korea.

About 70% of total yield of rice is being produced in the west coastal areas.

According to the results of calculation, the rice fields in DPR of Korea have contributed to the methane emissions of 163.8 Gg in 1990.

About 85% of total emissions from rice fields came from continuously flooded rice fields.

C) Emission of N_2O from Agriculture Soils

N_2O emissions from agriculture soils are divided into three categories; direct and indirect emissions and emissions from grazing animals.

Direct emissions include those coming from the use of synthetic fertilizers, animal waste and crop residues.

The indirect emissions come from atmospheric deposition of NH_3 and Nox, and leaching /runoff of Nitrogen in soils.

In 1989-1990, an annual average of about 551 Gg of Nitrogen was consumed in form of synthetic fertilizers. Direct emission of N_2O from fertilizer and animal waste was estimated to be about 11.7 Gg N_2O-N.

Total N_2O emission from direct, indirect and grazing was about 20 Gg. Table 2-9 shows the summary of GHG emissions from agriculture in 1990.

Table 2-9. Summary of GHG Emissions from agriculture sector in 1990

No	Sector				Total			
		CH_4 (Gg)		N_2O (Gg)	CH_4 (Gg)	CO	N_2O	NOx
1	Animal	Enteric	Manure					
	Cattle	39.972	13.728		53.7			
	Sheep	2.84	0.0988		2.93			
	Goat	3.3	0.11		3.41			
	Swine	6.08	24.32		30.4			
	Poultry		0.449		0.45			
	Subtotal	52.192	38.70		90.89		0.02	
2	Rice							
	Contin-	134.67						
	Inter-	13.07						
	Rain-	16.08						
	Subtotal	163.82			163.8			
3	Soils							
	Direct			11.7			11.7	
	Indirect			8.46			8.46	
	Grazing			0.11			0.11	
	Subtotal			20.3			20.3	
	Total				254.7		20.32	

2.4 Industrial Processes

The emission of GHG from industrial processes is not from energy related activities, but from the production process. The type of GHG emitted depends on the nature of the production process. Table 2-9 shows GHG emissions from industrial processes.

Table 2-10. GHG emissions from industrial processes (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 Emissions	CO_2 emovals	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Subtotal emissions from Industrial Processes	9,502.7	0.0	0.1	1.1	6.8	0.0	0.0	4,170.0
A Mineral Products	8,074.7					0.0	0.0	4,170.0
B Chemical Industry	595.1		0.1	1.1	6.8	0.0	0.0	0.0
C Metal Production	833.0		0.0	0.0	0.0	0.0	0.0	0.0
D Other Production	0.0				0.0	0.0	0.0	0.0

Main sources of GHG emissions in industrial process are cement and magnesite production.

2.5 Waste.

Solid waste and wastewater produce CH4 under anaerobic conditions.

In 1990, 66.51 Gg of CH4 emissions from landfills, and 4.04 Gg from wastewater treatment.

Charpter 3. Impact and Vulnerability Assessment on Anticipated Climate Change

State Meteohydrological Bureau and Environment and Development Centre under the Ministry of Land and Environment Protection since 1994.

Considering the potential pervasive effects of climate change, the DPRK Government supports basic research related to risk assessment of climate change. The most comprehensive study was done by the Central Meteohydrological Institute under the State Meteohydrological Bureau and Environment and Development Centre under the Ministry of Land and Environment Protection since 1994.

The study analysed the impact of climate change on the ecosystem, agriculture, forestry, the ocean, hydrology, etc.

Detailed risk assessment studies have been carried out based on climate change scenario studies of the Korean Peninsula. The study analysed the case of the doubling of carbon dioxide around the Korean Peninsula. The report will contribute to the evaluation of regional effects and the establishment of regional adaptation policies.

According to the global climate models, when a doubling of carbon dioxide, it is predicted that temperatures will increase by 1.0-3.5 °C, with a probable range expected to be between 2.0 °C and 2.5 °C, and precipitation being 7~14%, by the year 2100 in Korean peninsular. As for regional and seasonal distributions, the East Sea coast of DPRK will have greater temperature changes than midwest coastal areas. Temperature change during winter will be greater than summer.

Summer-time variability is expected to be greater than annual average variability. Rainfall changes during, winter are also expected to be less than during summer.

3.1 Impact on Water Resources

Climate changes cause variations in soil moisture and water resources. The most important factor responsible is regional rainfall. The study analysed past rainfall and river flow data based on Korean Peninsula temperature and rainfall change prediction scenarios reported by the State Meteohydrological Bureau.

The calculated regional outflow varies significantly depending on the scenario. With a 14% increase in rainfall considered to be a representative scenario, the study estimates Daedong River- flow would increase 25%, Amnok river 21%, and Tumen River 18 %, resulting in an average increase in flow of up to 22%. The potential for heavy flood damage increases in the summer due to increased river flow.

It is expected that rainfall will increase with climate change. The general-circulation model predictions, however, indicate great variability during summer rainfall from ±25% to ± 30%. Such rainfall could cause catastrophic drought and floods. Adaptation strategies for drastic drought would be needed along with modifications to the design of water resource facilities and a revision of the comprehensive long-term water resource plan.

3.2 Impact on Agriculture and Crop Growing

Under the condition that other environmental factors are constant, except precipitation and temperature (rising higher than current levels), the study predicted changes in agricultural climate zones and crop growth periods.

Such changes were studied using various agricultural climate sources and sample cases of temperatures increasing 1°C to 3.5 °C, relative to the present.

It is expected for rice cultivation that an average increase of 2°C would result in the possibility of growing pseudo-late-season cultivar or late-season cultivar, across the Korean peninsular. Problems due to low temperatures during growing seasons would be reduced considerably. As the time needed to vegetate reaches 190-200 days in the southern west coastal regions, it would be possible to introduce a multiple cropping system.

Latent crop productivity, particularly rice production should increase for the year due to the lengthening of summer. However, this only applies in a very limited fashion to dominant crops that would enjoy these new conditions. In the current ecosystem, pure "first level" productivity would decrease due to exaggerated high temperature conditions and the explosive demand for evapotranspiration that would follow.

Accelerated global environmental change should rather be an accepted factor toward deterring or damaging agricultural ecosystem stability, and it would be preferable to formulate active response measures.

3.3 Impact on Forest

Changes to the forestry growth pattern were analysed with a scenario of a doubling of carbon dioxide after 100 years, accompanied by 1~3.5 °C rising of mean temperature and increase of precipitation by ±7~±14. The forest area of DPRK is about 75% of the territory. It gives great effects to the general ecosystems including agriculture, rivers and streams.

In recent years, DPRK's geographical peculiarity and abnormal climatic conditions entailing continuous natural disasters did a great harm to forest resources and raised many challenges in forest management. In 1995 and 1996, several spells of heavy rain brought by abnormal climate damaged several hundreds of thousands of hectares of forest.

And severe drought and heavy flood caused many harmful forest insects to be broken out in some regions and their increased damages have decreased production of seedlings and afforestation to ruin eco-environment with tremendous economic loss.

Annual net primary productivity is the function of annual average temperature(T), precipitation(P), net radiation(Rn), real radiation(Rr), radiative dryness index(RDI) and fertility(F), etc.

$$NPP = f(T, P, Rn, Rr, RDI, F)$$

Regarding the plant growth, many climate factors are correlated in several levels to result in different impacts. Major climate factors play the different role in defining the primary productivity.

Such factors as temperature, precipitation, radiative dryness index and fertility, etc. are correlated, however, in disregard of their mutual relation, two main factors of climate

such as average annual temperature and precipitation are considered to be independent impacts on primary productivity.

$$NPP = f(T, P)$$

Vulnerability assessment has been proceeded according to the climate change scenario.

The most vulnerable species are Pine, Larch and Deodar; the rise of temperature with low precipitation(T: 3.5°C, P: -14%) would greatly decrease Pine productivity.

Several broad-leaved species will extend their range northwards. However, natural expansion of the range of a tree species is usually very slow.

Milder winters may increase the risk of damage caused by insect pests overwintering as eggs in tree canopies.

However, there might be some counteracting effects, especially through changes in the activity of natural enemies.

Moreover, the risk of damages from fungi, fire and wind may be greater as a result of milder winters, less snow and shorter periods of frozen soil, and possibly drier springs.

Predictions are that decline of forests would start approximately 30 years after climate change began and severe damage would occur after 100 years.

Therefore, to maintain and improve development of forestry resources continuously and to maintain the ecosystem, it is imperative to formulate a plan to develop forestry planting , and growth technology for each respective species.

3.4 Impact on Sea Level, Coastline and Coastal Structure

Coastal areas are usually characterized by high population and vigorous economy. Such areas are very sensitive to environmental impacts. A certain sea level rise would result in many problems, especially for western coastal areas, and destroy the ecosystem. Therefore, it is important to relocate basic structures and industries and to establish harmony between environment and industry.

Numerical experiments with coupled atmosphere-ocean generated circulation models project a warming of between 2 to 3 °C over the annual mean of the region at the time of CO_2 doubling. Then the general sea level would increase with water temperature being warm as well as polar ice sheets melting.

Current best estimate of sea level rise is 1.0-2.5 mm/yr, represent a rate 2 to 5 times higher than that experienced in the past 100 years.

Should the sea level rise, there would be seriously affected Korean West Sea coastal areas and ecosystem.

West Sea coastal area of DPR of Korea, given its historical formation process and its geography / meteomorphology, is characterized as much more sensitive one over sea level rise (SLR) than any other places.

The compared analysis and assessment on vulnerability were conducted with three scenarios; minimum 0.3m, middle 0.5m and maximum 1.0m of sea level rise (SLR) suggested in IPCC.

Data necessary for vulnerability assessment was collected from weather stations located in northern (Silk island), middle (Nampo), and southern (Haeju) parts as well as from main relevant sectors cross country.

Assuming that SLR would increase with even much more 1m than present value by the year 2100, maximum height of tidal wave would be projected to range from 8m to 10m at full tide, although it represents regional differences along West Sea coastal area.

Recent studies on this area represent that about 1/5 of arable land is likely to be flooded as a result of maximum scenario, 1m of SLR in response to climate change.

3.5 Impact on Marine Products

If sea water temperature of the Korean Peninsula rises, the most significant impact will be on cold-water fish. There are "water masses" in summer, cold during winter season, along the deepest caves in the Yellow Sea which provide habitat for cold-water fish like codfish. In cases that the "cold'-water masses" are extinguished before the summer season and that the cold-water masses are not formed because of the stream of the Kurilian Current becoming more rapid, cold-water fish could become extinct in the Yellow Sea.

Since it is uncertain if temperature rise in surface water directly causes temperature rise in the lowest-depth water, it is difficult to know whether bottom- or middle-depth cold – water fish are sustainable. Habitat of cold-water fish like salmon and herring would likely move northward.

Chapter 4. National Response Strategies on Climate Change

The DPR of Korea formulated a national response strategy to honour its commitment as a signatory to the Convention. This national response strategy will be implemented by the Environment and Development Centre under the Ministry of Land and Environment Protection.

This chapter describe some of the major adaptation measures of the agriculture, forestry and coastal zone responding to climate change in DPR of Korea for addressing issues related to global climate change.

4.1 Agriculture

Agriculture is an important sector of DPR of Korea's economy. In DPRK, the rural population accounts for about 40% of the total population.

DPRK's agricultural production has always been influenced by changes in climate.

Flooding due to unprecedented heavy rain in 1995 and 1996 damaged DPR Korea.

Table 4.1 Damage by flooding in 1995 and 1996

Indices	1995	1996
Total damaged cost (000 US$)	15,000,000	2,270,862
Affected counties (number)	145	117
Inhabitants affected (000)	5,200	3,270
Inhabitants outdoor (000)		147
Victims (person)		116
- Damaged cost cross sectors (millionUS$)		2,271
Agricultural sector (millionUS$)		782
Land managerial sector (millionUS$)		203
Municipal managerial sector (millionUS$)		391
Industrial sector (millionUS$)		110
Railway sector (millionUS$)		126
Communication sector (millionUS$)		214
Educational sector (millionUS$)		196
Public health sector (millionUS$)		
Loss of farming land (millionUS$)	925	
Loss of husbandry (millionUS$)	111	

Source: CBS

Historically, fluctuations in agricultural production have affected to the national economy.

The government of DPRK has attached great importance to stabilization of agricultural production and development of local economy.

It is important to study the possible effects of climate change on agricultural production and develop measures for the reduction of its impacts.

The dynamic nature of water availability is a key to agricultural production. If the temperature rises by climate change world over, it is projected to experience a decrease in precipitation in upper latitudes and an increase in precipitation in lower latitudes in DPRK.

Variation in temperature and rainfall leads to increasing the probability of disastrous harvests and destabilizing crop products. Preliminary estimates suggest that at least 20% of grain products decrease in DPRK, due to global climate change.

In DPR of Korea, a number of the adaptation measures for agricultural sector can be taken to reduce vulnerability to climate change.

Some of them are described below.

a) Changes in transplanting date and Seeding date

Suitable selection of transplanting time and seeding time, considering the climatic conditions by regions, is very important for crops to resist drought and high temperature.

And it is important to prevent losses of crop yield by the cold weather, storm and heavy rain.

b) Irrigation

The need for irrigation to compensate for moisture losses caused by increased evapotranspiration may be significantly increased.

Introduction of irrigation system to cornfield is very important to increase crop production.

c) Fertilization

In some areas, an increase in amount of fertilizer applied may compensate for yield losses caused by climate change.

d) Improvement of crop variety

It is important to introduce new high-yielding variety against higher temperature for currently cultivating crop under the increasing temperature.

Some researchers have also considered hypothetical new varieties genetically adapted to climate change condition.

e) Change in crop variety

An important way for increasing crop production is to convert maize field dropping in crop yield by effect of climate change into potato and sweet potato field.

Double cultivating system, as well should be introduced into the regions with the suitable temperature condition.

f) Increase the diversity and adaptability of present-day agricultural methods in light of probable climate change;

g) Develop and introduce crops that are better suited to extreme climate conditions (such as heat, aridity, and humidity);

h) Develop technological measures to secure vulnerable areas against meteorological extremes (irrigation, etc.); and

i) Increase investment in the agricultural sector to upgrade the rudimentary techniques used in many parts of DPR of Korea today.

Since rice is the main food grain in DPRK, studies are just beginning on alternative rice cultivars that are high in yield, but low in methane emissions. Experiments are being conducted on time-of-day management of water and fertiliser addition, development of non-ploughing methods, and development of microbiological techniques such as bacteria that consume methane.

4.2 Forestry

The DPR of Korea has about 9.2 million hectares (Mha) of forestry lands. However, the amount of wood cut annually exceeds nearly the amount grown, resulting in decrease of forest cover.

Firewood consumption between 1990-1996 increased from 3 million m^3 to 7.2 million m^3.

The quality of forest in many areas is rather low, both in terms of canopy cover and the health of the trees due to abnormal climate.

According to the predicted climate change, adaptation measures in DPR of Korea's forestry are considered as follows;

a) Plantations

- Produce domestic breeds of good quality, which grow fast and are fit for disease, draught and cold
- Introduce imported species of best quality by acclimation.
- Further nutrition breeding method for developing and producing new species, and plant many pine-nut trees with economic value after completing the method of engrafting pine-nut trees upon Pine, on a large scale.
- Intensify the research for developing the first hybrid and good breeds that can increase the production by 1.5 times more with better endurance from diseases, and new oil trees and fruit trees which yield high harvests.

b) Forest management

- Well manage existing plantations and cultivate crops including beans and wild herbs including bellflowers under trees in plantations to enhance the ability to absorb carbon dioxide per unit area of forest.
- Assimilate the experience and success of others to suit to the country's specific conditions in preventing damages from harmful forest insects.

Research and develop the attractant and evader for effective control of harmful insects.

- Build monitoring posts in some severely damaged regions to proceed survey and forecast fire and harmful forest insects, and equip them with modern monitoring facilities.
- Research on fauna and flora with economic significance.
- Enhance ex-situ protection including botanical garden.

In some parts of the country, particularly the middle of south, the availability of water is the major limitation on increasing forested lands.

The use of scarce water for forestry would have to compete with its use for agriculture and meeting the demands of the industrial and residential sectors.

The DPRK is committed to the preservation of biodiversity in Northeast Asia. The maintenance of such diversity is important in the forestry area as well.

Arrangements for the monitoring of trees and forests should be improved, and techniques for cutting wood and for afforestation should be modernized. The overall system for managing forests and the pricing of forest products could also be improved.

4.3 Water Resources

Global climatic change will have a marked effect on the periodicity of wet and dry periods in DPRK and on flood and drought disasters. Models have indicated that global warming will lead to a strengthening of the summer monsoon.

The DPR of Korea is strongly affected by the monsoon climate, and the distribution of its precipitation may change greatly, evidenced in particular by prolonged dry periods in the river basins of the East and the West.

Droughts may be aggravated by increases in evapotranspiration. On the other hand, floods may increase in the east and the west coastal areas.

The DPRK's per capita water availability is high. However, in terms of the quality of fresh water resources and ecosystems, population growth, urbanization and economic development may all contributed to water degradation, and are likely to aggravate it in the future.

Thus it is imperative to make better use of existing water resources, prevent water pollution, and protect water-related ecosystems, even in the absence of climatic change.

With the probability of climatic change, the need is all the more urgent to take effective action in using water resources more wisely.

Such action will have to rely heavily on demand management. Here, DPR of Korea has already taken some important steps to protect and control water resources by improving its water management institutions.

Greater focus has been placed on integrated management at the regional and river basin levels, as well as in coordinating the use of surface and underground water resources.

Regulations have been issued to improve the protection of water resources, a water extraction permit system has been inaugurated, and charges have been levied for water resource utilization and the discharge of waste water.

It is important to use water with relatively low cost, but in the case of irrigation, it may be necessary to continue to use water with relatively higher economical value rather than allowing a reduction in crop yields.

At present, considerable scope would appear to remain for continued efforts in demand management for water. It will be possible for such policies to accommodate many of the changes that would be induced by global climatic change in DPR of Korea.

Consideration must be given to water supply structure. Improved river control is imperative to reduce flood disasters; efforts in this area would need to be strengthened, raising design standards and reducing siltation for vulnerable regions to climate change in DPRK.

While efforts should continue to boost crop yields in unirrigated fields, irrigation remains an effective means of preventing or reducing crop losses by drought. Where possible, the irrigated area should be expanded, even if it comes expensive.

Other supply-enhancing measures which merit continued consideration are artificial recharge of groundwater, the use of lower-quality water for some purposes, the reuse of waste water, and desalinization. A number of problems, primarily of an economic or insitutional nature, face the more extensive use of these techniques. The net effect of climate change on supply-oriented projects is likely to be economic by increasing the investment of attaining the required flood control or supply capacity.

4.4 Coastal Zones

With expansion effect of the sea by increase of water temperature and melting glaciers and eternal snow, sea level in DPR of Korea is gradually rising.

Most of DPRK's large cities and industrial bases are concentrated in coastal zones.

Some cities and port facilities are about 1.5-4.0 m above sea level, with the lowest less than 1.0 m above mean sea level.

A further rise in the sea level anticipates threatening cities, ports, and salt farms with flooding. It would also cause more salinization of agricultural lands in west coastal zones and aggravate storm surge damage.

Assessment is focused on sea level rise over the Korean West Sea Coastal zone (hereunder western coastal zone) in DPR of Korea.

Adaptation measures in western coastal zones are considered as follows;

a) Tideland protection measures

A rise in sea level would lead to flooding over the low coastal area and coastal marshes, especially tidelands.

- **Damage to bank of tidelands**

  The height and thickness of existing breakwaters constructed in tidelands should be reviewed, responding to the sea level rise in western coastal zones.

  The study should be focused on sea level rise in order to protect breakwaters and seawalls already built there.

- **Damage by flooding**

At present, the banks, dams and drainage systems to prevent flooding have been built up in all rivers and streams in DPRK, however, most layouts do not reflect the projected impact of climate change.

The issue on design standard of existing banks in down streams remains imperative.

It should be further considered that artificial drainage systems are set up and existing treatment capacity levels are enhanced in down streams.

A setting up of forecast and early warning systems is imperative over the flooding,.

b) Ecosystem protection

Sea level rise causes changes of numbers and distributions of wildlife and vegetation, while altering its species composition and scope of habitats and ecosystems.

The ecosystem protection in coastal areas needs to establish integrated coastal zone management system for conserving and managing the habitats of fauna and flora.

And new project will consider its impact on ecosystem in coastal areas.

c) Facilities protection

The reinforcement of existing design level is required for infrastructure including port, wharf, drainage system and water breaks, responding to sea level rise.

d) Prevention of soil inundation

The vulnerability assessment to more sensitive areas over sea level rise shows that seawalls should be constructed in specific sites along the coastline.

Such areas may be estuaries of Amnok, Chongchon and Daedong River.

Furthermore, in order to reduce the expansion of soil inundation through land erosion, the exceeding of underground water may not be permitted in coastal areas.

Chapter 5. National GHG Abatement Action Plan

Proper and effective policies in various aspects are imperative to guarantee the healthy development of the national economy and at the same time to establish and implement GHG mitigation strategies.

5.1 Sectoral Objectives

Energy

The overall national policy in the energy sector is to ensure energy supply with indigenous resources, considering the environmental concerns. The specific objectives focus on energy self-sufficiency, diversification of energy resources, use of new and renewable energy, and efficient production and use of energy.

These long-term energy strategies will support the national, social and economic development plans. They are also important strategies for GHG abatement.

Industrial energy consumption accounts for about 50 percent of total energy consumption. Iron and steel, nonferrous metals, chemicals, etc., are not only the major industries of the national economy, but high energy intensive industries as well.

Therefore, the industry sector is the focal area for improving energy efficiency.

The principal means of improving energy efficiency in the industrial sector is to adopt new technologies and practices that will help avoid the huge losses of energy presently associated with activities in this sector. Technical innovations for existing technologies and equipment as well as development and introduction of new technologies are the main ways to improve energy efficiency in the energy sector.

Apart from the direct energy savings from technical progress, attention should also be paid to indirect energy savings by strengthening the production management, energy audit and training of skilled staff and workers, etc. It is estimated that the development and use such resources will lead to significant energy savings in the future.

The overall policy for the residential and service sectors is to have no increase in the per capita consumption of energy and raw material, and to reduce the environmental pollution caused by energy consumption and waste while improving people's living standards. The heating system for new public buildings should comply with the new norms of energy conservation. For the buildings with central heating and electric heating system, the related meters and other adjusters have to be installed.

Technical renovations incorporating energy-saving technologies will be carried out systematically for the buildings in district heating.

In rural areas, one of the most important tasks is to introduce and disseminate technologies that improve energy efficiency, such as the coal briquette, biogas, solar water heater, wind power and mini hydro power, etc. These measures will help increase the level of energy services to rural households while not increasing the level of energy consumption or GHG emissions from this sector. The lack of development in the transport sector is a hindrance to social and economic development. At present, the transportation infrastructure in DPRK is not adequate to meet growing demands of the population and the economy. The principal policy objectives of the transport sector are

i) to speed up transport infrastructure construction to alleviate congestion in this sector
ii) to support economic development and the improvement of the standard of living and
iii) to promote sustainable development of the society and the national economy.

Agriculture

Agriculture is a solid base for the national economy in DPRK.

The goal of the agricultural sector is to increase productivity in order to achieve self-sufficiency in food production. There are no programs that directly aim at GHG abatement. The environmental objective of the agricultural sector is to sustain the food requirements of the country by harnessing strategies and technologies that are most appropriate.

The cost efficient and environment friend GHG reduction strategies in agriculture have not been identified.

Forestry

Sustainable Forest Development along with environmental protection and improvement of socio-economic conditions of the people are the DPRK's National Development Goal. The strategies and programs identified in the forestry sector include the integration of environmental consideration in decision making, strengthening the capacity for the planning and sustainable management of the forestry, rehabilitation of degraded ecosystem, strengthening the natural reserves and implementation of forest protection program, etc.

5.2 National Objectives

The national development goal aims to provide DPRK with a better quality of life in a politically, economically and environmentally sustainable manner. To successfully make the transition to sustainable development, DPRK National Action Plan for Agenda 21 was formulated in 1993.

The government of DPRK has promulgated the energy development strategies according to the availability of energy resources and the rapidly growing energy demand. Among the strategies, the important ones include i) giving priority to energy conservation while establishing new energy supply capacities; ii) actively developing hydro power and nuclear power and iii) integrating the development of renewable energy in the overall rural energy development plan.

The objectives of the energy strategies are mainly to improve energy efficiency, to use more alternative energy resources for increasing energy supply capacity, and to protect the environment. These long-term energy strategies are also important strategies for GHG abatement.

Afforestation is not the only way to increase wood supply, but is a cost-effective option for carbon sequestration. The carbon sequestration potential of idle and harvested lands is being enhanced by the establishment of woody vegetative cover.

Through the establishment of plantation forests with high productive tree species by adaptation of improved management techniques it will provide the production of timber for the economic development in sustainable manner while avoiding the degradation of forests.

The international objectives of the DPRK's policies are summarised below.

(i) At present, as dramatic changes happen in the political, economic, social, scientific, technological, and other fields in the world. Extensive and effective international cooperation is the only sensible option for the world to address the opportunities and challenges and is the tight option for every country. Environment and development are just two of the areas where such cooperation is most needed and vividly manifested.

(ii) The DPRK has been implementing international conventions, seriously fulfilling its international duties, and actively participating in global environmental affairs. In 1994, the DPRK signed the UNFCCC. The principle of "common but differentiated responsibilities" agreed at the UNCED should be truly adhered to, and the process of providing additional funds and transferring technology from the developed countries to developing countries should be accelerated.

(iii) The DPRK is a developing country. Its capacity for sustainable development is not very strong, and it needs more international support in the aspects of science and technology, modern management, and capital and investments. International cooperation on environment and development will help the DPRK to coordinate development of its economy and environment.

5.3 Coordinated GHG Abatement Action Plan

The most important measures for abating GHG emissions are improving energy efficiency and substituting fossil fuels with hydropower, nuclear energy, and renewable energy. These findings are proven not only by experiences and practice but are also the results derived from the models, calculations, and analyses. There is a significant potential for energy saving in the fields of energy conversion and end-use so energy saving will continue to be a top priority for abating GHG emissions. This is consistent with national social and economic development objectives. This conclusion is supported by the MEDEE/S and EFOM model analysis.

To abate GHG emissions, the main national abatement strategies most suitable for the DPRK's own economic development status are as follows:

(i) Implement sustainable development within the overall development strategy to integrate major issues of energy efficiency, environmental protection, and resource conservation.

(ii) Promotion of economic growth. The essential objective is to improve economic efficiency, resources saving, and energy efficiencies.

(iii) Focus on energy conservation while developing new energy facilities. To make efforts to reduce the coal share in total primary energy, and at the same time to adopt clean coal technologies that would contribute significantly to CO_2 emissions abatement.

(iv) Afforestation is the most important option for sequestering $C0_2$. The DPRK has the potential to expand forestry resources gradually in the medium and long-term.

(v) In the agriculture sector, adopt technical options in animal raising and rice production for methane abatement.

Undertaking actual projects is an important step toward implementing the national GHG abatement strategy.

The energy efficiency improvement options are focused on the areas and sectors where large potential exists. The most important measure is to improve thermal power generation efficiency by adopting several effective options: renovation of low- and medium-pressure generators, installation of large-scale generators, development of cogeneration, underground coal gasification, and adoption of advanced technologies such as pressurized fluidized bed combustion (PFBC) and integrated gasification combined cycle (IGCC).

PFBC and IGCC technologies are expected to be commissioned after 2005 and will help improve the net generation efficiency of power plants from 39 to 45 percent. Besides the energy supply sector, the energy end-use sectors have many technical measures to improve energy efficiency.

Commonly used equipment such as boilers and motors are the most important ones and has the largest potential for energy savings.

Technical options for improving boiler efficiencies may include fuel preparation, advanced combustion technologies and auxiliary equipment, as well as process control. Technical options could be adopted to save energy consumption by electric motors by substituting high-efficiency motors for low-efficiency ones and by replacing fixed speed motors with variable speed motors.

In the residential and service sectors, options of increasing gas fuels supply to substitute for coal stoves in household cooking should be placed at a high priority, since it will result in the dual benefits of reducing indoor air pollution and mitigating GHG emissions. The other option would be the gradual increase in the use of high efficiency lighting to replace traditional incandescent lamps.

Because of constraints in coal production and transportation abilities, thermal power substitution by hydropower and nuclear power altogether should have a fast development to meet the rapidly growing demand for electricity.

In afforestation, fast-growing and high-yield afforestation is one of the important options. Use of these species can increase biomass supply to ease the rural energy shortage. Special tree species should be identified and timber cultivation and plantation technologies need to be developed. Further, to raise biomass utilization efficiency, gasification technologies should, be studied.

Chapter 6. Education, Training, and Public Awareness

DPR of Korea recognizes that some of the greatest contribution to global environment conservation could be made by public participation.

The development of educational and public awareness programs on climate change, providing public access to information on climate change issues and public participation (including NGOs) are important parts for implementation of the general obligations of UNFCCC and development of the National Action Plan.

6.1 Public Relations on Environmental Conservation

A program for public participation on different aspects of climate change is currently being developed.

Climate change issues and study results are presented in quarterly science and technical journals, newspapers, and on radio and TV.

Both the national and local governments engage in various campaign for environmental conservation. These programs are often conducted in June, which is World Environment Day, and particularly March and November, which are DPRK's Land and Environment Protection Campaign Period.

6.2 Education and Training on Environmental Conservation

To encourage people to address the problem of climate change in their daily lives, opportunities for people to learn about environmental issues should be provided in homes, schools, regions, companies and other situations. The content of these programs focuses on the importance of preserving the global environment, the relations between global warming and daily life, the energy issues that are the prime cause of global warming.

Specific measures for promoting environmental education and learning are as follows.

a) Environmental education in schools

It is possible to obtain basic professional knowledge on the scientific aspects of the global climate change issues at all universities in DPR of Korea.

As a means of deepening understanding of recycling, DPRK also promotes the public collection of used materials such as paper and plastics in schools.

In higher education, some colleges and universities have a Environment Department, and many books for environment protection are being published.

The government created environment faculties in Universities including Kim Il Song University, Kim Chaek Engineering University and Humhung Chemical Industry University.

b) Environmental education in local communities

The Government conducts statutory education for civil servants and for environment managers in the private sector.

Quality of environment education, in particular in senior middle schools and collages, is not enough high to meet requirement of sustainable development.

To address such issues, the government has established Education Center for Environment in Grand People's Study House to give concentrated education for staffs and officials related.

With the strengthened environmental education in senior middle schools and universities, children and youth are actively participated in sustainable development activities such reforestation, natural conservation and support on farming.

To strengthen education and public awareness for sustainable development, the government will improve the quality of environmental education in education

sector and integrate training, education and public awareness into sustainable socio-economic development.

Priority in above-mentioned activities is training to educational staff and environment related officials.

The government will establish national network system for training on sustainable development, increase investment to education sector and widely disseminate information and knowledge related to sustainable development through mass media.

Local governments also conduct environmental education for officials related environment in companies and enterprises.

6.3 Support for Environmental NGOs

The vital activity and healthy development of environmental NGOs and other private groups are indispensable for success in solving environmental issues. Such groups can also play important roles as leaders or advisors in efforts to get the general public involved.

Environment-related activities of non-governmental organizations include public information capaings for environmental conservation, academic surveys and research, and sminars on environmental issues.

The government will increase the support to environmental NGOs which plays a positive role in public environment-related activities.

Charpter 7. Climate Change Research and Technology Development

Climate is traditionally one of the main fields of research interest in DPRK and a lots of studies on its genesis and characteristics have been carried out.

A major part of these studies has been performed by the institutes of the Meteorology and Hydrology Commission, Universities and Sciences of Academy in DPR of Korea.

The government has initiated the implementation of the National Action Plan for Implementation of Agenda 21 (NAP) developed in 1994, and Ministry of Land and Environment Protection is a coordinator of that progrmme.

NAP sets long-term objectives for the establishment of an environmentally sound socioeconomic system. The plan is designed to comprehensively and systematically promote policies for environmental conservation. It includes improvement of scientific research, monitoring and observation, development of appropriate technology, and international cooperation for research, monitoring and observation.

7.1 Research

7.1.1 Basic Research for National Communication

The DPR of Korea signed the UNFCCC in June 1992, and ratified it on 5 December 1994. The Convention has entered into force on 5 March 1995.

The preparation of the national communication was a first step in the actual implementation of the UNFCCC in DPRK.

Environment and Development Centre has been designated to conduct basic research, investigating and presenting the National Communication.

Research done by Environment and Development Centre had four objectives;

a) Report the national statistics on greenhouse gas emissions and removals, using IPCC methodologies,

b) Analyze potential influences climate change on DPRK,

c) Research national policies for establishing a cost effective measures to minimize GHG emissions,

d) Establish a strategy to minimize the economic burden and contribute to national economic growth.

7.1.2 Energy Research and Energy Technology

The energy sector accounts for the largest share of total CO_2 emissions. Reductions of CO_2 emissions can be achieved by increasing efficiency of energy transformation, as well as through use of renewable energies and through more efficient energy use.

Basic research has produced findings regarding more cost-effective, more environmentally compatible operation of power stations and combustion systems for fossil fuels. Applied basic research is expected to lead to further efficiency increase and environmental relief.

Research has the following support emphases:

1) Reduction of energy requirements

Efficiency increase in energy transformation, new secondary energies

a) Power station technology, combustion research

b) Fuel cells, batteries

c) District heating

Efficient energy use, reduced use of fossil energies in the final energy sector

a) Solar heating, heat for buildings

b) Enhancement of energy productivity in industry

2) Reduction of CO_2 emissions and pollution in the energy supply

Renewable energies

a) Hydro power

b) Wind power

c) Biomass

Overarching issues

a) System analysis

b) Barriers to innovation in energy saving

c) Provision of information

7.1.3 Research for Adaptation to Climate Change

a) A Complex study of the drought phenomenon in DPR of Korea

b) Study of the sea level rise and forecast of its variations along the Korean West Sea and Korean East Sea

c) The effects of changing climatic elements on agriculture and silviculture and on fisheries.

d) Regional Climate variations and change in DPRK

7.2 Systematic Observation

The DPR of Korea makes synoptic and other meteorological observations.

These include not only surface weather observation, upper air observation, and marine meteorological observation but also radar observation, lightning, earthquake monitoring, etc. The government of DPRK has introduced and operated many climate monitoring equipment.

The DPRK's National Action Plan for Implementation of Agenda 21 proposes modernization of meteo-hydrological equipment, increase in investment, international cooperation, activation of meteorological research and development, and improvement of a weather service system and weather information system.

The government of DPRK will improve its meteorological information system by expanding the meteorological observation network and improve weather services.

Chapter 8. Follow-up Activities

Formulating, implementing and regularly updating national programs containing measures to mitigate climate change and facilitate adequate adaptation to climate change impacts are the general commitments of all Parties in accordance with Article 4 (1b) UNFCCC.

Basic State Policies for Environmental Protection

In the 1980s, the DPRK Government made environmental protection a basic State policy. Since then, progress has been achieved in environmental protection. But there still exists comparatively severe natural resources waste and environmental pollution, caused by the economic development, population growth, increased resource consumption, and inefficiencies of production and use. In protecting the environment, a series of measures and strategies may be undertaken.

(i) Formulate and implement a sustainable development strategy, which should be reflected in social and economic development plans and programs of the State, and enhance the coordination of environmental protection and resources conservation. This is consistent with the goals of economic growth pattern that the DPRK is making efforts to realize.

(ii) Establish a law and regulation system for environment protection. Some laws, regulations and a preliminary legal system of environmental protection suitable for DPRK's own situation is set up. It plays an important role in reducing harmful substances and GHG, and in protecting the global and regional environment. However, environmental protection legislation needs further enhancement.

(iii) Increase funds for environmental protection through various channels. Environmental protection funds are certainly necessary, and more input and earlier input can bring out obvious and better social, economic, and environmental benefits.

Improve Energy Efficiency and Reduce Energy Consumption

Energy efficiency improvement is considered one of the most important strategies for abating GHG emissions in the DPRK.

In DPR of Korea, there still exists significant potential for further energy saving in each sector. The cost of GHGs abatement from energy saving is the lowest among all other abatement measures.

Energy saving is not only a key measure for GHG abatement, but consistent with the State's sustainable development goal. Therefore, it is clear that measures need to be adopted to promote energy saving because of its significance and effects.

The long-term energy saving strategy should be reflected in social and economic development plans of the future.

Technical improvements should be accelerated, and the research development, the adoption and dissemination of advanced technologies have to be promoted.

Cogeneration should be considered where possible. In the industry sector, average energy efficiency of widely used equipment, especially industrial boilers and kilns, should be improved by means of technical innovation and installation of new models.

In the commercial and residential sectors, coal and firewood-saving stoves should be widely popularized all over the country.

Finally, adoption of clean coal technologies such as briquetting, gasification and advanced combustion, etc., should be expanded. This is a very important strategy for abating GHG emissions, as coal will be the major energy source in the DPRK for a long time in the future.

At the same time, it is also important to raise people's consciousness of energy conservation, resources conservation and environmental protection through information dissemination and education.

Accelerate and Expand Energy Substitution

Given the fact that fossil fuels account for a major proportion of primary energy in the DPRK, the other major option for large-scale abatement of GHGs emissions is the substitution of low and non-carbon energy for fossil fuels, especially coal. Long-term alternative energy development programs should be formulated early for this long run strategy.

Hydropower and renewable energy are the main fields of non-carbon energy development. Hydropower generation in 1990 provided 50 percent of total electricity.

Solar and wind energy are the major fields of renewable energy development, especially in the rural areas and remote regions of the DPRK. These sources can improve local energy supply shortages and protect the global and regional environments.

Strengthen Development and Protection of Forestry Resources

Forests are the major part of the land ecological system, which absorb and sequester large amounts of CO_2.

To advance the very significant functions of forests in addressing global climate change, the following key measures should be carried out.

(i) Strengthen the management and protection of existing forest resources, controlling forest resources expenditure, and strictly checking activities that destroy forest resources.

(ii) Simultaneously promote afforestation along with forest protection. Encourage and organise "entire-people tree plantations" by making various afforestation plans and programs. Plantations of fast-growing and high-yield firewood should be rapidly developed in the areas where there is a serious firewood shortage. Although firewood plantations themselves do not contribute greatly to carbon sequestration, they protect forest resources by limiting the destructive cut of natural forests and providing rural areas with fuelwood for daily use.

(iii Develop appropriate policies that will accelerate forestry development and its protection.

Develop Techniques for Abating GHG Emissions in Agriculture Production

Rice production, nitrogen fertilizer, and animal production are the three major sources of GHG emissions in the agriculture sector. Efforts will be made to abate them subject to the imperative of producing enough grains and livestock.

The rice production practices for abating methane emissions from paddy fields should be further analyzed. They have some financial benefits, but also some uncertainties and additional costs that must be investigated further.

Upgrade of forecasting service and alarm systems in vulnerable areas along West and East Coastal Zones over sea-level rise

Over the flooding, there should be upgraded existing projecting service system and alarm system for emergency as well as established new ones in areas much sensitive to flooding cross country. Since the Korean West Sea coastal zone is much sensitive to flooding, it is considered as most proper option responding for SLR to reinforce and strengthen its height and thickness of existing banks and seawalls much more higher as against present design, while introducing advanced construction technology to new banks and seawalls.

Both comprehensive and integrated management over Eastern and Western Coastal Regions of DPR of Korea should be established, responding to climate change.

Join and Expand International Cooperation on Protecting Global Environment and Climate

The DPRK will continue to join international activities related to global climate change and will offer its new and strenuous efforts to realize the UNFCCC goals.

Solving the problems of environment and climate change will require identifying funding inputs and a set of priority projects in key fields. Settlement of the DPRK's environmental problems emerging in social and economic development depends on its efforts in policy research, organization, management, technology progress, and fund raising. It is necessary to expand the input of funds in protecting the environment.

DPRK Government has paid much attention to raising funds for environmental protection. DPR of Korea is a developing country. Hence, apart from domestic funds, the other important channel for raising environmental protection funds is to further expand the external financial inputs. Foreign funds can act as catalysts to accelerate the steps for environmental protection in DPR of Korea.

Resolution of the environmental problems in DPRK will also be a contribution to addressing global environmental issues. International technical and financial assistance is helpful for capacity building to abate GHG emissions in DPRK.

Chapter 9 Priority Activities for Climate Change

Climate change activities in DPR of Korea do provide indications of possible areas where further work ought to be done.

Such areas include extension of classical country studies (inventories, mitigation options, climate change impacts etc), institutional building so as to support decision-making framework by policy makers, enhancement of private sector participation in mitigation approaches, targeted research and building of greenhouse gas databases for further national communication uses. The project concepts treated in this chapter need further development and financing in order to be implemented.

9.1. Enhancing Capacity in the Environment and Development Centre to Develop the Policies and Measures to respond to Climate Change.

This project will provide technical and financing support to the Environment and Development Centre to enable it to extend its present research programmes to include the studies concerned to climate change.

Main areas for such studies include environment analysis, environment monitoring, environment impact assessment, water resource management, public health, forest protection, waste management, economic losses, ecosystem damage etc.

Though Climate Change Country Study Team has been organized in the Environment and Development Centre, its capacity to develop the policies and measures to respond to climate change is very low due to old dated equipment and lack of human resources skilled.

Activities expected in this project are:

a) Modernization of old dated equipment in the Centre

b) Establishment of environment statistics system through the country

c) Establishment of integrated environment analysis and monitoring

d) Training of relevant experts

The total cost of this action is estimated at around $5 million.

9.2 Construction of Mini-hydrel Turbine and Generator Factory

The proposed project aims at to reduce GHG emissions by raising hydro turbine efficiency. Exploitable medium and small scale hydropower resources account for about 1.9 Gw and 0.25 Gw of them have been developed.

Power generation by natural energy is of great significance in preventing global warming, conservation of clean natural environment and ensuring sustainable energy supply. Particularly, considering abundant medium and small hydropower resources in the country, it is of great importance to manufacture the modern mini hydrel turbine and generator to ensure high generating efficiency in small hydrel and to solve the increasing energy demand.

The activities expected in the project are as follows:

a) Procurement of manufacturing equipment of small hydrel turbine

b) Procurement of manufacturing equipment of mini hydrel generator

c) Training of experts concerned

The total cost of this action is estimated at around $4 million.

9.3 Establishment of Monitoring System for Acid Rain and Air Pollution

This project would help DPRK to establish a foundation for accurate measurement and monitoring system of acid rain and air pollution, and for taking effective measures.

Through implement of this project, posts for monitoring acid rain and air pollution would be built around cities and northern forest areas to survey acid rain and air pollution. This project will contribute to prevent forest damage by acid rain and to increase CO_2 sinking capacity of forest. The Government built the monitoring posts in some cities, however, due to the lack of facilities, comprehensive monitoring has not proceeded for acid rain, NOx and SO_2 throughout the country. After implementing this project, 5 monitoring posts equipped with measuring facilities including acid rain analyzer, NOx and SO_2 automatic analyzer and conventional air pollution analyzing facilities will be built.

The activities expected in the project are as follows.

a) Procurement of modern equipment for monitoring acid rain and air pollution

b) Training of experts concerned

The total cost of this action is estimated at around $1million.

9.4 Introduction of Clean Coal Technology.

In DPRK, half of electricity consumption relies on thermal power generation using domestic coal, so the demand for coal is continuously increasing, resulting in rapid rising of potential GHG emissions.

Due to the outdated equipment in thermal power plants, coal combustion efficiency and generation efficiency is about 91%, 28% respectively, and it is urgent to replace old equipment with new one. Introduction of CCT, especially Integrated Gasfication Combined Cycle will save coal consumption per generated electricity to reduce GHG and pollutant emissions greatly and to meet increasing electricity demand.

This project will coincide with the global environment strategy to reduce GHG emissions and has great importance in implementation of national energy strategy.

The activities expected in the project are as follows.

a) Development of gas-steam combined cycle generation system necessary for Pyongyang Thermal Power Plant.

b) Training of experts concerned to IGCC system operation.

c) Procurement of IGCC equipment

d) Examination on generalization possibility of IGCC technology on national level and

e) development of technical measures for generalization.

9.5 Industrial Boiler Efficiency Improvement

The proposed project aims at reducing GHG emissions by improving the efficiency of fossil fuel boilers in the industry sector and promote the capability of the energy sector institutions to implement efficiency improvement in the industry.

In DPRK, there are about ten thousand boilers using fluidized combustion technology.

The proposed project will basically focus on short term and medium term investment opportunities. The areas of improvement shall include;

a) boiler efficiency,

b) combustion monitoring and control system retrofit and

c) waste heat recovery.

The project will deliver on-the-spot assessment of boiler performance and identify shortcoming in the operation. Efficiency improvements to be considered in the assessment shall involve energy saving measures with and without capital investment.

Total project cost is estimated to be US$ 12.34 million.

9.6 Reforestation and Afforestation.

In DPRK, about 80% of total terrestrial area are covered with forest, and it plays an important role in national development. The forest has the great capacity of carbon sequestration. In 1990, the amount of carbon sequestered by forest was estimated to be 15 Tg or about 8% of total national CO_2 emissions. However, this capacity tends to decline due to rapid growth of population, increase of demand for forest products by economic development, pressure for more firewood and natural disasters such as fire.

In 1990, the degraded forests estimated to be 2.2 Mha. or 24% of total forest area and the non-woody forest of 380 thousand ha. This project has the objectives to enhance the carbon sink capacity of degraded and non-woody (barren) forests by reforestation and afforestation, meeting the growing demand for forest products. The major activities to be undertaken shall include:

a) social preparation (information and education campaign, community organizing/ development)

b) infrastructure development

c) nursery establishment and planting stock production

d) plantation establishment, maintenance and protection

e) monitoring and evaluation

f) harvesting and

g) replanting/re-establishment.

The project shall be implemented by the active participation of the local communities. Total project cost is estimated to be US$ 5.35 million. US$ 4.35 million of which will be used for investments and US$ 1 million will be used for technical assistance.

9.7 Creation of Demonstrations for Establishment and Management of Firewood Forest

In DPRK, the people in rural satisfy their energy demand necessary for cooking and space heating with firewood.

Annually more than 5 million M^3 of firewood was extracted from forests, resulting in loss of forestry, ecosystem destruction, flooding, soil erosion and, in turn, great adverse impacts on living of local people.

The project is aimed at creating the demonstration unit for establishment and sustainable management of high productive firewood forest suitable to regional specific conditions, and generalizing it to the whole country, in order to prevent the forest degradation, prevent the soil erosion and improve the livelihood of local people.

The major activities to be undertaken are as follows.

a) Survey on the site suitable to firewood forest

b) Selection of tree species

c) Preparation of plantation plan

d) Creation of demonstration units using the firewood for cooking and space heating

e) Training related to fire-wood plantation and management

Total project cost is estimated to be US$ 1.25 million.

9.8 Establishment of water pollution monitoring and surveillance system for Amnok and Taedong rivers.

This project aims at to establishing water pollution monitoring system for Amnok and Taedong rivers to get global environmental benefits through sustainable use of water resources and conservation of international water.

Amnok and Taedong rivers, flowing into the Korean West Sea, are the main water resources for drinking, industry, and irrigation for western areas. So the Government has paid great concern to the water pollution prevention of these rivers.

This project will strengthen the scientific and technical capacity to take measures for preventing pollution of West Sea, the international water body (DPRK-China).

Due to the lack of equipment, there are some obstacles in sound management of Amnok and Taedong rivers. The project would establish integrated monitoring system for the sound management and use of Amnok and Taedong rivers.

The activities expected in the project are as follows.

a) Establishment of monitoring posts along with Amnok and Daedong rivers

b) Procurement of modern analytical equipment necessary for the posts

c) Establishment of information exchange system using computer network.

d) Training for experts.

Total project cost is estimated to be US$ 1 million.

9.9 Construction of High Efficiency Thin Fluorescent Lamp Factory

In DPRK, electric power consumption for lighting is about 10~15% of total electric energy consumption. Especially, the electrical load due to lighting is very high in the evening. Replacement of conventional lamp by high efficiency thin fluorescent lamp in residential sector has great importance in saving electric energy consumption of lighting, lowering of electrical load peak and improving cost effectiveness in lighting. Also, this project proposal will contribute to save electric energy to decrease the GHG emissions, and to rise people's cultural standard. The activities expected in the project are as follows:

a) Procurement of high efficiency thin fluorescent lamp production equipment

b) Training of experts concerned

Total project cost is estimated to be US$ 2.5 million.

9.10 The treatment of municipal solid waste and its recycling

Pyongyang, with the population of over 2 million, has about 10 waste disposal sites around it. However, most of the wastes are disposed of without assortment and recycling.

Through the implementation of the project, a waste disposal station will be reconstructed with modern technologies, and the experiences gained from the project will be disseminated to all cities of the country, contributing significantly to urban environment management.

The activities expected in the project are as follows.

a) Environment Impacts Assessment of municipal waste treatment in Pyongyang.

b) Modernization of waste disposal station in Ryokpo district.

c) Preparation of the plan for the waste management and disposal.

The total cost necessary for the project is estimated to be US$ 2 million.

9.11 Pilot project for the treatment of municipal wastewater and its recycling.

In Pyongyang, hundreds of thousands cubic meter of wastewater are released from households every day and treated in several stations including Pyongchon, Kumchon, and Ryongsong purification station.

However, the Pyongchon station, in particular, is equipped with old fashioned facilities and treats the waste water with low purification efficiency, contaminating its surroundings with odor.

Besides, most of the wastewater is treated without recycling.

The activities expected in the project are as follows.

a) Modernization of Pyongchon Waste Water Treatment Station.

b) Introduction of biotechnological waste water treatment technologies.

c) Designing and establishing waste water-recycling process.

d) Training on waste water treatment and recycling.

Total project cost is estimated to be US$ 2.5 million.

9.12 Capacity building of Seed Production for Sustainable Forest Development

In national forest development plan of DPRK, it is envisioned to establish reforestation and plantation in all degraded and non-woody forests up to 2020 to increase the biomass density and carbon sink capacity.

To achieve this objective, it is necessary to produce 1.5 billion saplings to plant 100,000-200,000 hectares every year. However, existing capacity of seedling production is not enough to meet the requirements and even has been declined in nursery areas because of the constraints of resources, lack of up-to-date management techniques and the damages from natural disasters such as floods and landslides.

Through the demonstration and dissemination of advanced seedling production techniques, this project will contribute to the enhancement of the country's capacity of seedling production necessary for reforestation and plantation in response to the GHG abatement strategy.

While implementing this project, the demonstration sites for seedling production would be created. Proper tree species would be introduced and selected for reforestation. Advanced techniques and methodologies for seedling production would be introduced. Technicians and management officials would be trained. Modern equipment and facilities for seedling production would be purchased.

The activities expected in the project are as follows.

a) Selection of the proper demonstration site for seedling production.

b) Collection and introduction of proper tree samplings.

c) Study tour to the specific projects already implemented in other countries.

d) Purchase of necessary equipment and facilities,

e) National workshop on advanced techniques for seedling production and training of technicians and managers through field visit.

Total project cost is estimated to be US$ 3.5 million.

9.13 Establishment of forecasting service and alarm systems in vulnerable areas along West and East Coastal Zones over sea-level rise

Over the flooding, there should be upgraded existing projecting service system and alarm system for emergency as well as established new ones in areas much sensitive to flooding cross country.

This project aims at to establishment of the early alarm system for preventing damages form typhoon and tidal wave in ports, coastal areas, cities, industrial areas and tourist regions, and of the measures for saving lives.

The activities expected in the project are as follows.

a) Purchase of equipment necessary for early alarm system

b) Training for experts related

c) Purchase of relief equipment

The total estimated cost of the project is about 1 million US$.

9.14 Research capacity building for development of new crop variety

In DPRK, research on new crop variety to increase grain production is actively proceeded, but no considering the projected climate change.

This project will arrange the material and technical conditions for getting new crop varieties responsible to climate change.

The activities expected in the project include;

a) Purchase modern breeding facilities

b) Training experts related

The total estimated cost is about 1 million US$.

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   Ma Gyong Hui, Environment & Development Center

   Li So Hwa, Academy of Forest Science

4. Vulnerability and Impacts Assessment on Agriculture

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5. Vulnerability and Impacts Assessment on Sea Level Rise

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