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DPR KOREA'S SECOND NATIONAL COMMUNICATION ON CLIMATE CHANGE

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DPR Korea's Second National Communication on Climate Change

Submitted under the United Nations Framework Convention on Climate Change

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FOREWORD

The Government of Democratic People's Republic of Korea (DPR Korea) always paid great attention to the environment protection work in building up the man-centered socialism of our own style.

The great leader comrade KIM Jong Il said:

"To provide more favorable natural environment for the existence and activities of human beings by conducting sound environment protection work is the intrinsic demand of the man-centered socialism of our own style."

DPR Korea signed the United Nations Framework Convention on Climate Change (UNFCCC) at the United Nations Conference on the Environment and Development in June 1992, and ratified it on December 5, 1994. The UNFCCC has been entered into force for DPR Korea on March 5, 1995.

The Government of DPR Korea has designated the National Coordinating Committee for Environment (NCCE) as the National Focal Point of the UNFCCC. The NCCE has started the implementation of the project for preparation of the Second National Communication (SNC) under financial support of the UNEP/GEF since April 2006 and has completed the SNC in close cooperation with experts and officials from concerned ministries, academic and research institutes.

In comparison with the DPR Korea's First National Communication submitted to the Conference of the Parties to the UNFCCC in September 2002, the SNC contains new information on the national greenhouse gas inventory for the period 1990-2002, vulnerability and adaptation assessment for key socio-economic sectors, analysis of mitigation options and other information related to the achievement of the objectives of the UNFCCC, as well as constraints, gaps, related financial, technical and capacity needs.

The national greenhouse gas inventory includes many sources of emissions and removals that were not included in the First National Communication.

I am confident that the SNC will be an essential document that addresses serious climate change issues and provides the potential to attract financial resources to support the implementation of the UNFCCC, thus contributing to the DPR Korea's sustainable development.

DPR Korea will make continued efforts to fulfill obligations under the UNFCCC including the presentation of the DPR Korea's national communications on a continuous basis with a view to protect our planet from the ravages of climate change for new generations to come, keeping in close relationships with all relevant international agencies.

RI Hung Sik

Secretary-General

National Coordinating Committee for Environment, DPR Korea

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ACRONYMS

AAS	Academy of Agricultural Sciences
AASSA	Association of Academies and Societies of Sciences in Asia
AFOLU	Agriculture, Forestry and Other Land Use
ALGAS	Asia Least-Cost Greenhouse Gas Abatement Strategy
BAU	Business as Usual
CBS	Central Bureau of Statistics
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFL	Compact Fluorescent Lamp
CGE	Consultative Group of Experts
CMP	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
CNC	Computer Numerical Control
COD	Chemical Oxygen Demand
COMAP	Comprehensive Mitigation Analysis Process
COP	Conference of Parties
CP	Conference of Parties
CRUE	Centre for Rational Use of Energy
DIVA	Dynamic and Interactive Vulnerability Assessment
DNA	Designated National Authority
DPR Korea	Democratic People's Republic of Korea
DSSAT	Decision Support for Agrotechnology Transfer
EB	Executive Board
EEDP	Environment Education and Dissemination Programme
EFDB	Emission Factor Database
FAO	Food and Agriculture Organization
FEB RAS	Far Eastern Branch of Russian Academy of Sciences
FNC	First National Communication
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GPSH	Grand People's Study House
GWP	Global Warming Potential
ICL	Incandescent Lamp
IGEI	Institute of Global Environment Information
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ISBN	International Standard Book Number
ISPSA	Improved Seed Production for Sustainable Agriculture
ITE	Institute of Thermal Engineering
KGFST	Korean General Federation of Science and Technology
KNCU	Korean Nature Conservation Union
LEAP	Long-range Energy Alternatives Planning system
MDG	Millennium Development Goal
MEI	Ministry of Electricity Industry
MFT	Ministry of Foreign Trade

MLEP	Ministry of Land and Environment Protection
MMI	Ministry of Metal Industry
NAMA	Nationally Appropriate Mitigation Action
NCCE	National Coordinating Committee for Environment
NCCO	National Climate Change Office
NCPC	National Cleaner Production Centre
NCSA	National Capacity Self Assessment
NPC	National Project Coordinator
ODS	Ozone depleting substances
PSC	Project Steering Committee
PGTF	Perez-Guerrero Trust Fund
PMG	Project Management Group
PoA	Programme of Activity
QA/QC	Quality Assurance/Quality Control
REDD	Reducing Emissions from Deforestation and Forest Degradation
RPHLFS	Reduction of Post Harvest Losses for Food Security
SAOS	State Academy of Sciences
SCST	State Commission of Science and Technology
SDSM	Statistical Downscaling Model
SFAIS	Strengthening of Food and Agriculture Information System
SHMA	State Hydro Meteorological Administration
SNC	Second National Communication
SPC	State Planning Commission
SRED	Sustainable Rural Energy Development
SRES	Special Report on Emission Scenarios
SWEDPRA	Small Wind Energy Development and Promotion in Rural Areas
TEG	Technical Expert Group
TNA	Technology Needs Assessment
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
V&A	Vulnerability and Adaptation
VIC	Variable Infiltration Capacity
WEAP	Water Evaluation and Planning System
WMO	World Meteorological Organization

SYMBOLS

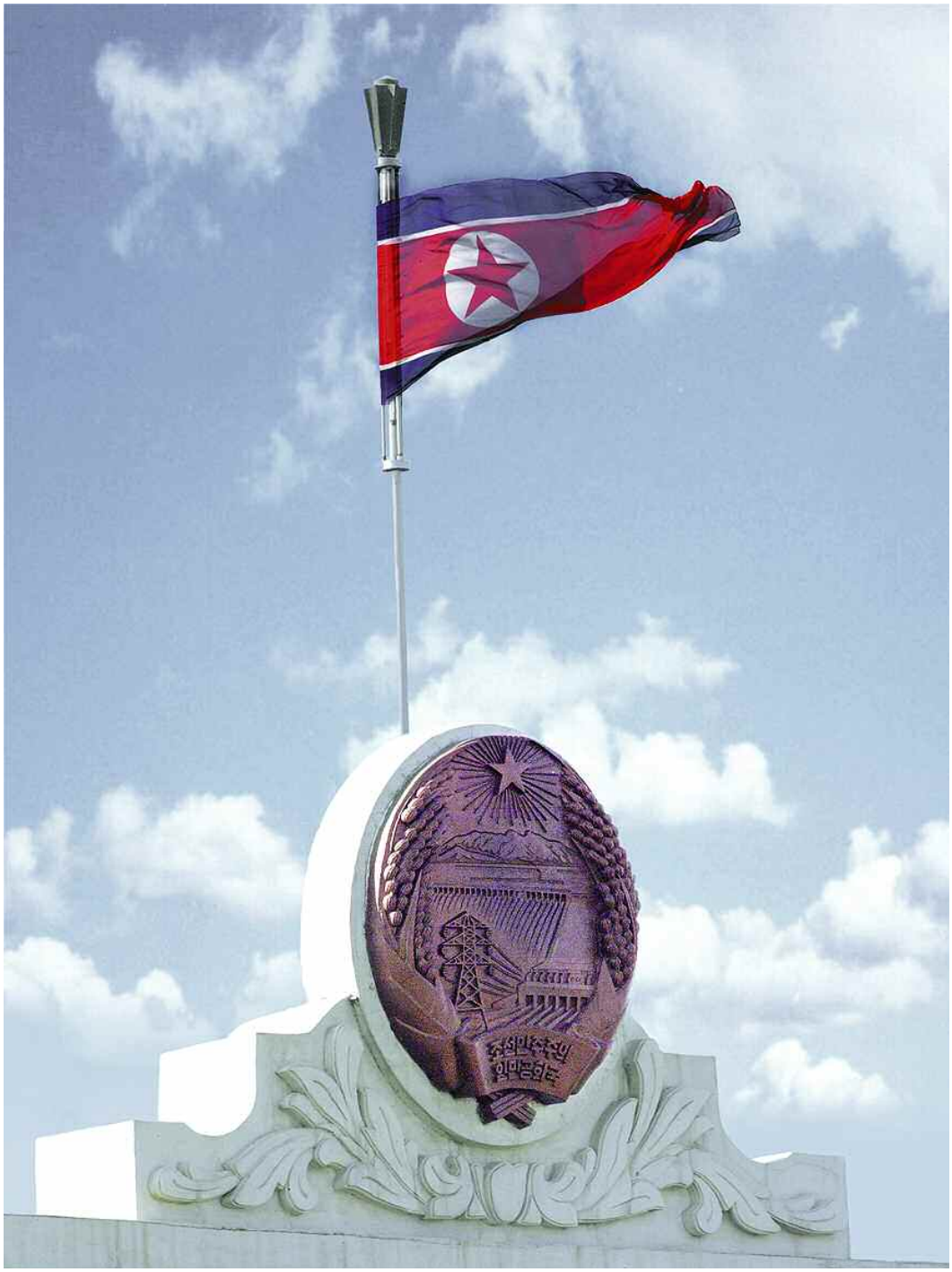
CFC-11	CCl_3F
CFC-113	$C_2Cl_3F_3$
CFC-12	CCl_2F_2
CH_4	Methane
Cl^-	Chlorine Ion
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
HFC	Hydrofluorocarbon
N_2O	Nitrous Oxide
NH_4-N	Ammonia Nitrogen
NMVOC	Non-methane Volatile Organic Compound
NO_x	Nitrogen Oxides

PFC	Perfluorocarbon
SF_6	Sulphur Hexafluoride
SO_2	Sulphur Dioxide

UNITS

%	Percent
‰	Permillage
Gg	Gigagram
ha	Hectare
kbps	Kilobits per Second
kg	Kilogram
km	Kilometer
km^2	Square Kilometer
km^3	Cubic Kilometer
kW	Kilowatt
kWh	Kilowatt Hour
m	Meter
m/s	Meter per Second
m^3	Cubic Meter
mm	Millimeter
MW	Megawatt
ºC	Degree Celsius
s	Second
t	Tonne
Tg	Teragram
TWh	Terawatt Hour

EXECUTIVE SUMMARY



Executive Summary

S1 National Circumstances

State Apparatus and Development Priorities

The Democrtic People's Republic of Korea, founded on the 9th of September, 1948, has been waging a vigorous strggle to bring about a decisive turnabout in building of an economic giant and improving of the people livelihood, considering the continued enhancing of people's living standard to be the highest principle of the state activities.

Geographical Context

Geographic specifications

The Democratic People's Republic of Korea is located in the east of the Asian continent. Our country is bound on the north by China and Russia sharing River Amnok and Tumen respectively; Japan is over the East Sea of Korea, and China is over the West Sea of Korea. Pyongyang is the capital city of the country and it covers an area of 123 138km^2.

Climate

DPR of Korea has a temperate monsoon climate with strong continentality; the annual temperature in average is 8.2℃, and the annual precipitation in average is 927mm.

Natural resources

DPR of Korea is rich in river and streams, and abundant with ground water resources. Reservoirs built all over the country gives sufficient water supply.

Number of the plant species distributed in the country is 9 548; that of the vertebrate and invertebrate animals are 1 434 and 7 031 respectively.

The country has rich and diverse marine resources. Several hundreds of thousands of hectares of tideline on the coast of the West Sea can be reclaimed as farmland, reed field, salt farm and others.

DPR of Korea is rich in coal, peat and other fossil fuel. Main resources for coal is anthracite and lignite. From its natural and geographic circumstances, our country has abundant energy resources as hydro energy, solar energy, wind energy, geothermal energy and tidal energy.

Land use

The country's territory is mainly covered with forest, and thus its arable land quite limited. The ratio of forest land and farm land was 74.7% and 15.2% as of 2011, and that respectively per capita was 0.38ha and 0.08ha.

Population Context

The population of DPR Korea which was 24,052,000 in 2008 has increased to 24,489,000 in 2011. The proportion of males to females was 48.7% and 51.3%, population rate in towns and countries 60.6% and 39.4%, rate of population growth 13.4%, and those for male and female 13.5% and 13.3%, respectively, and annual average rate of population growth 0.86% compared with 1993.

Economic Context

Recent revitalization of the vanguard sectors of the national economy and the sectors of basic industries like metallurgical industries, electric power, rail transport and vigorous acceleration of the modernization of the industry, agriculture and ligh industry sectors brought about an unprecedent increase of the production and epoch-making turn in the economic construction.

In DPR Korea, GDP has reached US$ 22,070 million in 2011, which is 2.1 times compared with 2000.

The output of electric power was increased from 27.9TWh to 42.9TWh, and per capita output of electricity from 1,279kWh to 1,773kWh for the period 1995-2009. The output of steel, cement and chemical fertilizer in 2007 increased by 1.1 times, 1.7 times and about 2 times compared

with 2000.

Ushering in the 1990's, grain output has significantly declined for economic hardship and serious natural disasters such as flood, drought and tidal wave, but grain output is gradually increasing by active efforts of the Government to increase grain output in recent years. As a result, grain output has reached 5,120,000t in 2010.

Social Development Profile

DPR Korea enforces universal free education with the state expense.

The Government of DPR Korea is consistently holding to a foremost importance to science and technology, considering development of science and technology with a key problem decisive of vicissitudes of the country and the nation.

DPR Korea enforces universal free medical care.

Framework for Implementation of the UNFCCC

DPR Korea has enacted laws and regulations related to climate change, revised and supplemented them on several occasions in accordance with requirements of the developing situation in recent years.

And, with the importance of the work protecting global environment, DPR Korea has acceded to several multilateral environmental conventions and actively cooperated with international activities under the close contact with international organizations.

The UNFCCC focal point in DPR Korea is the National Coordinating Committee for Environment (NCCE).

S2 National Greenhouse Gas Inventory

GHG Inventory for the Year 2000

In 2000, the total national GHG emissions [1] have amounted to 65,714 $GgCO_2e$, representing 65% decrease compared with that in 1990. Meanwhile, CO_2 removals by sinks have reached 19,087Gg in 2000 (Table 3-10), representing 16.0% increase compared with 1990.

Per capita GHG emissions and GHG emissions per GDP, major GHG emission indicators, in 2000 were $2.9tCO_2e$/person and $6.2tCO_2e$/ US$ 1,000 respectively, also representing decrease by 69.0% and 26.8% compared with 1990.

Considering by sector, energy sector was the largest emission source with $73,417GgCO_2e$ of GHG emissions, accounting for 92.5% of the total national GHG emissions with consideration of CO_2 removals, followed by waste and IPPU sector with 6.1% at $4,840GgCO_2e$ and 1.4% at $1,143GgCO_2e$ in 2000. Emissions from energy and IPPU sector in 2000 were decreased by 58.9% and 79.7% respectively, and that from waste sector were increased by 9.3% compared to the level in 1990.

Considering by gas, net emissions of CO_2, CH_4, N_2O and PFCs in 2000 have amounted to 52,108Gg, $12,227GgCO_2e$, $1,376GgCO_2e$ and 3Gg CO_2e respectively.

With regard to the proportion of each GHG in the total GHG emission, net CO_2 emissions have accounted for 79.3%, the largest proportion, followed by CH_4 and N_2O at 18.6% and 2.1%, respectively.

And, net CO_2, CH_4 and N_2O emissions in 2000 have decreased by 68.4%, 50.7% and 62.8% compared to those in 1990, respectively.

GHG Emissions Trends for 1990-2002

Regarding the trend of the total national GHG emissions for the period 1990-2002, it systematically decreased in the 1990's and increased to some extent in the early 2000's, but was still in far low level in 2002 compared with 1990.

In 2002, the total national GHG emissions amounted to $87,251GgCO_2e$, representing decrease by 56.2% compared to the level in 1990 and increase by 6.7% compared to the level in 2000.

[1] National total calculated by summing up emissions and removals for each gas expressed in CO_2e

With respect to the sectoral emission trends, energy sector had kept the largest proportion in the total national GHG emissions for the period 1990-2002. But, emission proportion from IPPU systematically has been decreased.

In 2002, emissions from energy and IPPU sector have decreased by 56.4% and 75.6% and that from waste sector increased by 10.9% compared to the level in 1990 respectively And, emissions from energy, IPPU and waste sector have increased by 6.1%, 20.0% and 1.4% compared to the level in 2000 respectively.

Considering the emission trends by gas, net CO_2 emissions have kept the largest proportion, followed by CH_4 in proportion by gas in the total national GHG emissions for the period 1990-2002.

In 2002, net CO_2, CH_4 and N_2O emissions have decreased by 62.1%, 36.5% and 38.0% compared to the level in 1990, whereas increased by 8.8%, 2.8% and 3.0% compared to the level in 2000.

Meanwhile, per capita GHG emissions significantly have decreased and GHG emissions per GDP also decreased, regarding the change trends of the main GHG emission indicators for the period 1990-2002.

In 2002, GHG emissions per capita and per GDP were 3.0tCO_2e/person and 6.2tCO_2e/US$ 1,000 respectively, representing decrease by 67.0% and 26.3% compared to the level in 1990. But, GHG emissions per capita increased by 6.5% and that per GDP decreased by 0.8% in comparison with the level in 2000.

S3 Climate Change Impacts and Adaptation Measures

Current and Future Climate Change

Current climate change

During the period 1918 to 2000, annual mean temperature in DPR Korea has increased by 0.019℃ per year (Figure 4-1). Namely, warming rate in the country in the 20th century was 0.19℃/10years, which was over 3 times compared with global warming rate, and greater than that in other countries in the east Asia. Meanwhile, during the period from 1971 to 2005, annual mean temperature in the country has increased by 0.035℃ per year, that is, 0.35℃/10years. Winter has become short, while spring and summer have become longer in change of season of the country by the impact of warming.

Unlike temperature, annual precipitation during the period from 1918 to 2000 had no systematic variation trend.

Sea-level in the Korean East Sea and West Sea has rised by 1.5mm per year every year over 1963 to 2000 period.

Future Climate Change

In the late 21st century, annual mean temperature and annual precipitation in DPR Korea are expected to increase by 2.8℃ to 4.7℃ and 10.7 to 15.2% compared to the average (8.2℃ and 927mm, 1971-2000).

And, sea-level in DPR Korea by 2100 is expected to rise by 0.67m to 0.89m compared to that in 2000.

Climate Change Impact

Impacts on water resources

In the late 21st century, water resources in DPR Korea are expected to be almost the same as the average (1971-2000) or decrease by 7.9%. Annual variation and regional differences in water resources will be great and it is expected that severe shortage of water will appear in urban regions and main agricultural areas in the West Sea coast.

Warmer water temperature and great seasonal variation in water resources will deteriorate water quality and water pollution will be more serious issues with variation in hydrological conditions and strengthening of activities for development of water resources.

In future, it is expected that severer flood than the present will appear during rainy season, severe drought than the present will appear in spring. Food production in flat

areas in the West Sea coast is expected to get significant threat from flood and drought and flood-frequency will increase, and as a result, disaster will become larger in middle mountainous regions. More frequent landslides could occur in inland mountainous regions, and by increase of flood, landslide and drought events, loss in land resources and land degradation will be accelerated.

Impacts on agriculture

The accumulated temperature by bounds and its duration days will systematically be increased and Percentage of sunshine will significantly vary, too. The current cultivated boundary line of crops will move 150 to 250km northwards and rise above 150 to 200m in height of sea-level. By 2100, per ha yield for main crops will increase by 18 to 27% for paddy rice, by 11 to 26% for maize and by 4 to 23% for bean. Crop production including maize, kaoliang, bean, rice and cotton would all suffer damage from high temperature.

Meanwhile, Arable areas for some fruit trees including apple would be less suited to culture.

In addition, first generation period of harmful insects will be fast and the number of breeding generations of insects of the year will increase, thus resulting in increased crop damages. Tropical or subtropical harmful insects may bring forth as a result of increase in double cropping areas and change in agricultural species.

Impacts on coastal zone

Inundated area and damages from coastal flooding will be increased further and saltwater intrusion will lead to the hurdle of freshwater use. Coastlines in the East and the West Sea may retreat by 67 to 89m and 670 to 890m over 100 years in future, respectively and damages from sea-level rise will increase.

Impacts on human health

The loss of life may increase by natural disasters such as flood, typhoon and high temperature and incidence of infectious diseases such as malaria, cholera and acute diarrhea and various maladies may increase.

Impacts on ecosystem

The land area suitable to culture major forest tree species will decrease and the productivity will decline. Forest damages from flood, landslide and forest fire, etc. would increase and forest pests would explosively frequent generate.

The land suitable to culture and the cultivated boundary line of economic plants originated in subtropical zone including persimmon tree will continue to rise northwards.

The number of plant species and the range of plant community will vary. The number of animal species and their range will vary, too. Rise in temperature in winter season and serious loss of habitats will give very unfavorable effects on inhabitation of migratory birds. Many exotic species will settle down, which will bring much of damages.

In the Korean East Sea, aestival migratory fish resources will increase, hydric habitat of seaweeds will move northwards and their harvest time will be moved up. In Korean West Sea, resources of non-migratory and migratory fish living in warm water will increase, and seaweeds will be bred on a large scale in coastal region in North Phyongan Province.

Climate Change Adaptation Measures

Climate change expected in DPR Korea in the 21st century is promised to give significant adverse impacts to the national sustainable development and people's living, in particular to water resources, agriculture, forest and ecosystem, coastal zones and public health. Therefore, reducing negative impacts of climate change through development and implementation of adaptation strategy and measures to climate change presents itself as a most important problem.

Adaptation strategy

The general goal of adaptation strategy to climate change is to recover degraded natural eco-environment, improve its

function, establish economic, social and environmental structures coping with climate change, and raise up adaptation capacity to negative impacts of climate change into the advanced level.

Priority adaptation options

Priority adaptation options in above-mentioned sectoral adaptation measures to climate change for sustainable development of the country are as follows:

- Cross-cutting: Improvement of climate information service in DPR Korea; improvement of observation network in DPR Korea; capacity building for integrated water resources management in the Taedong River basin; capacity building for improving the community-based disaster management system.
- Water resources: Introduction of technologies for water pollution prevention and efficient water purification; establishment of systems for rational distribution and consumption of water resources; capacity building for management of reservoirs and rivers.
- Agriculture: Promotion of developmet and dissemination of advanced agricultural technologies coping with climate change; establishment of integrated and sustainable management system of arable soil; establishment of integrated system for prevention of harmful insects and weed management.
- Coastal zone: Capacity building for integrated management of coastal zone; construction of infrastructures such as seawalls and protective facilities in coastal zones; rearrangement of population and economic activities.
- Public health: Strengthening of hygienic and anti-epidemic work; strengthening of medical services related to the diseases caused by hot weather; establishment of database for various infectious diseases and sustainable monitoring system for dieseases.

Ecosystems: Recovery of degraded forest and firewood forest management in community areas; control of forest pests outbreaks by climate change and integrated forest pest management; improvement of ecosystem conservation system in coastal zone of the Korean West Sea; improvement of management system for existing nature reserves.

S4 Climate Change Mitigation Steps and Measures

Mitigation Policies and Measures

Mitigation policies and measures by sector

DPR Korea as Annex I party of the UNFCCC is not required to take on GHG emission reduction commitments by the UNFCCC and Kyoto protocol, but actively proceeding the GHG mitigation strategies, policies and measures by sector as follows.

- Energy supply
- Strategy: Technical modernization, and development and utilization of renewable and new energy resources.
- Policies and measures: Enactment and enforcement of laws and regulations related to energy; energy strategy; modernization of existing thermal power plants; creation of hydropower generation capacity; development of new energy resources including atomic energy; introduction of clean coal combustion technology; improvement of the network for transmission and distribution of electricity; promotion of development and implementation of CDM projects.

- Transport
- Strategy: Modernization and improvement of transport management.
- Policies and measures: Introduction of heavy rails and modernization of railway; introduction of modernized, heavy-duty and high-speed road; car service by date of the week and control of loadless trucks; encouragement of public transport facilities; encouragement of walking and bicycle use; improvement of transport organization and control, and vehicles.

- Building
  - Strategy: Improvement of energy efficiency
  - Policies and measures: Introduction of efficient lighting and card type watt-hour meter; saving of residential fuel; supply of cooking, heating and hot water by solar energy; heating and cooling of buildings by geothermal energy; improvement of heat insulation of buildings; energy efficiency standards and labeling.
- Industry
  - Strategy: Modernization and energy saving.
  - Policies and measures: Clean production and improvement of energy efficiency; energy saving; introduction of high temperature air combustion technology.
- Agriculture
  - Strategy: Sustainable development of agriculture
  - Policies and measures: Development strategy in agricultural sector; establishment of naturally flowing irrigation system; methanization in rural households; introduction of advanced farming methods including organic farming method; effective use of fertilizer and irrigation.
- Forestry/forest
  - Strategy: Forestation and landscape-orientation of the whole country.
  - Policies and measures: Enactment and enforcement of laws and regulations related to forestation, and forest conservation and management; scientification, industrialization and intensification of sapling production; all-people campaign for planting trees; innovation of forestation, and forest conservation and management work; sustainable forest management.
- Waste management
  - Strategy: Sustainable waste management.
  - Policies and measures: Enactment and enforcement of laws and regulations for waste management; integrated solid waste management; composting of organic waste; recycling of waste; controlled waste water treatment.

CDM activities

DPR Korea actively is accelerating CDM project activities through building institutional and human capacity for development and implementation of CDM projects contributable to sustainable development of the country.

As of November 2012, 5 CDM projects were registered, one CDM project is requested for registration and one CDM project and 4 CDM PoA projects were in validation. But DPR Korea still is one of the countries whose registered CDM projects are less than 10.

Projection for GHG Emission Trends up to 2020

By the trends for GHG emissions up to 2020, total national GHG emissions are projected to continue increasing after 2000 on for recovery of the national economy declined in the early 1990's.

By 2020, the total national GHG emissions are projected to amount to 121,203GgCO_2e, which is the decreased value by 37.4% compared with 1990 and the increased value by 84.4% compared with 2000.

For the period 2000-2020, annual average growth rate of total GHG emissions will account for 3.1%.

Meanwhile, CO_2 removals by sinks in the country in 2020 will amount to 32,442Gg and annual average growth rate will account for 2.7%.

For the period 2000-2020, emissions from energy, IPPU and waste sector will increase by 3.0%, 5.8% and 1.0% on annual average for population and economic growth, and that from AFOLU sector will decrease by 3.5% on annual average for increase of CO_2 removals by sinks. And, variation in proportion of energy, IPPU and AFOLU sector in the total national GHG emissions for the period 2000-2020 is projected to be insignificant. Attaining 2020, energy sector

is projected to be the largest emission source, accounting for 89.0% of the total national GHG emissions without consideration of CO_2 removals, and IPPU and waste sector to account for 10.1% and 0.9% respectively.

GHG Mitigation Options

Up to 2020, potential mitigation options including energy supply and residential sector are 15 options in all.

According to the assessment on GHG abatement cost for each mitigation option, annual GHG abatement potential of available mitigation options in DPR Korea up to 2020 totally amounts to 35,740GgCO_2e/yr.

The options with great economic profit in mitigation options are efficient lighting scheme, reduction in specific consumption of fuel of vehicles, efficient refrigerators, creation of new hydropower generation capacity, methane utilization and destruction programme from animal waste management system, coal mine methane utilization and destruction programme, modernization of existing thermal power plants, saving of residential fuel and methane utilization and destruction programme from industrial wastewater.

S5 Other Information

Integration of Climate Change

In order to address the adverse effects of climate change while achieving sustainable development, it is important to rightly integrate climate change considerations into relevant social, economic and environmental policies and actions in accordance with the Article 4, paragraph 1(f) of the UNFCCC. DPR Korea therefore has integrated climate change issues into "DPR Korea's National Strategy for Sustainable Development", "Millenium Development Goals in DPR Korea", "National Biodiversity Strategy and Action Plan of DPR Korea", "National Action Plan for Combating Desertification/Land Degradation" and others.

Technology Transfer

Activities relating to technology transfer

DPR Korea laid legal basis for development and transfer of ESTs such as Law on Science and Technology, Law on Energy Management, Law for Export and Import of Technology, Law on Joint Venture, Law for Aliens Enterprise, Law on Aliens Investment and others.

In DPR Korea, development and introduction of ESTs are actively being carried forward by research institutes under various ministries and central agencies including the SCST, SAOS and AAS, and many universities including Kim Il Sung University and KIM Chaek University of Technology. In spread and exchange of new technique in DPR Korea, SCST, SAOS, KGFST, KNCU, GPSH, Bureau of Invention, Central Science and Technology Information Bureau play an important role.

Besides, various cooperation projects related to transfer of climate change mitigation and adaptation technologies were implemented or are under implementing and international training also were excuted in DPR Korea.

Priority technology needs

The priority technology needs are as follows.

- Climate change mitigation
  - Hydropower generation, modernization of thermal power plants, encouragement of public vehicles, energy saving, small combined heat and power, improvement of energy efficiency, animal waste management, integrated forest pest management and municipal solid waste treatment.
- Climate change adaptation
  - Integrated water resources management, advanced agricultural technologies, integrated management of coastal zones, improvement of public awareness and recovery of forest and creation of firewood forest.

Research and Systematic Observation

Climate change research

DPR Korea concentrates efforts and turns

much state investment on the climate change related research, considering environment protection as a vital problem relating to future destiny of the nation.

Systematic observation

The SHMA is responsible for systematic observation, hydrometeorological and marine meteorological forecast in DPR Korea. Also, with the special services for agriculture, hydropower generation, public health and salt production areas, and the sandy dust forecast, the SHMA keeps in close contact with the Bureau for Disaster Prevention of SPC responsible for disaster measures and responses.

Education, Training and Public Awareness

The Ministry of Common Education improved the teaching materials and methods on climate since the year 2002, and Kim Il Sung University newly set up the College of Global Environment Science in 2003 and trains capable experts in the field of global environment protection and management.

The Government of DPR Korea, in view of importance of climate change issues, drawn many officials, scientists and technicians from various related agencies such as the SCST, MLEP, MEI, SAOS, SHMA and AAS into national and international workshops, meetings and trainings and strengthened their capacities, using various opportunities including the implementation of the SNC project in recent years.

In DPR Korea, mass media including TV, newspaper and popular magazine, etc., hold very important place in public awareness on climate change and its effects.

In DPR Korea, various public awareness activities on the topic of climate change and environment protection are launched under the national and public interest on the occasion of "World Environment Day" every year.

In DPR Korea, the KNCU, KGFST and GPSH play an important role in public awareness related to climate change and its effects.

Capacity Building

In DPR Korea, various kinds of activities for capacity building including collaborative projects, symposiums and training courses, etc., are conducted, and institutional, systematic, and human capacity for implementation of the UNFCCC have been built to a certain degree.

In particular, the basis of strategy for national capacity building to implement the UNFCCC, United Nations Convention on Biodiversity and United Nations Convention on Combating Desertification has been made through implementation of the NCSA project.

Information Sharing

In recent years, several institutions such as the SAOS and Industrial Publishing House have published many literatures, translated literatures, references related to climate change, and disseminated among the SNC participants and broad stakeholders.

S6 Constraints, Gaps and Needs

Constraints and gaps

The constraints and gaps identified in implementation of the SNC project are summarized as follows:

- Implementation of the UNFCCC including preparation of the national communication: Nonexistence of permanent organization coordinating successful implementation of the UNFCCC; nonexistence of national centre able to concentrate all potentials on solution of issues relating to climate change; undeveloped national climate change policy and plan; lack of integration of climate change into the national laws, regulations, policies and plans; lack of understanding on climate change among policy makers, decision makers and broad stakeholders.
- GHG Inventory: Lack of institutional framework for preparation of the GHG

inventory; nonexistence of strategy for the GHG inventory; lack of capacity of institutions that are involved in preparation of the GHG inventory and data management; insufficient data, high uncertainty, and lack of disaggregated activity data; use of the default emission factors in the IPCC guidelines; bugs in IPCC 2006 software for national GHG inventory; nonexistence of integrated QA/QC procedure; frequent turnover of inventory experts; lack of capacity and expertise of experts, and insufficient activities for international training and exchange.

- Climate change adaptation: Lack of capacity of research institutions related to climate change adaptation; nonexistence of national adaptation action plan to climate change; incompletion of the adaptation strategy to climate change; insufficient collaboration between stakeholders involved in V&A assessment; nonuse of most advanced adaptation assessment model and insufficient basic data; lack of disaster management capacity.
- Climate change mitigation: Unclear institutional framework for mitigation assessment and lack of relationship between stakeholders; insufficiency of data for projection of emission trends and their high uncertainty; nonexistence of the NAMA plan, and the strategy and action plan for CDM activities; complexity in management procedure of CDM and lack of connection with CERs buyers; lack of legal and institutional frameworks to promote introduction of energy efficiency improvement and renewable energy, and inexistence of energy efficiency standards; lack of financial resources for implementation of mitigation options; lack of capable experts, insufficient training and lack of application capacity of mitigation assessment models.
- Technology transfer: Insufficient technology needs assessment on climate change and inexistence of technology action plans; lack of fund for technology development and transfer; lack of capacity for development and implementation of technology transfer projects.
- Research and systematic observation: Lack of capacity for systematic observation and climate change research, insufficient and old observation equipment; unsatisfied accuracy of climate change scenario and sea-level rise scenario up to 2100; insufficient development of resolution climate data and assessment of climate resources by numerical dynamical model; monthly and seasonal climate unestimated by regional climate model; lack of expert system for forecasting disastrous climatic events; insufficient risk assessment and forecast alarm system for flood, landslide and avalanche of earth and rocks.
- Education, training and public awareness: Nonexistence of implementation framework of the Article 6 of the UNFCCC; lack of specific climate change degree courses, and its low quality; insufficient activities and data for public awareness and lack of public understanding.
- Capacity building: Inexistence of the strategy and the integrated implementation programme for capacity building.

Capacity building needs

Priority capacity building needs are as follows:

- Institutional: Strengthening the authority and role of the NCCE; establishing the National Climate Change Centre and building its capacity; maintaining the National Climate Change Office and building its capacity; strengthening the institutions that are involved in preparation of the GHG inventory and data management; strengthening the institutions relating to climate change mitigation and adaptation.
- Systematic: Developing the national climate change policy and plan, and mainstreaming climate change into the national plans, policies, laws and

regulations; developing and implementing the GHG inventory strategy; developing the national adaptation action plan; developing the NAMAs plan; developing the CDM strategy and action plan; developing the integrated implementation programme for capacity building; conducting the climate change technology needs assessment and developing technology action plan; improving the climate information service and the observation network; developing the specific climate change degree courses and raising public awareness.

- Individual: Enhancing the capacity to design adaptation measures, CDM projects and climate change projects; building the capacity of policy makers, decision makers and a wide range of stakeholders.

Financial Needs

Financial support conditions

For the past 21 years (1991 to 2012) the GEF, through the UN organizations such as the UNDP and UNEP, provided a total of US$ 6,155,405 of financial support for implementation of the UNFCCC in DPR Korea.

In recent years, the implementation of projects under the financial support by GEF in DPR Korea met with serious barriers such as cooperation interruption (from March 2007 to October 2009), delay of cash advance.

Projects for financing

The projects for financing to be implemented with top priority in DPR Korea are as follows:

- Cross-cutting: Establishment of National Climate Change Centre and its capacity building;
- Inventory: Development of GHG inventory strategy and capacity building; Preparation of biennial GHG inventory in DPR Korea;
- Mitigation: Promotion of CDM project activities in DPR Korea; Capacity building of the CRUE; Clean production and energy efficiency; Energy efficiency standards and labeling in DPR Korea; Climate change technology needs assessment in DPR Korea; Chongchon River cascade hydropower generation project; Replacement of incandescent lamps by CFLs/LEDs; Capacity building for sustainable forest management; Production of energy, fuel and fertilizer from municipal solid waste; Capacity building for integrated management of solid waste;
- Adaptation: Improvement of climate information service in DPR Korea; Improvement of observation network in DPR Korea; Capacity building for integrated water resources management in the Teadong River Basin; Recovery of degraded forest and firewood forest management in community areas; Capacity building for integrated management of coastal zones; Promotion of development and dissemination of advanced agricultural technologies for coping with climate change; Control of forest pests outbreaks by climate change and integrated forest pest management; Improvement of ecosystem conservation system in coastal zone of the Korean West Sea; Capacity building for improving the community-based disaster management system.

CHAPTER 1 INTRODUCTION

Chapter 1 Introduction

Challenged by the climate change, the world has taken major strides and moved on from scientific analysis, to public concern and to developing and implementing an international convention.

The United Nations Framework Convention on Climate Change (UNFCCC), which entered into force in March 1994, was a crucial step in this direction - aiming to achieve stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (KNCU, 2005). Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Today, the UNFCCC has near-universal membership and 195 countries are its Parties.

DPR Korea has become a non-Annex I Party to the UNFCCC after its ratification in December 1994.

According to the Article 4, paragraph 1, and Article 12, paragraph 1 of the UNFCCC, DPR Korea has submitted its FNC to the COP to the UNFCCC in September 2002 upon the implementation of the Project "Enabling DPR Korea to Prepare its First National Communication in Response to its Commitments to UNFCCC" from 1997 to 2001 supported by UNDP/GEF. The FNC was the very first step in the actual implementation of the UNFCCC in DPR Korea and included the GHG inventory for the year 1990, the scenario on the sectoral GHG emissions and removals, vulnerability assessment and adaptation measures, and mitigation measures.

As a part of continued efforts to fulfill obligations under the UNFCCC, DPR Korea has started the Project "Enabling Activity for the Preparation of the Second National Communication of Democratic People's Republic of Korea to the UNFCCC" from April 2006 under the financial support of UNEP/GEF. The principal objective of the SNC Project was to prepare the national GHG inventory up to the year 2002, to facilitate activities for adequate adaptation to and mitigating climate change, and to prepare the SNC. Implementation of the Project had two breaks from April 2007 to March 2008 and from October 2008 to March 2011 because of interruption of financial support from the UNEP/GEF due to withdrawal of the UNDP office in DPR Korea, but it has successfully accomplished in September 2012. The activities within the Project were a continuation and upgrade of the work done under the FNC Project.

The overall budget of the Project was US$ 405,000 from GEF expedited financing mechanism and in-kind contribution of the Government of DPR Korea was US$ 50,000, including some logistical support, basic communication and office facilities, supply of library and information facilities, and others.

The Project has been executed under overall supervision of the NCCE. To provide guidance and direction on the SNC process, the Project Steering Committee, comprising representatives from various Government agencies including the SCST, SAOS, MLEP, SHMA and CBS, was established. The NCCO was set up and conducted advisory activities related to climate change under the Project.

For technical assistance of the project activities and guidance on scientific and methodological aspects of the project, the PMG and TEGs were reconstituted based on the institutional arrangements under the FNC Project and the key elements of the national communication.

The PMG was headed by the NPC drawn with approval of the NCCE and UNEP, who managed the project implementation under the UNEP supervision. The NPC and the leaders of each TEGs formed the PMG, and

the PMG and NPC were supported by an administrative assistant and an accountant (on a part-time basis).

The SNC was compiled, edited and prepared by the leaders of the TEGs, under the coordination and supervision of the NCCE and PAC. The SNC was also subjected to a thorough third-party review by national experts who were directly or indirectly involved in the SNC process.

The SNC contains seven chapters constituting the main reporting elements as elaborated in the Article 4, paragraph 1, and Article 12, paragraph 1 of the UNFCCC and the UNFCCC Guidelines for National Communication by non-Annex I Parties as contained in the annex to decision 17/CP.8.

Chapter 1 introduces the background and structure of the SNC, followed by the national circumstances in Chapter 2, which includes information on features of geography, climate and economy which may affect the national GHG inventory and mitigation and adaptation to climate change.

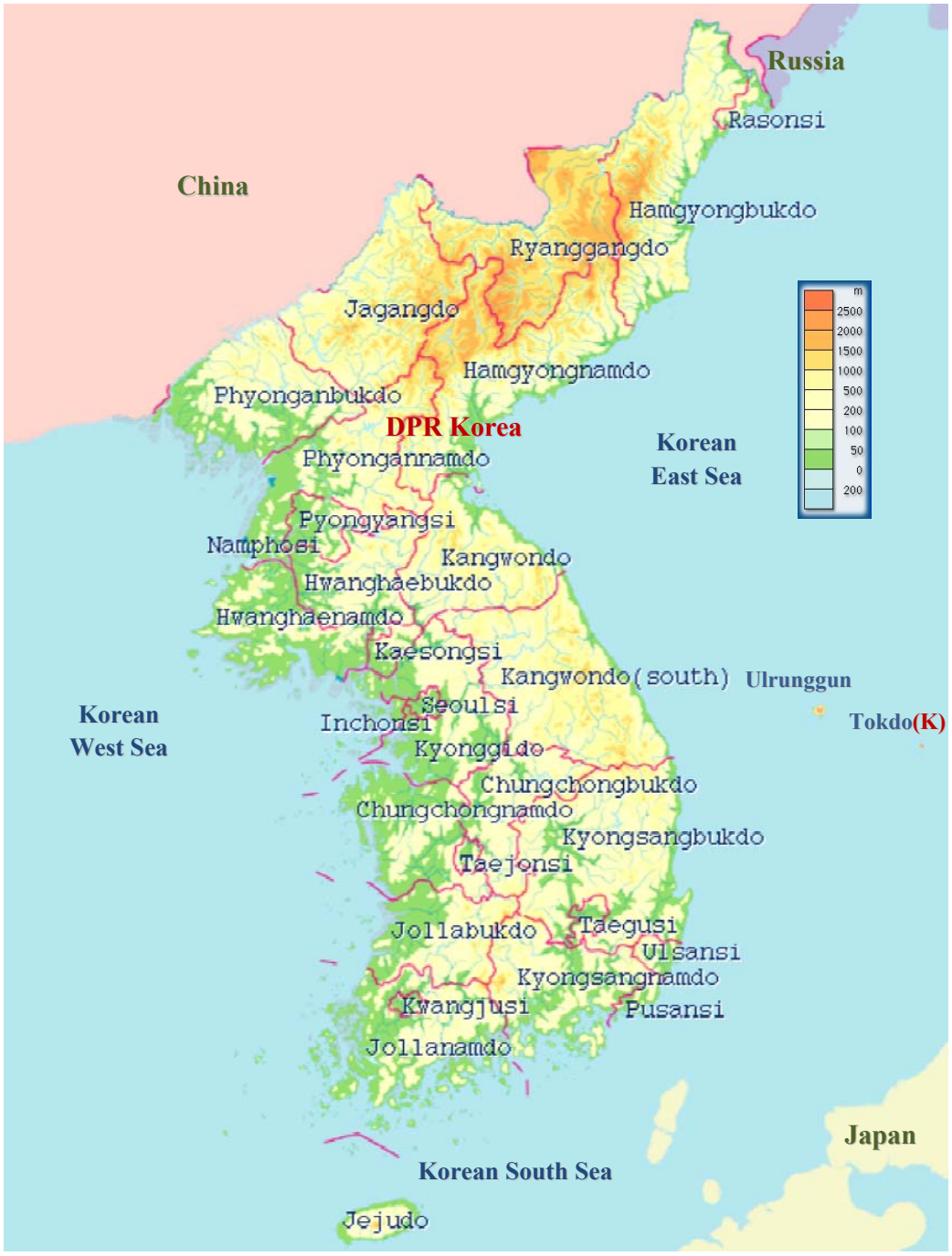
Chapter 3 is devoted to national GHG inventory for the period 1990-2002 in accordance with the relevant methodologies recommended by the UNFCCC Secretariat and the IPCC. The inventory is complemented by figures and tables providing details on estimations carried out.

Chapter 4 and 5 summarize the vulnerability and adaptation assessment for key socio-economic sectors and the mitigation options analysis.

Chapter 6 deals with other informations related to the implementation of the UNFCCC, including development and transfer of ESTs; research and systematic observation; education, training and public awareness; and capacity building.

Finally, chapter 7 is devoted to the assessment of the constraints and gaps, and related financial, technical and capacity needs to promote the implementation of the UNFCCC.

CHAPTER 2 NATIONAL CIRCUMSTANCES



Chapter 2 National Circumstances

2.1 State Apparatus and Development Priorities

2.1.1 State apparatus

Democratic People's Republic of Korea (DPR Korea) found on September 9, 1948 is an independent socialist country venerating the great leader Comrade KIM Il Sung as the eternal president of the Republic and the great leader Comrade KIM Jong Il as the eternal chairman of the National Defense Commission of the Republic.

The respected marshal KIM Jong Un, the first chairman of the National Defense Commission, is the supreme leader of DPR Korea.

Box 2-1 Socialist Constitution of DPR Korea

The socialist constitution of DPR Korea enacted on December 27, 1972 has been revised and supplemented several times, and developed and completed as the KIM Il Sung-KIM Jong Il Constitution at the fifth meeting of the twelfth session, Supreme People's Assembly on April 13, 2012.

The constitution was made up of preface and 7 chapters (1. Policy, 2. Economy, 3. Culture, 4. National defense, 5. Basic rights and duties of citizen, 6. State apparatus, 7. National emblem, national flag, national anthem and capital) of 172 articles.

Source: DPR Korea, 2012

The state apparatus of DPR Korea is made up of the Supreme People's Assembly, the first chairman of the National Defense Commission, the National Defense Commission, the Standing Committee of the Supreme People's Assembly, the Cabinet, Local People's Assembly, Local People's Committee, Public prosecutors office and court of justice (DPR Korea, 2012).

- The Supreme People's Assembly is the highest organ of State power of DPR Korea. It exercises legislative power and its term of office is 5 years.
- The National Defense Commission is the highest national defense leading organ for the national sovereignty.
- The Standing Committee of the Supreme People's Assembly is the highest organ of state power in recess of the Supreme People's Assembly. The chairman of the Standing Committee of the Supreme People's Assembly represents the state.
- The Cabinet is the administrative execute organ of the highest sovereignty and overall Government control organ. The Premiere of the Cabinet represents the Government of DPR Korea. The commissions and ministries under the Cabinet are the sectoral executive organs of the Cabinet and at the same time, the sectoral administrative central organs.

2.1.2 Development priorities

The Government of DPR Korea whose supreme principle is to steadily improve the people's livelihood launches a campaign to make a decisive turn in the building of economically powerful state and the improvement of people's standard of living. Today, DPR Korea has completed the production systems of iron, fiber and fertilizer based on its own technologies and resources while introducing Computer Numerical Control (CNC) of its own type and flexible production system into various sectors of the national economy, and building up numerous modernized factories and great monumental creations.

The Government of DPR Korea has put forward the objective to convert the country into knowledge oriented economically powerful state in the near future and layed down the development strategy and innovative way of its own type to carry out that strategy. ("Rodongsinmun" Oct. 17, 2012)

The Government of DPR Korea

concentrates its efforts in the economic construction on accelerating modernization of the national economy, creating industries fed with domestic raw materials, fuels and technologies, and increasing investment for light industry and agriculture, by focusing on the strengthening the Juche character and independence of the national economy and dramatically improving people's livelihood. ("Rodongsinmun" Dec 5, 2012)

In the present stage, the Government of DPR Korea puts forward the increase in grain production as the primary priority for the state development (Central Bureau of Statistics, 2011).

2.2 Geographic Context

2.2.1 Geographic characteristics

DPR Korea is situated in the east of the Asian continent. DPR Korea is bounded on the north by China and Russia at intervals of Amnok River and Tuman River, on the east by Japan at intervals of the Korean East Sea and on the west by China at intervals of the Korean West Sea.

DPR Korea encompasses approximately 123,138km^2 of land (Central Bureau of Statistics, 2011).

The Capital of DPR Korea is Pyongyang.

Administratively, DPR Korea is made up of 9 provinces and 3 cities under the direct control. Provinces are further divided into 207 cities (districts) and counties, which are divided up into over 4,000 ri-s (towns, gu and dong) (Central Bureau of Statistics, 2011).

DPR Korea is a country with many mountains, rivers and streams and long coastline.

Having many mountains is the key feature of the topography of DPR Korea. Mountains account for significant proportion in the territorial area of DPR Korea, but the absolute altitudes of mountains are low. The mean sea-level in DPR Korea is 586m, lower than the mean sea-level of the terrestrial land of the world, which is 875m (Central Bureau of Statistics, 2012). This is because high mountains are limited and low mountains take up many areas. In DPR Korea, the sea-level of mountains is 2,000 to 2,300m in the northern mountainous region, 1,400-1,600m in the eastern mountainous region and 600-800m in the western mountainous region (RI Ho et al, 2009). Therefore, the topography of DPR Korea is high in the north and the east, and low going down to the west and the south.

The other topographic feature of DPR Korea is that topography of river valley was developed with much sloping fields because of many rivers. In DPR Korea there are 2,433 rivers with over 5km of each length. (CHOE Song Chol, 2006).

Another feature of DPR Korea's topography is that the coastline is very long and horizontal geology is very complex.

2.2.2 Climate

The climate of DPR Korea is the temperate monsoon climate with strong continentality.

Climate with four distinct seasons

Geographically, DPR Korea is laied down in the temperate zone, thus four seasons: spring, summer, autumn and winter distinctly appear (RI Ho *et al.*, 2009).

The climatic feature in spring is that wind is very strong in daytime with many clear days. In spring, spring drought appears because of small precipitation and much evaporation resulted from strong wind and rapid increase in temperature.

The feature of climate in summer is sultriness caused by the highest temperature and much humidity because hot and humid air streams in from the south. In DPR Korea, summer is the rainy season with much rain, and in summer, various disastrous climatic events such as heavy rain and typhoon appear. The other feature of climate in summer is many cloudy days, small change in temperature during a day and high in relative moisture. The main feature of climate in autumn is the lasting of relatively dry period with rapid falling in temperature.

The area where temperature falls down rapidly is the northern inland area and intermediary area of the West Sea coast. The main feature of climate in winter is that it is cold and dry by the effect of high atmospheric pressure overlying Siberia. The other feature of climate in winter is alternation of three cold days and four warm days. But in recent years, the alternation of three cold days and four warm days appears occasionally for global warming (CHO Song Ha *et al.*, 2007).

Typical monsoon climate

The climate of DPR Korea is the typical monsoon climate belonging to the temperate monsoon climate zone (RI Ho *et al.*, 2009). The reason why DPR Korea is laied in monsoon climate zone is that the country was linked with the Eurasian continent, the largest one in the world and abutted with the Pacific Ocean, the largest one in the world. By the effect of seasonal wind, winter is cold and dry, and rainy season accompanying with high temperature and much rain appears in summer in the country.

Climate with great regional differences

DPR Korea was laied down between the Eurasian continent and the Pacific Ocean, and the most part of the territory is mountainous region, thus there exists significant regional difference in climate (RI Ho *et al.*, 2009). The climate in the East Sea coast is different from that in the West Sea coast though both are coastal zones, that in plain region is different from that in inland mountainous region, and in mountainous regions, the front, backside, ridge of a mountain, a mountain's breast and base of a mountain have different climatic features each other.

Temperature

The annual mean temperature of DPR Korea is 8.2℃ (average for 1971 to 2000) (SONG Kyong Ran, 2007). The annual mean temperature in Kaema plateau and Paektu plateau in the northern inland region where annual mean temperature is lowest is below 2℃ (RI Ho *et al.*, 2009).

The general feature of distribution of annual mean temperature in DPR Korea firstly is that there exist some differences between the East Sea coast and the West Sea coast (Figure 2-1). Temperature in the East Sea costal zone is higher by about 1℃ than that in the West Sea costal zone on same latitude. The second is that there exist significant differences in temperature between the coastal region and inland region. Difference in temperature between the coastal region and inland region is different by latitude and region; generally large in the East Sea coastal region and, in particular, larger in the northern part of the East Sea coast.

Mountain ranges affect significantly distribution of annual mean temperature in the country.

The average temperature in northern inland region is -13℃ in January, which is lowest in the country. And the average temperature in July characterizing summertime temperature is about 23℃ to 24℃ in overall regions and average temperature in Kaema plateau, Paektu plateau and northern coastal region in North Hamgyong province where average temperature is lowest is below 21℃.

Precipitation

DPR Korea is a country with much precipitation. The annual precipitation of the country is 927mm (average for 1971 to 2000), which is greater than 840mm, the annual average precipitation of the terrestrial part of the world (SONG Kyong Ran, 2007).

Annual precipitation in the country is very different by region (Figure 2-2).

The regions rich in precipitation are the middle inland region in South Phyongan Province where are the basins of upper and middle streams of Taedong River and Chongchon River, inclined region of the middle course of Rimjin River, inclined region in the middle of Kangwon Province and Kosong in Kangwon Province, where annual precipitation is 1,200 to 1,400mm (RI Ho *et al.*, 2009).

The region poor in precipitation is the area of Ryanggang Province in northern

inland unaffected by sea as surrounded with high mountain ranges, where the annual precipitation is about 680mm.

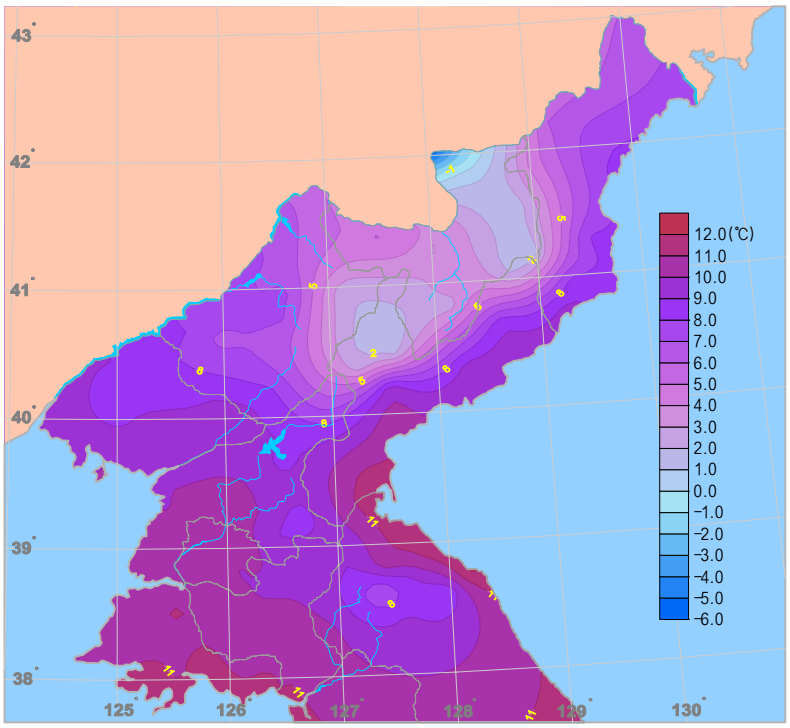


Figure 2-1 Distribution of annual mean temperature

Source: SONG Yong Chol, 2011b

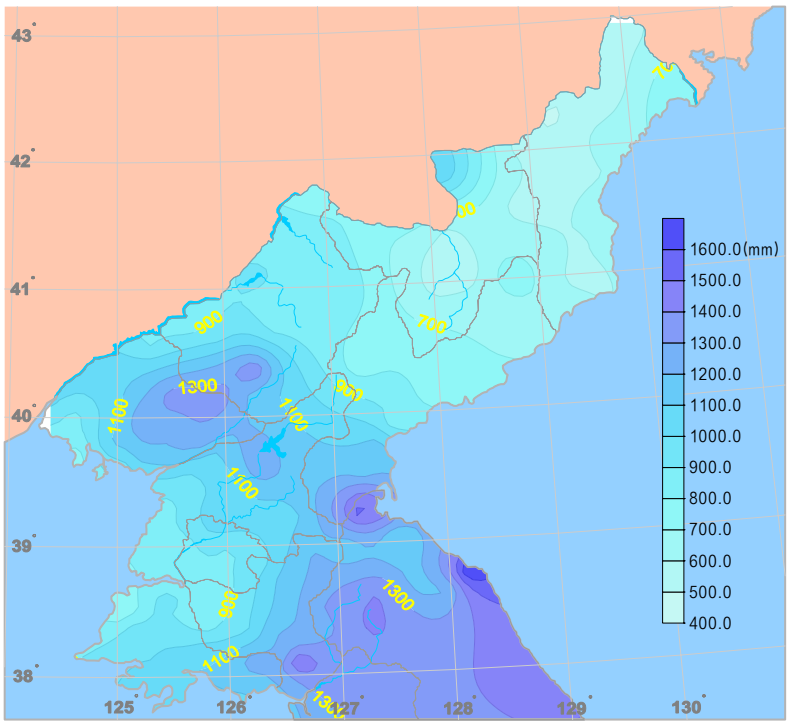


Figure 2-2 Distribution of annual precipitation

Source: SONG Yong Chol, 2011b

The annual precipitation in the Tuman River basin and northern part of the East Sea coast is about 500-600mm, which is most limited. The shore vicinities and islands in

the West Sea coast around estuary of Taedong River also have little annual precipitation which is about 600-800mm.

The distribution of monthly precipitation also has some features. The precipitation in summer, the rainy season, accounts for 50% to 60% of annual precipitation, and especially, precipitation from July to August accounts for 40%. The precipitation in winter is most limited, and precipitation in January only accounts for 2% to 3% of annual ones. Spring and autumn also are limited in precipitation. The precipitation in spring accounts for 15% to 20% of annual ones in overall regions and that in autumn only about 13% to 24%.

2.2.3 Natural resources

Water resources

Having many rivers, streams, abundant underground water resources and reservoirs built everywhere; DPR Korea is abundant in water resources. River water accounts for the largest proportion in water resources in the country. Water resources of rivers and streams in DPR Korea is 67.1km^3 (RI Ho *et al.*, 2009).

Rivers

DPR Korea has many rivers over territorial area, and the density of rivers is 0.46 to 0.6km/km^2 meaning one of the countries with high density of rivers in the world (MLEP, 2012). There are 3 rivers: Amnok River, Tuman River and Taedong River with over 40km in length, 1,705 rivers whose basin areas are under 50km^2, 359 rivers whose basin areas are over 100 km^2, 38 rivers whose basin areas are over 1,000km^2 and 4 rivers (Amnok River, Tuman River, Taedong River and Chongchon River) whose basin areas are over 10,000km^2 in DPR Korea (CHOE Song Chol, 2006).

The regions with the largest flood amount in the country are the southwest region of North Phyongan and Chagang Province around the upper basin of Daeryong River and Chongchon River where flood amount per km^2 is 1.04m^3/(s·km^2) to 2.4m^3/(s·km^2), the upper and middle basin of Taedong River, the basin of Piryu River, Nam River, Kumya River, Ryesong River, Jaeryong River, Rimjin River and northern region of Han River where flood amount per km^2 is about 1.2 m^3/(s·km^2) to 1.4 m^3/(s·km^2) on average (RI Ho *et al.*, 2009).

Lakes

Now, there are about 100 lakes in DPR Korea (PAEK Hyon Song, 2009). There are 5 lakes whose area is over 5km^2 among them and the lake of Chon of Mt. Paektu is the first in water quantity (1.96km^3) (RI Ho *et al.*, 2009).

There are also about 1,800 man-made lakes built on the purpose of hydropower generation, irrigation, flood control, industrial water, drinking water, freshwater fish breeding and making of scenic beauty, etc (PAEK Hyon Song, 2009). The reservoirs for large hydropower generation are Lake Suphung, Lake Unpong, Lake Changjin, Lake Pujon and Reservoir Taechon, etc., and those for irrigation Lake Unpha, Lake Manphung, Lake Sohung and Lake Yonphung, etc.

Underground water

Underground water also is abundant for developed rivers and large precipitation in DPR Korea. DPR Korea is one of the countries dense in distribution of mineral spring. There are about 150 mineral springs with 90 mineral water springs and 60 hot springs (PAEK Hyon Song, 2009).

Animals and plants resources

Plants

DPR Korea is various and abundant in plant resources.

Geographical range of plants in the country has serial specific features with developed horizontal and vertical structures, and plenty of plants of economic value, as well as various elements and composition of species, many living fossils and endemic species, almost all plants of living form. Total number of species of plants distributed in the country is 9,548 with 4,280 species of higher plants (3,290 species in seed plant,

226 species in fern and 764 species in bryophyte) and 5,268 species of plants of a lower order (434 species in lichen, 2,141 species in fungi and 2,693 species in alga) (RI Ho *et al.*, 2009). Typical endemic plants distributed in the country are Keumkangsania asiatica, Pentactina rupicola, Rheum coreanum, Echinosophora koreensis, Forsythia ovata, Thymus quinquecostatus and Syringa dilatata, etc.

Typical plant communities constituting plant cover in the country are Abies nephrolepis-Picea jezoensis forest, larch/Larix olgensis forest, pine/Pinaceae forest, oak/Quercus acutissima forest, mongolian oak/Quercus mongolica-linden/Tilia amurensis forest, white birch/Betula platyphylla forest, aspen/Poplus davidiana forest, eurya japonica/Betula eramii forest, pine-nut tree/Pinus koraiensis forest, Cyclobalanopsis myrsinae folia forest, alpine plant community, limestone plant community and tideland plant community, etc.

Animals

DPR Korea was known as one of the regions with abundant zoons and various compositions of species of animal world.

Today, the number of species of vertebrates distributed in the country is 1,434 and the number of species of invertebrates 7,031; of vertebrates, mammalian has 97 species (including subspecies) of 47 genera of 26 families, bird has 394 species (including subspecies) of 192 genera of 60 families, reptile has 27 species of 18 genera of 11 families, amphibian has 14 species of 8 genera of 6 families and fish has 850 species of 198 genera, of which pure freshwater fish are 185 species of 100 genera of 34 families (RI Ho *et al.*, 2009). Besides, the number of species of insects, aquatic animals and lower animals of fine structure is numerous incomparably with that of animals known so far.

Meanwhile, there are 600 species of fish, 15 species of sea animals and 6 species of sea snakes in the Korean East Sea, 220 species of fish, 7 species of sea animals and 6 species of sea snakes in the Korean West Sea (PAEK Hyon Song, 2009).

Marine resources

DPR Korea has abundant and various marine resources.

First of all, it has abundant maritime resources. There are many migratory fishes migrating with seasons in the Korean East Sea. Shoal of mackerels and anchovies runs up and shoal of herrings comes down from the north in spring (RI Ho *et al.*, 2009). Besides, there are outer layer fishes such as gizzard shad and spanish mackerel flocking to the East and West Sea in spring, and high rank non-migratory fishes such as walleye pollack and hard-finned sandfish that spend summertime in deep sea and spawn in coast in winter in the Korean East Sea, and lockington that lives in deep place in winter and comes to coast in spring.

And, there are abundant in species and quantity of marine resources such as ray, flat back, cuttlefish, trepang, oyster, ear shell, scallop, blue mussel, large clam and sea tangle, etc., in the seas of the country.

And then, there are hundreds of thousands hectares of tideland that could be reclaimed into farmland, reed field, salt field and others in coast of the West Sea.

There are also abundant in mineral resources in coast and deep sea in the country.

Energy resources

Fossil fuels

There are abundant in fossil fuel resources such as coal, peat for fuel, oil shale and others in DPR Korea (Table 2-1).

Table 2-1 Fossil fuel resources in DPR Korea (Tg)

Classification		Value
Coal	Anthracite	7,300
	Lignite	7,800
	Meta-anthracite	2,000
	Total	17,100
Peat for fuel		76
Oil shale		140

Source: CBS, 2012

The basic coal resource is anthracite and lignite. With the exception of that, there are semi-anthracite and meta-anthracite resources distributed in several regions. There are peat resources in different regions in the country and oil shale resources in Onsong region in North Hamgyong Province and Kaechon region in South Phyongan Province (RI Ho *et al.*, 2009).

Hydraulic power

There are very abundant in hydraulic resources as the country, with much precipitation is mountainous. Hydraulic resource is abundant in Changjin River, Pujon River, Hochon River, the region of upper stream of Sodu River, the north of Han River, the region of upper sream of Rimjin River, the region of upper stream of Changja River and Chungman River and the main stream of Amnok River, Tuman River and Taedong River in the country (RI Ho *et al.*, 2009). From the topographical feature, changing basins of rivers of the West Sea coast into the East Sea coast makes it possible to get much energy in the north and middle regions of the country.

The height of annual average runoff in DPR Korea is 545mm and coefficient of annual average runoff is 0.58, which is larger than 0.39, terrestrial ones of the world, by far. But 70% to 80% of annual runoff is concentrated from June to September, and runoff from December to the next February is very small, accounting for about 5% of annual runoff.

Solar energy

The duration of annual sunshine is about 2,280-2,700 hours, and the duration of sunshine in summer, rainy season, exceeds even 200 hours on monthly average, as well as in spring and autumn (RI Ho *et al.*, 2009). Especially, the duration of sunshine is long in autumn.

Percentage of annual sunshine in the country is 45-60% and regional difference is relatively small. In the most of regions including the West Sea coast and the East Sea coast, as well as northern inland regions, percentage of sunshine in winter is high. Percentage of sunshine in January is over 60% in the most regions of the country.

Wind power

DPR Korea has abundant wind resources for its physiographical condition. Annual average wind speed in the most regions of the country is about 2-4m/s (RI Ho *et al.*, 2009).

Annual average wind speed in coastal regions is over 3m/s, and that in Rason City in the northern region of the East Sea coast and Cholsan County of the West Sea coast is as fast as 4m/s. Annual average wind speed in flat areas near coast is 2-3m/s and that in inland below 2m/s. Annual average wind speed in Kowon region, one of the windy regions in the country, is 3-4m/s, which is faster than in coastal regions.

Geotherm

There are abundant in geothermal resources whose temperatures are average temperature and low temperature in the country (RI Ho *et al.*, 2009). The temperatures of mineral water springing to the surface of the earth up in Ongjin and Paechon region, typical places for geothermal energy production, are about 100℃ and 70℃, respectively.

Tidal power

DPR Korea also has abundant tidal power resources (RI Ho *et al.*, 2009). The Korean West Sea is over 5m in difference between the ebb and high tides in every spot of the coast, which is the large value on the world scale, and has advantageous condition able to develop and use tidal power resource easily for having much indented coastline and many islands.

2.2.4 Land use

In DPR Korea, forest takes up most part of the territory, and thus, farming land is extremely limited. Forest land and farming land accounted for 74.7% and 15.2% of the territorial area (Figure 2-3), and the area of forest land and farming land per capita is 0.38ha and 0.08ha in 2011, respectively (CBS, 2012).

Thanks to the right forest policy of the

Government of DPR Korea to afforest mountains, conserve forests and make rational use of forest resources, the area of forest land was increased from 89,455 km^2 to 92,062 km^2 and that of farming land was decreased from 20,212 km^2 to 18,680km^2 during the period from 1990 to 2011 (Table 2-2).

But the area of forest tree land constituted of industry forest, forest of economic value, firewood forest and reserved forest was decreased from 81,333km^2 to 76,432km^2 and that of treeless place was increased from 4,324km^2 to 8,768km^2 during the period from 1990 to 2005 (Table 2-3).

This is because forest was degraded due to flood, drought, forest fire, damages by forest pests, forest clearing and excess deforestation of forest resource(e.g. for firewood) from the latter half of the 1990s.

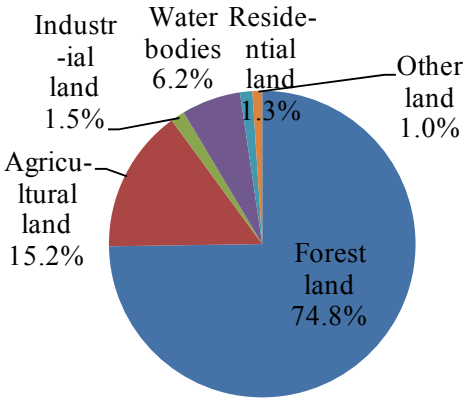


Figure 2-3 Land use in 2011

Source: CBS, 2012

Table 2-2 Land use change for the period 1990-2011 (km^2)

Year	1990	1993	1996	2002	2005	2011
Forest land	89,455	88,235	88,324	88,285	89,273	92,062
Agricultural land	20,212	20,698	20,856	20,856	20,421	18,680
Industrial land	1,874	1,944	1,974	2,003	2,063	1,844
Water bodies	7,041	7,141	7,210	7,210	7,374	7,683
Residential land	1,359	1,507	1,557	1,597	1,659	1,595

Source: CBS, 2012

Table 2-3 Variation in forest cover for the period 1990-2005 (km^2)

Year	1990	1996	2000	2005
Forest land	89,455	88,324	88,285	89,273
Timber forest	81,333	81,154	75,541	76,432
Non-timber forest	4,324	3,769	8,707	8,768
Non-forested area	3,798	3,402	4,036	4,073

Source: MLEP, 2012

Afforestation area was increased significantly as the result of forestation and afforestation activated to recover degraded forest in recent years, but ravage and degradation of forest still are raised as the national priority problem to be solved due to inefficiency of afforestation and unsustainable forest management.

Meanwhile, degradation of farming land also is raised as a serious problem. DPR Korea is constantly subjected to soil erosion from the topographical feature with many mountains and sloping fields. The area of paddy field was 5,650km^2 and that of corn field 4,990km^2 in 2008 (MLEP, 2012).

2.3 Population Profile

The population of DPR Korea which was 24,052,000 in 2008 has increased to 24,489,000 in 2011(CBS, 2012). The proportion of males to females was 48.7% and 51.3% and population rate in towns and countries was 60.6% and 39.4% by the whole scale census undertaken as of October

1, 2008. The rate of population growth was 13.4%, and those for male and female were 13.5% and 13.3%, respectively and annual average rate of population growth was 0.86% compared with 1993 (CBS, 2011). Population growth over the period 1990 to 2008 is shown in Table 2-4.

And then, density of population in DPR Korea was 195 persons per km^2 and the population of Pyongyang City, South Phyongan Province and South Hamgyong Province accounted for 44.4% of the total population (Figure 2-5). And the average life expectancy was 69.3 years, 72.7 years for female and 65.6 years for male, and birthrate was 14.4‰, total number of households was 5,887,000, and the population per family was 4.09 persons.

Box 2-2 DPR Korea's population (Whole scale census, October 1, 2008)

Population: 24 ,052,000		
Of which:	Male	48.7%
	Female	51.3%
	Urban population	60.6%
	Rural population	39.4%
Population density: 195 persons per km^2		
Average life expectancy: 69.3 years		

Source: CBS, 2011

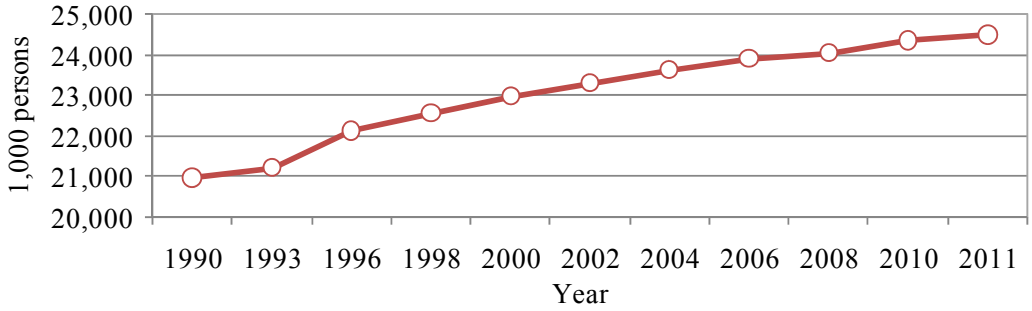


Figure 2-4 Population growth (1990-2011)

Source: CBS, 2012

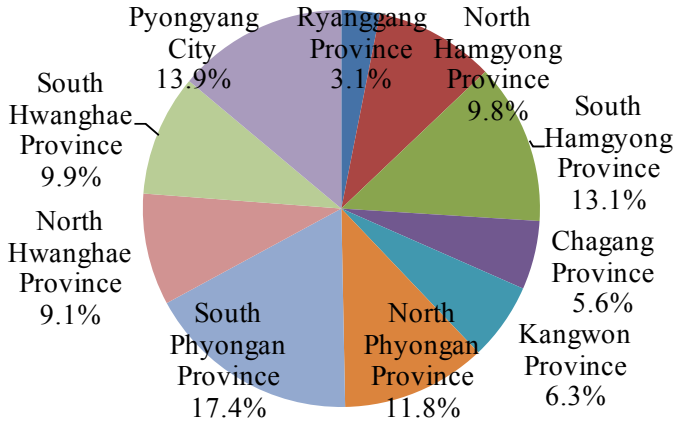


Figure 2-5 Share of population by province in DPR Korea (2008)

Source: CBS, 2011

2.4 Economic Context

DPR Korea holds on to the line of developing self-reliant national economy on the basis of one's own resources and technologies in economic construction.

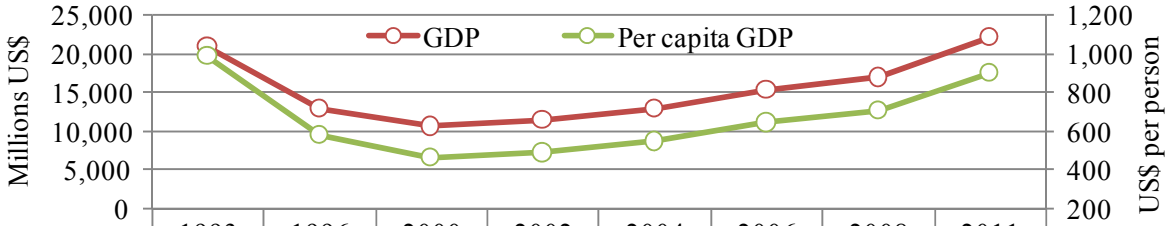
The country has made wonderful progress in economy before the 1990's, but the whole economy has encountered serious

difficulty because of natural calamities confronted continuously, foreign economic pressure and blockade, and collapse of socialist market, and as a result, the result that economy has been descended and level of many economic indicators has turned out unfavorable has been led. Production was increased unprecedentedly and epochal change was made in economic construction as the leading sectors of the national economy and basic industrial sectors such as metal, electricity and railway were activated and modernization of the industry, agriculture and light industry vigorously was accelerated in recent years.

In DPR Korea, GDP decreased to US$ 10,608 million in the 1990's has increased with high rate in the 2000's (Figure 2-6).

In DPR Korea, GDP has reached US$ 22,070 million in 2011, which is 2.1 times compared with 2000 (CBS, 2012).

Industry has accounted for the largest proportion as 46.4% and agriculture the third position as 14.6% in sectoral proportion of GDP in 2011 (Figure 2-7).



	1993	1996	2000	2002	2004	2006	2008	2011
GDP	20,875	12,802	10,608	11,378	12,859	15,326	16,913	22,070
Per capita GDP	984	579	462	488	545	641	703	901

Figure 2-6 GDP and per capita GDP in 1993-2011

Source: CBS, 2012

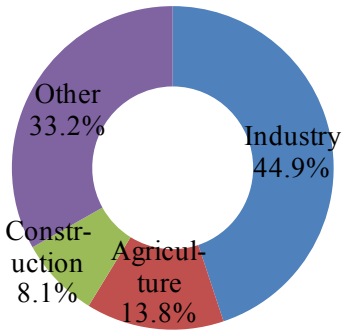


Figure 2-7 Share of GDP by sector in 2011

Source: CBS, 2012

Industry

The basic industrial sectors of the country are coal-mining, electric power, metallurgical industry, mining industry, machine-building industry, construction materials industry, chemical industry, light industry and others.

The Government of DPR Korea further strengthens the independence and Juche character of the industry by strictly observing the principle of developing the industry with its own raw material and fuel.

The country has not crude oil and natural gas resources, but abundant coal resources. Coal is used as raw material and fuel in every sectors of the national economy in the country. Table 2-4 shows the consumption of coal and crude oil during the period 1995-2007. Much coal is also used for people's living in the country. Proportion of coal and wood used for cooking in the country in 2008 was 63% and 28% in urban areas, 19% and 77% in rural areas, respectively (MLEP, 2012). Proportion of coal and wood used for heating in the same year was 64% and 26% in urban areas, 20% and 75% in rural areas, respectively. But coal production is still interrupted for low level of mechanization in coal mining and incomplete reactivation of coal mines submerged by flood in the mid 1990s.

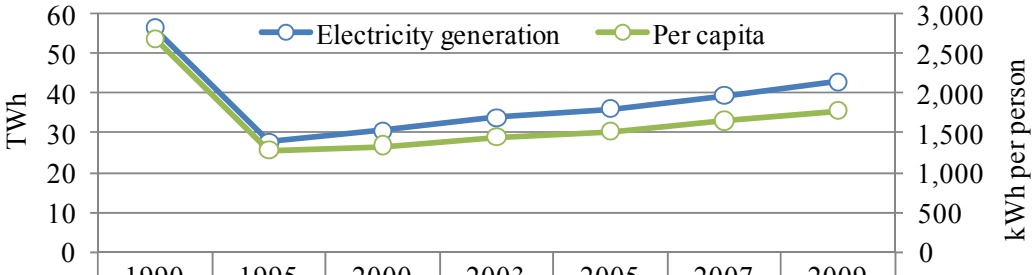
The Government of DPR Korea is concentrating all efforts on boosting the

electricity industry, attaching great importance to electricity generation in the development of the national economy.

Table 2-4 Consumption of coal and crude oil for the period 1995-2007 (Gg)

Year	1995	2000	2005	2007
Coal	30,200	22,730	25,050	27,430
Of which: Anthracite	23,820	19,210	20,340	22,540
Lignite	6,170	3,410	4,620	4,800
Crude oil	1,753	1,139	1,285	1,301

Source: MLEP, 2012



	1990	1995	2000	2003	2005	2007	2009
Electricity generation	56.4	27.9	30.7	34.0	36.2	39.5	42.9
Per capita	2,691	1,279	1,337	1,449	1,524	1,648	1,773

Figure 2-8 Electricity generation (1990-2009)

Source: CBS, 2012

Table 2-5 Share of hydro and thermal power of the total electricity generation in DPR Korea (%)

Year	1990	1995	2000	2003	2005	2007	2009
Hydro	50.7	52.3	54.1	58.9	59.7	64.6	64.8
Thermal	49.3	47.7	45.9	41.1	40.3	35.4	35.2
Total	100	100	100	100	100	100	100

Source: CBS, 2012

As a result, the output of electric power was increased from 27.9TWh to 42.9TWh, and per capita output of electricity from 1,279kWh to 1,773kWh during the period from 1995 to 2009 (Figure 2-8). Proportion of hydropower generation of total electricity output during the same period was gradually increased from 52.3% to 64.8% as many large or medium and small hydropower stations using abundant hydraulic resources of the country had been built all over the country (Table 2-5). But growing demand of electricity is not met smoothly because most of generating equipment were old and inefficient, and infrastructure of transmission and distribution of electricity was old and behind in the country.

The output of steel, cement and chemical fertilizer in 2007 increased by 1.1 times, 1.7 times and about 2 times compared with 2000 by reactivation of production in leading sectors of industry of the national economy in recent years (Figure 2-9). But there is a priority problem that is to reconstruct and modernize old and outdated production process and equipment in the industrial sectors consuming much energy such as steel, cement and chemical industry.

Meanwhile, the Government of DPR Korea has implemented the obligation for the year 2010 under the Montreal protocol requesting removal of main ozone depleting substances. DPR Korea has already stopped the production of Methyl bromide from

January, 1996, the production of CFC-11, CFC-12 and CFC-113 from November, 2003 and the production of carbon tetrachloride from November, 2005 (MLEP, 2012).

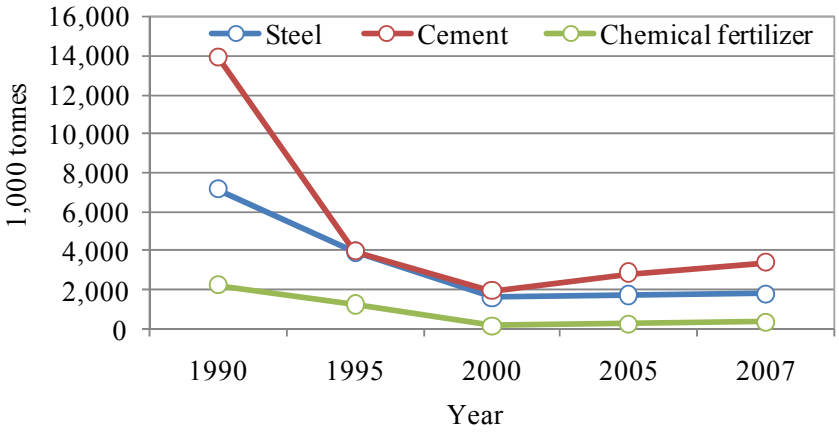


Figure 2-9 Output of main industrial products (1990-2007)

Source: MLEP, 2012

Agriculture

Agriculture in DPR Korea is one of the two main sectors of the national economy with industry and the main component of the self-reliant national economy. Main grain crops are rice and maize, and the other crops wheat, barley, kaoliang, beans, potato and so on.

Ushering in the 1990's, grain output has significantly declined for economic hardship and serious natural disasters such as flood, drought and tidal wave, but grain output is gradually increasing by active efforts of the Government to increase grain output in recent years.

As a result, grain output has reached 5,120,000t in 2010 (Figure 2-10). But per capita grain output is still in low level as 210kg/yr in 2010 (CBS, 2011).

The goal of the Government putting forward attainment of self-sufficiency in food as basic principle is to solve food problem basically and to regularize food supply for residents by producing 6,000,000t of grain for the present, and 7,000,000t of grain in 2015.

In recent years, the Government of DPR Korea has encouraged so as to produce and use various microbial fertilizer and organic fertilizer in large quantities while using chemical fertilizer in small quantities for agricultural production. The amount of fertilizer applied by the manuring year is as shown in Table 2-6.

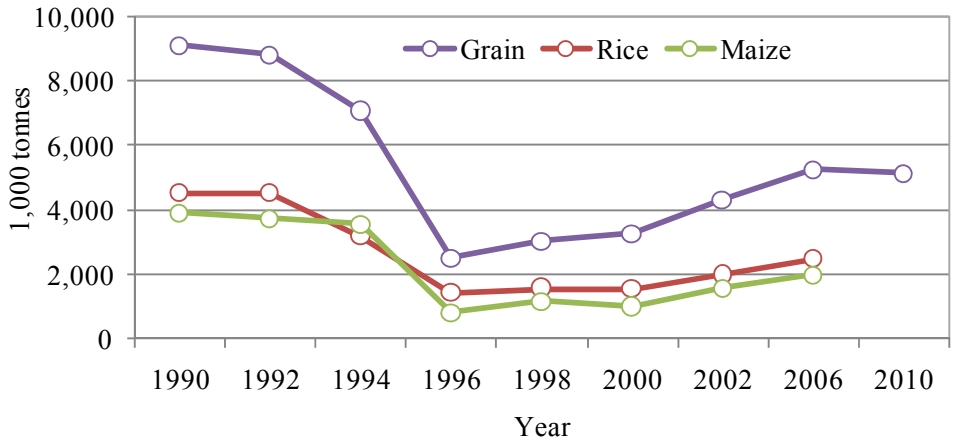


Figure 2-10 Grain Output (1990-2010)

Source: CBS, 2011

Table 2-6 Production, import and manuring of chemical fertilizer by manuring year (Gg)

Classification	Type of fertilizer	1997-1998	1999-2000	2004-2005	2007-2008
Output	Nitrogen	115	109	160	257
	Phosphorus	22	5	8	7
	Potassium	4	7	8	10
Import	Nitrogen	304	417	736	181
	Phosphorus	98	126	259	-
	Potassium	-	45	78	-
Manuring	Nitrogen	442	528	896	438
	Phosphorus	121	133	267	7
	Potassium	12	54	86	10

Source: MLEP, 2012

Table 2-7 Livestock population for the period 1995-2010 (1,000 heads)

Year	1995	2000	2002	2005	2007	2010
Cattle	886	579	575	576	576	577
Dairy	14	9	9	9	9	9
Swine	2,674	3,120	3,156	3,079	3,251	2,248
Sheep	248	185	170	165	165	166
Goat	713	2,276	2,693	2,761	2,775	3,556
Rabbit	3,056	11,475	19,482	19,679	20,051	28,571
Poultry	10,523	17,811	22,695	25,580	26,165	22,505

Source: CBS, 2012

Meanwhile, by breeding gross-eating livestock such as goat and rabbit through a mass movement, the number of heads of gross-eating livestock has been largely increased compared with the past period (Table 2-7).

The number of heads of goats and rabbits in 2010 has increased by 5 times and 9.3 times compared with that in 1995, respectively.

2.5 Education and Health Profile

2.5.1 Education, and Science and technology

Education

DPR Korea enforces universal free education with the state expense. In DPR Korea, the state also bears the expense for social education and adult education as well as formal school education of all education kinds from preschool education to primary school, middle school, university and postgraduate course. The Government of DPR Korea early has enforced compulsory primary education in 1956 for the first time in the east, continuously compulsory middle education in 1958, universal 9-year compulsory technical education and the universal 11-year free and compulsory education in 1972 for the first time in the world. The Government of DPR Korea has consolidated the system of universal 11-year free and compulsory education by law, enacting the law on education in 1999, revising and supplementing it several times after that (Table 2-9).

The Government of DPR Korea has adopted the Law "On the enforcement of the universal 12-year compulsory education" in the 6th session of the 12th Supreme People's Assembly on September 25, 2012, reflecting

requirements of education development to information economy era building powerful nation up extensively. According to this law, universal 12-year compulsory education for the youth and children from 5 years to 17 years goes into enforcement as from 2013-2014 school year.

Box 2-3 Education system in DPR Korea

Education system in DPR Korea consists of formal educational system and various systems of part-time study while working.

In common education, the universal 11-year compulsory education composed of 1-year of preschool education and 10-year of school education is enforced, at present, and the universal 12-year compulsory education goes into enforcement from 2013-2014 school year.

Higher education is composed of regular system of higher education and higher educational system of part-time study while working. Factory college, farm college, fishermen's college, factory higher specialized school, educational system by correspondence and others belong to the system of part-time study while working.

Source: RI Yong Bok *et al.*, 2011

Universal 12-year compulsory education is made up of 1-year of preschool education, 5-year of primary school education, 3-year of junior middle school education and 3-year of higher middle school education. Being brilliantly realized foremost importance to education of the Government of DPR Korea, the UN MDGs in the field of education has already exceeded international standards before long. Civilization rate of population over 5 years has reached almost 100% in 2008, and the population qualified as engineer, associate engineer and expert after graduation of universities and specialized schools has accounted for 12.4% of the total population all over the country in the same year (CBS, 2011). Meanwhile, the number of pupils allotted per teacher in education of primary school and middle school was 22 and 20, respectively.

Science and technology

The Government of DPR Korea has consistently held to a foremost importance to science and technology, considering development of science and technology with a key problem decisive of vicissitudes of the country and the nation.

The Government of DPR Korea has revised and supplemented the law on science and technology adopted in 1988 on several occasions in accordance with the requirements for building of powerful state up to now (Table 2-9).

The Law on Science and Technology has presented principle on foremost importance to science and technology, principle on modernization of economy by new technology, principle on development and use of natural resources, principle combining research and development of new technology with introduction of foreign advanced technology, principle combining science and technology with economy and others.

The SAOS established on December 1, 1953 when was at the height of the fierce fatherland liberation war, has been strengthened and developed with a leading scientific research institution during the past 60 years.

In recent years, scientists and technicians of the country has largely contributed to making the national economy more Juche-oriented, modern and scientific through establishing the system for production of Juche-oriented steel, Juche-oriented fertilizer and Juche-oriented fiber, making magnesia clinker industry more Juche-oriented and solving scientific and technical problems for establishment of integrated automation system in main factories and enterprises satisfactorily.

Scientists and technicians of the country have contributed to the improvement of people's living by developing seed breeding technology and advanced method of cultivation of new variety, various organic compound fertilizers and bio-agrochemicals, and achieving research results of value in improving quality of mass consumption goods and solving problem of drinking water and fuel. And then, they have made rapid progress, concentrating on development of advanced technology such

as programme technology, nanotechnology and space technology.

2.5.2 Human health

DPR Korea enforces universal free medical care.

The Government of DPR Korea has enforced universal free medical care on and after January 1, 1953, the midst of the Fatherland Liberation War, for the whole people, and perfect and universal free medical care from the year 1960. After that, the Government of DPR Korea has adopted the public health law in 1980, and revised and completed it to develop the public health service further on several occasions (Table 2-9).

Every person in the country has the right able to get medical care in time free of charge if falls ill.

Well-organized public health system from the centre (the ministry of public health) to province, city (district), county, ri (town, ku, dong) has been established and operated in the country (Table 2-8).

Every provincial people's hospital and city or county level people's hospital in the country has been linked with KIM Man Yu hospital via long distance medical service system as of the end of September, 2012.

During the period 1998-2008, under-one mortality rate has decreased from 23.5‰ to 19.3‰ and under-five mortality rate from 49.7‰ to 26.7‰ in the work to attain the MDGs in the field of public health (CBS, 2011).

In future, under-one mortality rate should be decreased to 12‰ and under-five mortality rate to 16.5‰ up to 2015.

Table 2-8 Number of medical and preventive institutions by administrative unit in 2007

Classification	Hospital			Clinic	Preventive centre	Sanatorium
	Central, Provincial	County	Ri			
Number (units)	133	601	974	6,263	55	682

Source: CBS, 2011

2.6 Framework for Implementation of the UNFCCC

2.6.1 Legal framework

Environment protection work in DPR Korea where popular masses are the master of everything and everything serves for the popular masses is the noble and patriotic work for the country and the nation, and the important work to provide the popular masses with independent and creative life environment.

DPR Korea has enacted laws and regulations related to climate change in accordance with requirements of the developing situation in recent years, revised and supplemented them on several occasions (Table 2-9).

And, with the importance of the work protecting global environment, DPR Korea has acceded to several multilateral environmental conventions and actively cooperated with international activities under the close contact with international organizations (Table 2-10).

2.6.2 Institutional framework

The activities related to climate change in DPR Korea are guided by the corresponding institutions with well-organized structural arrangement, duty and function prescribed clearly.

The UNFCCC focal point in DPR Korea is the National Coordinating Committee for Environment (NCCE).

The NCCE, a non-permanent organization, founded in 1994, coordinates all activities in the country related to climate change.

For successful implementation of the SNC project, the NCCE has reorganized the PSC, PMG, technical expert groups and organized the National Climate Change Office (NCCO) (Figure 2-11).

Table 2-9 DPR Korea laws related to climate change

№	Law	Date enacted	Remarks
1	Law on Agriculture, DPR Korea	18 Dec. 1998	Decree № 290
2	Law on Aliens Enterprise, DPR Korea	5 Oct. 1992	Decision № 19
3	Law on Aliens Investment, DPR Korea	5 Oct .1992	Decision № 17
4	Law on Atomic Energy, DPR Korea	12 Feb. 1992	Decision № 15
5	Law on Automotive Traffic, DPR Korea	12 Feb. 1997	Decision № 83
6	Law on Barrage, DPR Korea	21 Mar. 2001	Decree № 2140
7	Law on Border Quarantine of Animals and Plants, DPR Korea	16 July 1997	Decision № 89
8	Law on City Management, DPR Korea	29 Jan. 1992	Decision № 14
9	Law on Coal, DPR Korea	7 Jan. 2009	Decree № 3044
10	Law on Control of Thermal and Pressure Equipment, DPR Korea	24 Jan. 2007	Decree № 2125
11	Law on Cruid Oil, DPR Korea	10 Jan. 2007	Decree № 2112
12	Law on Education, DPR Korea	14 July 1999	Decree № 847
13	Law on Electric Power, DPR Korea	20 Dec. 1995	Decision № 65
14	Law on Energy Management, DPR Korea	4 Feb. 1998	Decision № 108
15	Law on Environment Impact Assessment, DPR Korea	9 Nov. 2005	Decree № 1367
16	Law on Environmental Protection, DPR Korea	9 Apr. 1986	Law № 5
17	Law on Export and Import of Technology, DPR Korea	10 June 1998	Decision № 119
18	Law on Fish Farming, DPR Korea	18 Dec. 1998	Decree № 288
19	Law on Fishery, DPR Korea	18 Jan. 1995	Decision № 49
20	Law on Foreign Trade, DPR Korea	10 Dec. 1997	Decision № 104
21	Law on Forest, DPR Korea	11 Dec. 1992	Law № 9
22	Law on Fruit Culture, DPR Korea	4 Dec. 2002	Decree № 3453
23	Law on Fuel for Resident, DPR Korea	18 Dec. 1998	Decree № 287
24	Law on Joint Venture, DPR Korea	8 Sep. 1984	Decision № 10
25	Law on Land Planning, DPR Korea	27 Mar. 2002	Law № 12
26	Law on Land, DPR Korea	29 April 1977	Law № 9
27	Law on Landscape, DPR Korea	25 Nov. 2010	Decision № 1214
28	Law on Livestock Farming, DPR Korea	12 Jan. 2006	Decree № 1523
29	Law on Management of Pyongyang City, Capital of DPR Korea	26 Nov. 1998	Decree № 286
30	Law on Management of Veterinary Medicine, DPR Korea	24 June 1998	Decision № 121
31	Law on Medicines Management, DPR Korea	12 Nov. 1997	Decision № 101
32	Law on Medium and Small Power Stations, DPR Korea	11 April 2007	Decree № 2206
33	Law on Meteorology, DPR Korea	9 Nov. 2005	Decree № 1368
34	Law on Nature Reserve, DPR Korea	25 Nov. 2009	Decree № 445
35	Law on Organic Industry, DPR Korea	23 Nov. 2005	Decree № 1396
36	Law on Pollution Prevention in Taedong River, DPR Korea	10 Feb. 2005	Decree № 946
37	Law on Prevention of Infectious Diseases, DPR Korea	5 Nov. 1997	Decision № 100

№	Law	Date enacted	Remarks
38	Law on Prevention of Sea Pollution, DPR Korea	22 Oct. 1997	Decision № 99
39	Law on Protection and Control of Land and Environment, DPR Korea	27 May 1998	Decision № 116
40	Law on Protection of Scenic Beauty Spot and Living Monument, DPR Korea	13 Dec. 1995	Decision № 64
41	Law on Protection of Useful Animals, DPR Korea	26 Nov. 1998	Decree № 283
42	Law on Public Health, DPR Korea	3 Apr. 1980	Law № 5
43	Law on Rivers and Streams, DPR Korea	27 Nov. 2002	Decree № 3436
44	Law on Road Traffic, DPR Korea	6 Oct. 2004	Decision № 709
45	Law on Sanitation, DPR Korea	15 July 1998	Decree № 123
46	Law on Science and Technology, DPR Korea	15 Dec. 1988	Decision № 14
47	Law on Sewer, DPR Korea	10 Dec. 2009	Decree № 486
48	Law on Tideland, DPR Korea	20 July 2005	Decree № 1199
49	Law on Underground Resources, DPR Korea	8 April 1993	Law № 14
50	Law on Veterinary and Anti-epizootic, DPR Korea	17 Dec. 1997	Decision № 105
51	Law on Wastes Disposal, DPR Korea	26 April 2007	Decree № 2215
52	Law on Water Resources, DPR Korea	18 June 1997	Decision № 86
53	Law on Waterway, DPR Korea	10 Mar. 2004	Decree № 314

Source: DPR Korea, 2012

Table 2-10 Environmental conventions/protocols signed by DPR Korea

Conventions/Protocols	Date
United Nations Convention on Biodiversity	26 Oct. 1994
United Nations Framework Convention on Climate Change	05 Dec. 1994
Vienna Convention on the Protection of Ozone Layer	05 May 1995
Montreal Protocol on Substances that Deplete the Ozone Layer	06 May 1995
Stockholm Convention on Persistent Organic Pollutants	19 Aug. 2002
Cartagena Protocol on Biosafety	29 July 2003
United Nations Convention on Combating Desertification	28 Mar. 2004
Kyoto Protocol to the United Nations Framework Convention on Climate Change	27 Apr. 2005
Basel Convention on Trans-boundary Movements of Hazardous Wastes and their Disposal	10 July 2008

The technical expert group was made up of the following 6 subgroups, and each subgroup enrolling several part-time experts in relevant sectors including the Government institutions such as the SCST, SAOS, CBS, MLEP, SHMA, AAS, KGFST and others, scientific research institutions and non-Government organizations:

(i) Subgroup for GHG inventory

(ii) Subgroup for Assessment of Vulnerability and Adaptation

(iii) Subgroup for Mitigation Analysis

(iv) Subgroup for Research and Systematic Observation

(v) Subgroup for Education, Training and Public Awareness

(vi) Subgroup for Environmentally Sound Technology

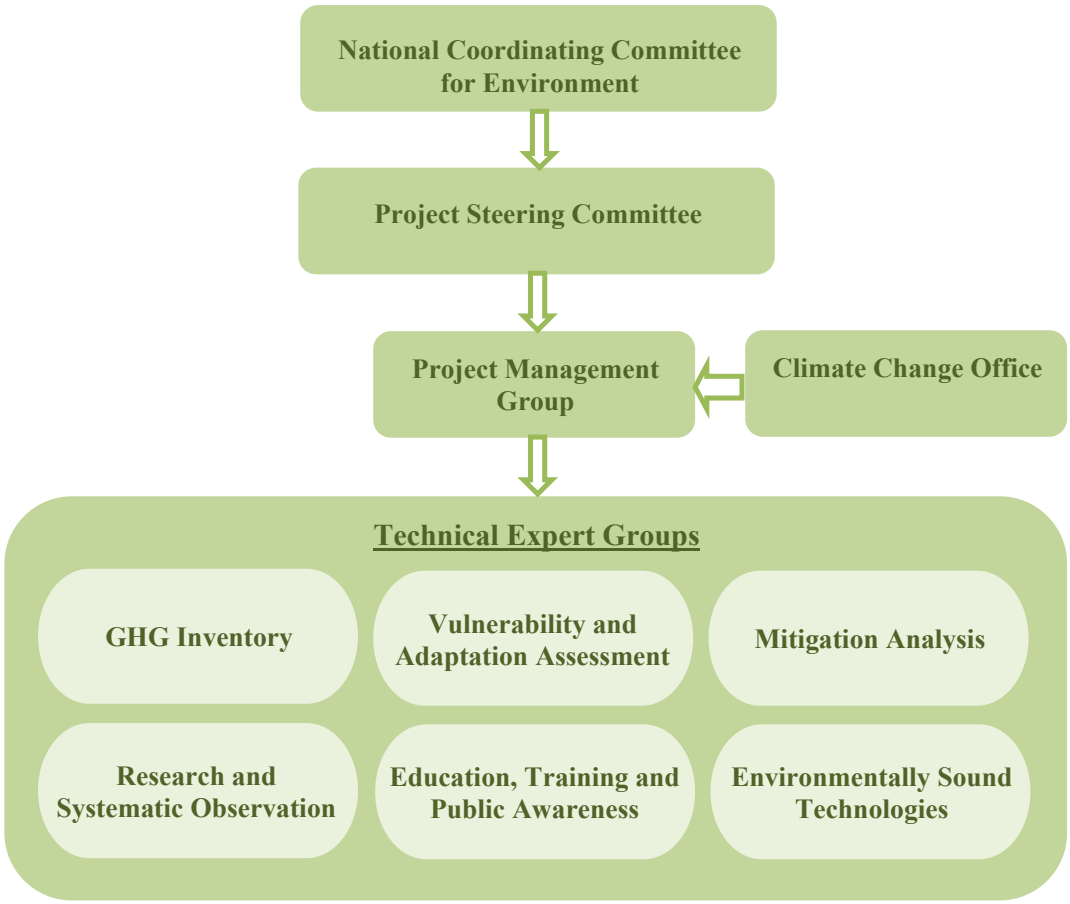


Figure 2-11 Institutional framework for the preparation of the SNC

CHAPTER 3 NATIONAL GREENHOUSE GAS INVENTORY

Chapter 3 National Greenhouse Gas Inventory

In this chapter, the national GHG inventory for the year 2000 prepared in accordance with Decision 17/CP.8, GHG emission trends for the period 1990-2002 and improvement of GHG inventory, etc., are presented.

3.1 Introduction

National GHG inventory is a key element of the national communication. According to Article 4, paragraph 1(a) of the UNFCCC, all Parties should develop, periodically update and publish national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol.

The GHG inventory for the year 1990, the first national GHG inventory in DPR Korea, has been developed under the UNDP/GEF project "Enabling DPR Korea to prepare its First National Communication in Response to its Commitments to UNFCCC" (1997 to 2001). At this time, the revised 1996 IPCC Guidelines (IPCC, 1997) were used in order to develop the GHG inventory for the base year 1990.

The current GHG inventory prepared within the framework of the UNEP/GEF project "Enabling Activity for the Preparation of the Second National Communication of Democratic People's Republic of Korea to the UNFCCC" (2006 to 2012) is the second national GHG inventory in DPR Korea.

DPR Korea has prepared not only the national GHG inventory for the year 2000 in line with decision 17/CP.8, but recalculated the national GHG inventory for the year 1990 and assessed the GHG emission trends through the whole time series for the period 1990 to 2002 according to the improvement of methodology and data.

Tthe GHG inventory group was prepared and compiled the national GHG inventory under the SNC project (Figure 3-1).

The part-time experts from several related agencies such as the ITE of SAOS, Statistical Data Office of CBS, Institute of Forest Management of MLEP and Agricultural Information Centre of AAS, etc., have actively cooperated to the preparation of the national GHG inventory.

Emissions of CO_2, CH_4, N_2O and PFC_S, in the national GHG inventory have been estimated based on Tier 1 method described in the 2006 IPCC Guidelines (IPCC, 2006).

Regarding the other gases, emissions of NO_x, CO, NMVOC and SO_2 have been estimated based on the methodologies described in the revised 1996 IPCC Guidelines. But emissions of the other gases have not been included in the total national emissions and only reported according to the recommendation described in the IPCC Guidelines.

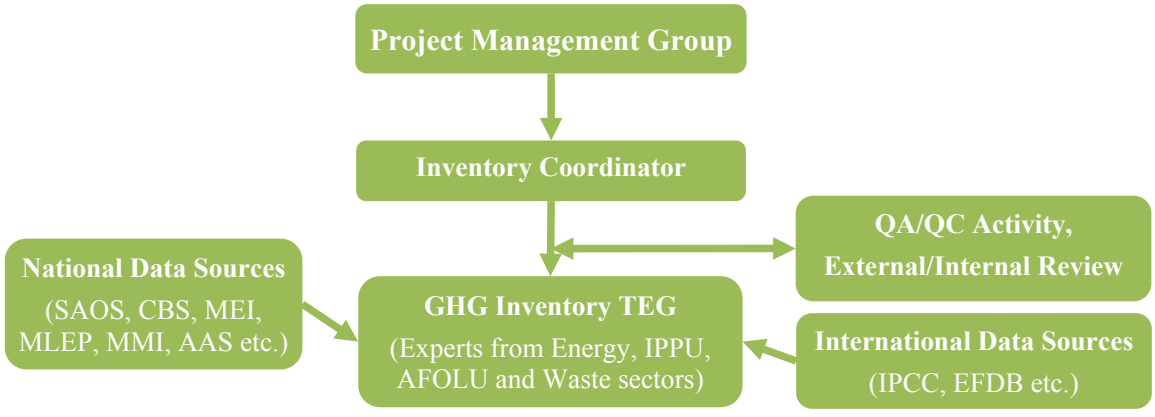


Figure 3-1 Institutional arrangement for the national GHG inventory

The fundamental source of the activity data used to estimate GHG emissions from the sectors of energy, IPPU, AFOLU and waste is the statistical data from the CBS.

And, statistical and survey data of ministries and central agencies such as the SAOS, MLEP, MMI and AAS, etc., and research data of universities and institutes also have been used.

Insufficient or inexistent data have been interpolated or decided by means of experts' judgment.

Most of used emission factors are the default value from the IPCC. In addition, some country-specific emission factors such as CH_4 emission factor from paddy fields and CO_2 emission factor from forest soil also have been developed and used.

"IPCC 2006 Software for national GHG inventory" (hereafter referred to as "IPCC 2006 Software) developed by the SPIRIT, Inc. (http://www.spirit.sk/) for inventory compilers using the methodologies described in the 2006 IPCC Guidelines has been used for preparation of inventory database.

Global Warming Potential (GWP) used for converting GHG emissions into CO_2e were from "IPCC 1995 GWP values" (i.e., 1 for CO_2, 21 for CH_4 and 310 for N_2O, etc) in accordance with recommendations specified in the UNFCCC Guidelines (UNFCCC, 2003).

This national GHG inventory is perfect in geographical coverage, but of some gaps in perfection aspect.

Great efforts was made to reflect all GHGs to the national GHG inventory, as well as all sources and sinks specified in the IPCC Guidelines, but some categories have not been included and emissions of HFCs and SF_6 have not been estimated due to the lack of data.

And, although a great deal of efforts have been made to improve the quality of the GHG inventory including transparency, consistency, comparability and accuracy of the national GHG inventory, etc., there still exist serial problems requiring further improvement because of lack of capacity and existence of some errors in the IPCC 2006 Software, etc., and the national GHG inventory, in accordance with the plan for the inventory improvement, will be continuously updated on continuous basis in sustainable manner in future.

3.2 GHG Inventory for the Year 2000

3.2.1 Summary of the inventory

In 2000, the total national GHG emissions [2] have amounted to 65,714 $GgCO_2e$, representing 65% decrease compared with that in 1990 (Table 3-1). This is why the national economy declined by continued severe natural disasters, external economic pressure and blockade, and collapse of the socialist market in the early 1990's has not been recovered until 2000.

Meanwhile, CO_2 removals by sinks have reached 19,087Gg in 2000 (Table 3-15), representing 16.0% increase over that in 1990 (hereinafter CO_2 removals have already been included in the calculation of the total national GHG emissions, and thus described only on the purpose of reporting).

Per capita GHG emissions and GHG emissions per GPD in 2000 were $2.9tCO_2e$/person and $6.2tCO_2e$/ US$ 1,000 respectively, also representing decrease by 69.0% and 26.8% over that in 1990 (Table 3-1).

Considering by sector, energy sector was the largest emission source with $73,417GgCO_2e$, accounting for 92.5% of the total national GHG emissions with consideration of CO_2 removals, followed by waste and IPPU sector with 6.1% at $4,840GgCO_2e$ and 1.4% at $1,143GgCO_2e$ in 2000 (Table 3-2, Figure 3-2).

Emissions from energy and IPPU sector in 2000 were decreased by 58.9% and 79.7% respectively, and that from waste

[2] National total calculated by summing up emissions and removals for each gas expressed in CO_2e

sector increased by 9.3% compared to the level in 1990 (Figure 3-3).

Considering by gas, net emissions of CO_2, CH_4, N_2O and PFCs in 2000 have amounted to 52,108Gg, 12,227GgCO_2e, 1,376GgCO_2e and 3Gg CO_2e respectively (Table 3-3).

Table 3-1 DPR Korea's GHG Emissions Indices in 1990 and 2000

Indices	1990	2000	2000 level as compared to 1990 (%)
Total national GHG emissions[1] (GgCO_2e)	193,489	65,714	34.0
GHG emissions per capita (tCO_2e per person)	9.2	2.9	31.0
GHG emissions per GDP (tCO_2e per 1,000US$)	8.5	6.2	73.2

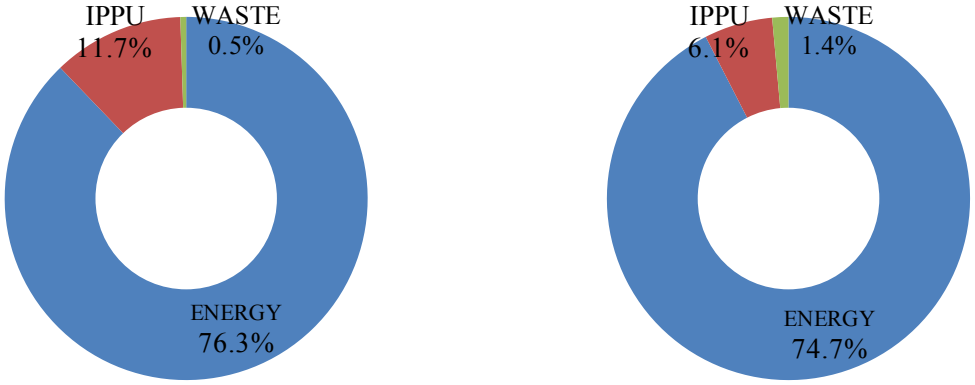
[1] National total calculated by summing up emissions and removals for each gas expressed in CO_2e

Source: CHOE Song Chol, 2011

Table 3-2 Emissions by sector in 1990 and 2000 (Gg)

Sector	Year	CO_2	CH_4	N_2O	PFCs (CO_2e)	CO_2e
1 ENERGY	1990	156,964	987	3	-	178,730
	2000	64,226	410	2	-	73,417
2 IPPU	1990	21,717	0	7	0	23,792
	2000	4,477	0	1	3	4,840
3 AFOLU	1990	-13,726	155	1	-	-10,078
	2000	-16,633	130	1	-	-13,686
4 WASTE	1990	33	38	1	-	1,045
	2000	38	42	1	-	1,143
Total	1990	164,989	1 181	12	0	193,489
	2000	52,108	582	4	3	65,714

Source: CHOE Song Chol, 2011



a) 1990 b) 2000

Figure 3-2 Share of emissions by sector in total GHG emissions in 1990 and 2000

With regard to the proportion of each GHG in the total GHG emission, net CO_2 emissions have accounted for 79.3%, the largest proportion, followed by CH_4 and N_2O at 18.6% and 2.1%, respectively (Figure 3-4)

And, net CO_2, CH_4 and N_2O emissions in 2000 have decreased by 68.4%, 50.7% and 62.8% compared to those in 1990, respectively (Figure 3-5).

The reason for relative significant

decrease in net CO_2 emissions is that coal production and corresponding industrial production have not been recovered to the level of the early 1990's since then.

The DPR Korea's GHG inventory for the year 2000 prepared by using the IPCC 2006 Software in line with the reporting guidelines of the 2006 IPCC Guidelines, in brief, are shown in Table 3-4.

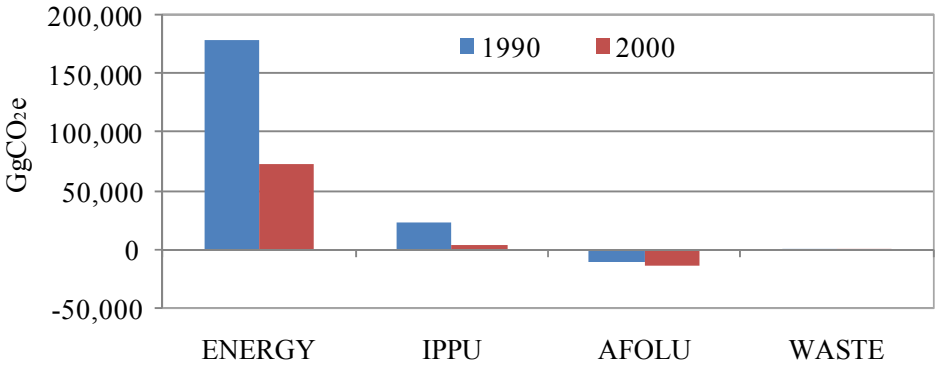


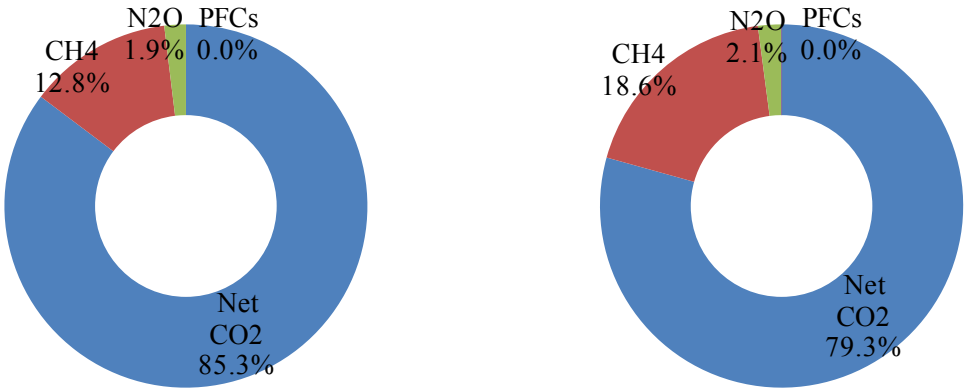
Figure 3-3 Emissions by sector in 1990 and 2000

Table 3-3 Emissions by gas in 1990 and 2000

Gas	Year	Emissions (Gg)	Emissions ($GgCO_2e$)	Share (%)
Net CO_2[(1)]	1990	164,989	164,989	85.3
	2000	52,108	52,108	79.3
CH_4	1990	1,181	24,805	12.8
	2000	582	12,227	18.6
N_2O	1990	12	3,695	1.9
	2000	4	1,376	2.1
PFCs	1990	-	0	0.0
	2000	-	3	0.0
Total	1990	-	193,489	100
	2000	-	65,714	100

[(1)] CO_2 net emissions (emissions minus removals)

Source: CHOE Song Chol, 2011



a) 1990 b) 2000

Figure 3-4 Share of emissions by gas in total GHG emissions in 1990 and 2000

Table 3-4 Summary of the DPR Korea's GHG inventory in 2000 (Gg)

Categories	Net CO_2[(1)]	CH_4	N_2O	PFC (CO_2e)	NO_x	CO	NMVOC	SO_2	Total (CO_2e)
Total National Emissions and Removals	52,108	582	4	3	2,448	161	1,297	2,448	65,714
1 ENERGY	64,226	410	2	0	1,332	161	1,297	1,332	73,417
1A Fuel Combustion Activities	64,226	99	2	0	1,332	161	1,297	1,332	66,892
1B Fugitive Emissions from Fuels	0	311	0	-	0	0	0	0	6,525
1C CO_2 Transport and Storage	0	-	-	-	0	0	0	0	0
2 IPPU	4,477	0	1	3	1	1	1	1	4,840
2A Mineral Industry	1,658	0	0	0	0	0	1	0	1,658
2B Chemical Industry	853	0	1	3	1	1	0	1	1,215
2C Metal Industry	1,965	0	0	0	0	0	0	0	1,967
2D Non-Energy Products from Fuels and Solvent Use	0	0	0	-	0	0	0	0	0
2E Electronics Industry	0	0	0	0	0	0	0	0	0
2F Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0	0	0	0
2G Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0
3 AFOLU	-16,633	130	1	-	1,115	0	0	1,115	-13,686
3A Livestock	-	52	0	-	0	0	0	0	1,202
3B Land	-16,781	0	0	-	0	0	0	0	-16,781
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	151	78	0	-	1,115	0	0	1,115	1,896
3D Other	-3	0	0	-	0	0	0	0	-3
4 WASTE	38	42	1	-	0	0	0	0	1,143
4A Solid Waste Disposal	-	7	0	-	0	0	0	0	144
4B Biological Treatment of Solid Waste	-	0	0	-	0	0	0	0	3
4C Incineration and Open Burning of Waste	38	1	0	-	0	0	0	0	69
4D Wastewater Treatment and Discharge	-	34	1	-	0	0	0	0	927

(1) CO_2 net emissions (emissions minus removals)

Source: CHOE Song Chol, 2011

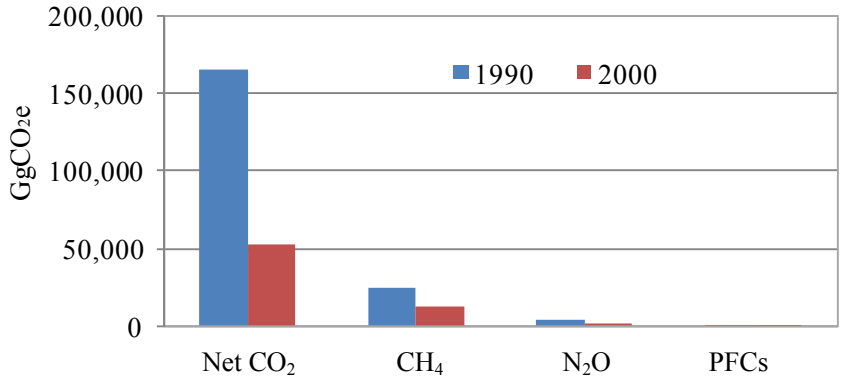


Figure 3-5 Emissions by gas in 1990 and 2000

The national GHG inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol for the year 1990, 1994, 2000 and 2002 which prepared in line with the UNFCCC Guidelines (UNFCCC, 2003) were presented in Annex 2.

3.2.2 Analysis of emissions by sector

Here analyzes only GHG emission such as CO_2, CH_4, N_2O and PFCs by sector.

ENERGY

Main emission sources in energy sector in DPR Korea are fuel combustion activities and fugitive emission from fuels, and in details, the following categories and subcategories:

- 1A Fuel Combustion Activities
  - 1A1 Energy Industries
    - 1A1a Main Activity Electricity and Heat Production
    - 1A1b Petroleum Refining
  - 1A2 Manufacturing Industries and Construction
    - 1A2a Iron and Steel
    - 1A2b Non-Ferrous Metals
    - 1A2c Chemicals
    - 1A2h Machinery
    - 1A2j Mining and Quarrying
    - 1A2k Construction
  - 1A3 Transport
  - 1A4 Other Sectors
    - 1A4a Commercial/Institutional
    - 1A4b Residential
    - 1A4c Agriculture/Forestry/Fishing /Fish Farms
- 1B Fugitive Emissions from Fuels
  - 1B1 Solid Fuel

In 2000, energy sector emitted GHGs equivalent to 92.5% of the total national GHG emissions without consideration of CO_2 removals (Table 3-6).

Of GHG emissions from energy sector, CO_2 emissions were the largest emission source with 87.5%, followed by CH_4 with 11.7% and the other N_2O emissions (Table 3-5)

Fuel combustion activities

In 2000, GHG emissions from fuel combustion activities which accounted for 91.1% of the emissions from energy sector, most of the emissions from energy sector, have reached 66,892$GgCO_2e$ (Table 3-6).

With regard to contribution of the three subcategories to emissions from energy sector, 1A1 Energy Industries with 35.8% was the largest emission source, followed by 1A2 Manufacturing Industries and Construction with 25.5%, 1A4 Other Sectors with 22.5%, 1A5 Non-Specified with 5.3% and 1A3 Transport with 2.0% (Figure 3-6).

Considering proportion of emissions by fuel in fuel combustion activities, solid fuels with 91.2% were the largest and liquid fuels have accounted for 8.8% (Table 3-7).

This was because domestic coals have

been used as fuel in subcategories of fuel combustion activities such as electricity generation and residential.

Fugitive emissions from fuels

In 2000, fugitive emissions related to extraction and transportation of coal, that is, CH_4 emissions were 6,525GgCO_2e, which was equivalent to 8.9% of the total emissions from energy sector (Table 3-6).

Comparison between the reference approach and sectoral approach

The reference approach is a top-down approach, using a country's energy supply data to calculate the emissions of CO_2 from combustion of mainly fossil fuels.

In 2000, CO_2 emissions from fuel combustion which have been estimated by using the reference approach and sectoral approach were 64,146GgCO_2 and 64,226GgCO_2, respectively, and thus, the difference was only about 0.1%.

Table 3-5 Emissions by gas in energy sector in 2000

Gas	Categories	Emissions (Gg)	Emissions (GgCO_2e)	Percentage (%)
CO_2	1A Fuel Combustion Activities	64,226	64,226	87.5
CH_4	1A Fuel Combustion Activities	99	2,084	2.8
	1B Fugitive Emissions from Fuels	311	6,525	8.9
N_2O	1A Fuel Combustion Activities	2	582	0.8
Total	-	-	73,417	100

Source: CHOE Song Chol, 2011

Table 3-6 Emissions by category and sub-category in energy sector in 2000 (Gg)

Categories	CO_2	CH_4	N_2O	CO_2e	Share in emissions from energy sector (%)
1 ENERGY	64,226	410	2	73,417	100
1A Fuel Combustion Activities	64,226	99	2	66,892	91.1
1A1 Energy Industries	26,127	0	0	26,254	35.8
1A2 Manufacturing Industries and Construction	18,617	2	0	18,737	25.5
1A3 Transport	1,414	0	0	1,438	2.0
1A4 Other Sectors	14,224	96	1	16,550	22.5
1A5 Non-Specified	3,844	1	0	3,913	5.3
1B Fugitive Emissions from Fuels	0	311	0	6,525	8.9
1B1 Solid Fuel	0	311	0	6,525	8.9

Source: CHOE Song Chol, 2011

Table 3-7 Emissions by fuel type in fuel combustion activities in 2000 (Gg)

Fuel Type	CO_2	CH_4	N_2O	CO_2e	Share in emissions from fuel combustion (%)
Solid Fuel	58,420	41	1	59,560	91.2
Liquid Fuel	5,686	1	0	5,771	8.8
Total	64,106	42	1	65,331	100

Source: CHOE Song Chol, 2011

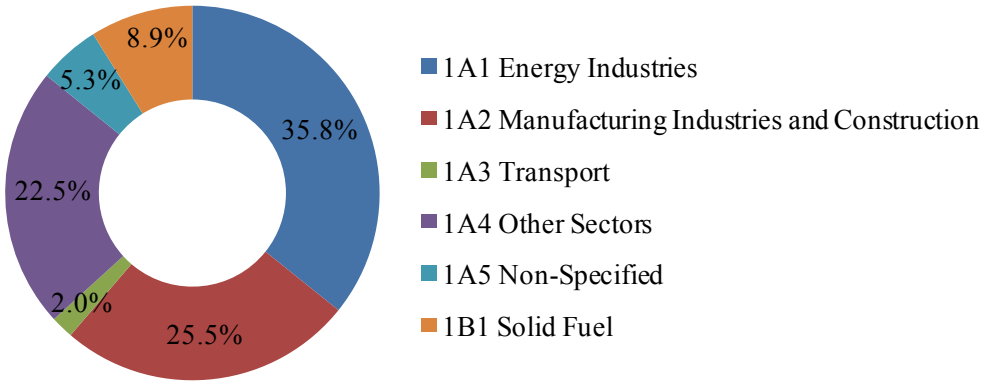


Figure 3-6 Share of emissions by sub-category in energy sector in 2000

IPPU

GHGs are emitted from a wide variety of industrial activities. The main emission sources are releases from industrial processes that chemically or physically transform materials.

Main emission sources in IPPU in the country are divided into the following categories and subcategories:

- 2A Mineral Industry
  - 2A1 Cement Production
  - 2A2 Lime Production
  - 2A3 Glass Production
  - 2A4 Other Process Uses of Carbonates
- 2B Chemical Industry
  - 2B1 Ammonia Production
  - 2B2 Nitric Acid Production
  - 2B5 Carbide Production
  - 2B8 Petrochemical and Carbon Black Production
  - 2B9 Fluorochemical Production
- 2C Metal Industry
  - 2C1 Iron and Steel Production
  - 2C2 Ferroalloys Production
  - 2C3 Aluminium Production
  - 2C5 Lead Production
  - 2C6 Zinc Production

In 2000, IPPU sector has emitted 4,840GgCO_2e accounting for 6.1% of the total national GHG emissions without CO_2 removals (Table 3-9).

Table 3-8 Emissions by gas in IPPU sector in 2000

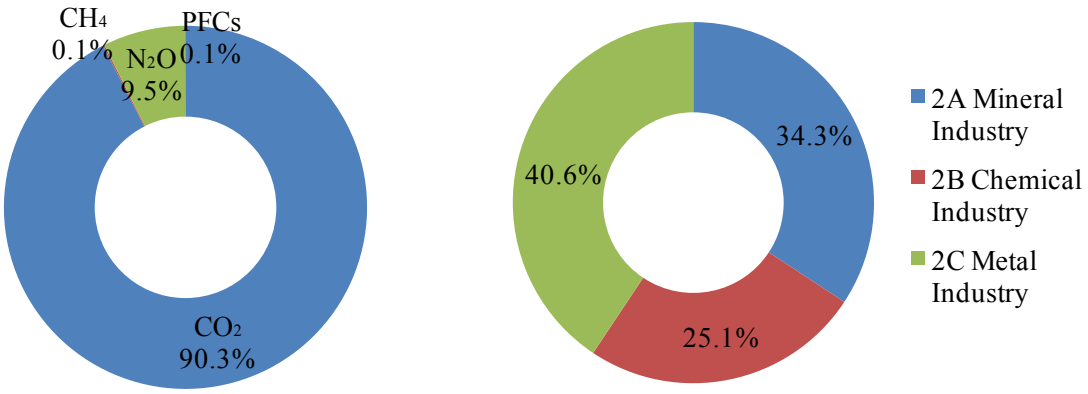
Gas	Emissions (Gg)	Emissions (GgCO_2e)	Percentage (%)
CO_2	4,477	4,477	92.5
CH_4	0	6	0.1
N_2O	1	354	7.3
PFCs	3	3	0.1
Total	-	4,840	100

Source: CHOE Song Chol, 2011

Table 3-9 Emissions by category in IPPU sector in 2000 (Gg)

Categories	CO_2	CH_4	N_2O	PFCs (CO_2e)	CO_2e	Share in emissions from IPPU sector (%)
2 IPPU	4,477	0	1	3	4,840	100
2A Mineral Industry	1,658	0	0	0	1,658	34.3
2B Chemical Industry	853	0	1	3	1,215	25.1
2C Metal Industry	1,965	0	0	0	1,967	40.6

Source: CHOE Song Chol, 2011



a) By gas b) By sector

Figure 3-7 Share of emissions by gas and category in IPPU sector in 2000

By gas, CO_2 emissions accounted for 92.5%, the largest proportion, and the largest CO_2 emission sources were Iron and Steel Production and Cement Production (Table 3-8, Figure 3-7), followed by N_2O with 7.3% and CH_4 and PFCs with above 0.1% and under 0.1% respectively.

Considering by category, 2C Metal Industry has accounted for 40.6%, the largest proportion, followed by 2A Mineral Industry with 34.3% and 2B Chemical Industry with 25.1% (Table 3-9, Figure 3-7).

AFOLU

In AFOLU sector, anthropogenic GHG emissions and removals occurring on managed land where human interventions and practices have been applied to perform production, ecological or social functions should be estimated.

Main emission/removal sources in AFOLU sector in the country are divided into the following categories and subcategories:

- 3A Livestock
  - 3A1 Enteric Fermentation
  - 3A2 Manure Management
- 3B Land
  - 3B1 Forest Land
  - 3B2 Cropland
  - 3B3 Grassland
  - 3B4 Wetlands
  - 3B5 Settlements
- 3C Aggregate Sources and Non-CO_2 Emissions Sources on Land
  - 3C2 Liming
  - 3C3 Urea Application
  - 3C4 Direct N_2O Emissions from Managed Soils
  - 3C5 Indirect N_2O Emissions from Managed Soils
  - 3C6 Indirect N_2O Emissions from Manure Management
  - 3C7 Rice Cultivations
- 3D Other
  - 3D1 Harvested Wood Products

In 2000, GHG removals from the AFOLU sector totally amounted to 13,686GgCO_2e (Figure 3-2, Figure 3-8).

This was because CO_2 removals by sinks (forest land, grassland, wetlands, settlements, harvested wood products) in this sector in 2000 were 19,087Gg (Table 3-10).

Livestock

In 2000, 3A Livestock category has emitted 1,202GgCO_2e of GHG, of which CH_4 emissions by enteric fermentation and manure management were 924GgCO_2e and 278GgCO_2e respectively (Table 3-10).

Land

In 2000, net CO_2 emissions in 3B Land category were -16,781GgCO_2e. In details, land emitted 2,303Gg of CO_2, and forest land removed 19,084Gg of CO_2 (Figure 3-9).

Aggregate sources and non-CO_2 emissions sources on land

In 2000, GHG emissions from "3C Aggregate sources and non-CO_2 emissions sources on land" category were 1,896GgCO_2e (Table 3-10). The emission sources significantly contributed to the emissions from this category were rice cultivation (86.2%) and urea manuring (8.0%) (Figure 3-10).

Figure 3-10 shows the emission proportion by subcategory under the "3C Aggregate sources and non-CO_2 emissions sources on land" category in 2000.

Table 3-10 Emissions/removals by category and sub-category in AFOLU sector in 2000 (Gg)

Categories	Net CO_2	CH_4	N_2O	CO_2e
3 AFOLU	-16,633	130	1	-13,686
3A Livestock	0	52	0	1,202
3A1 Enteric Fermentation	-	44	-	924
3A2 Manure Management	-	8	0	278
3B Land	-16,781	-	-	-16,781
3B1 Forest Land	-19,084	-	-	-19,084
3B2 Cropland	2,303	-	-	2,303
3B3 Grassland	0	-	-	0
3B5 Settlements	0	-	-	0
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	151	78	0	1,896
3C2 Liming	0	-	-	0
3C3 Urea Application	151	-	-	151
3C4 Direct N_2O Emissions from Managed Soils	-	-	0	49
3C5 Indirect N_2O Emissions from Managed Soils	-	-	0	47
3C6 Indirect N_2O Emissions from Manure Management	-	-	0	16
3C7 Rice Cultivations	-	78	-	1,634
3D Other	-3	0	0	-3
3D1 Harvested Wood Products	-3	-	-	-3

Source: CHOE Song Chol, 2011

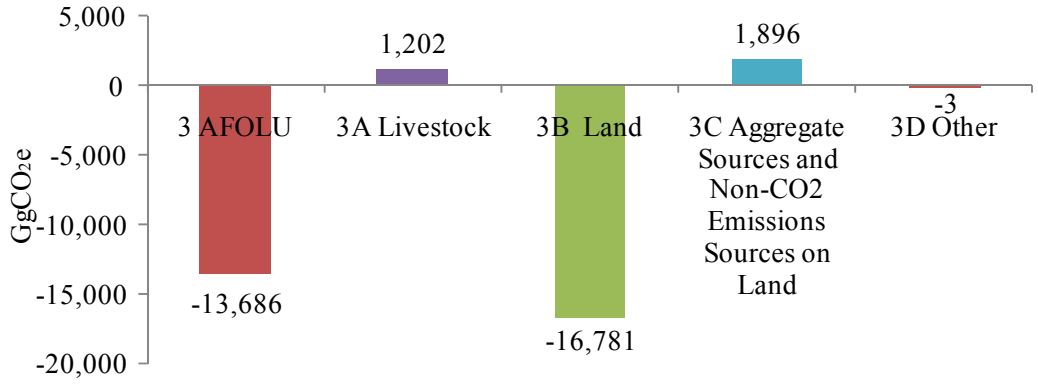


Figure 3-8 Emissions/removals by category in AFOLU sector in 2000

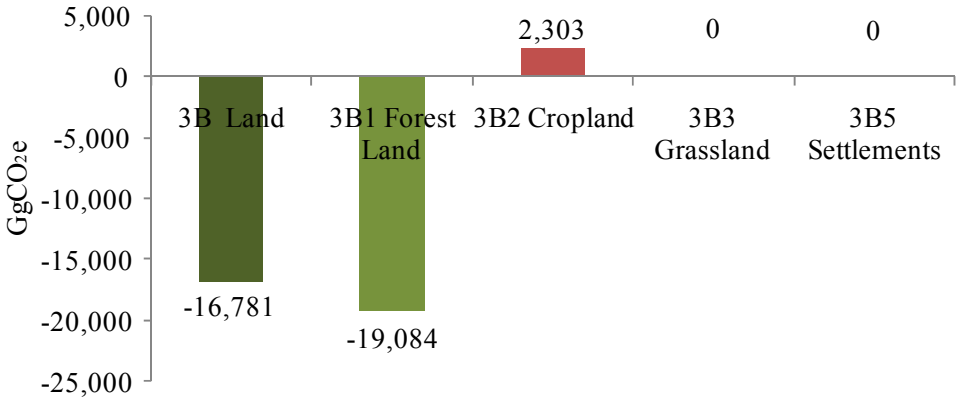


Figure 3-9 Emissions/removals by sub-category in category "3B Land" in 2000

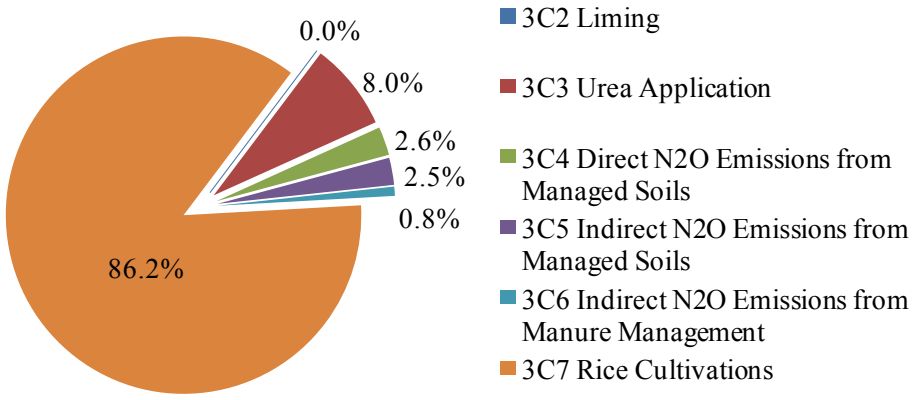


Figure 3-10 Emissions by sub-category in category "3C" in 2000

Other

In 2000, CO_2 removals due to carbon stock associated with harvested wood product, i.e., other sector were 3Gg (Table 3-10).

WASTE

In DPR Korea, main GHG emission sources in waste sector are the following categories:

- 4A Solid Waste Disposal
- 4B Biological Treatment of Solid Waste
- 4C Incineration and Open Burning of Waste
- 4D Wastewater Treatment and Discharge

Waste sector where 1,143GgCO_2e were emitted from in 2000 was the emission source with 1.4% of the total national GHG emissions without CO_2 removals (Table 3-11, Figure 3-13).

Table 3-11 Emissions by category in waste sector in 2000 (Gg)

Categories	CO_2	CH_4	N_2O	CO_2e	Share in emissions from energy sector (%)
4 WASTE	38	42	1	1,143	100
4A Solid Waste Disposal	0	7	0	144	12.6
4B Biological Treatment of Solid Waste	0	0	0	3	0.3
4C Incineration and Open Burning of Waste	38	1	0	69	6.0
4D Wastewater Treatment and Discharge	0	34	1	927	81.2

Source: CHOE Song Chol, 2011

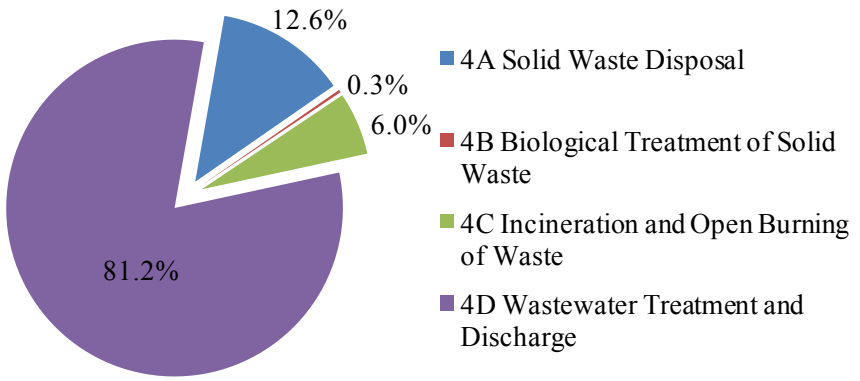


Figure 3-11 Share of emissions by category in waste sector in 2000

The largest emission source in waste sector was the "4A Solid Waste Disposal" which accounted for 74.9% of the GHG emissions from waste sector and emitted only CH_4, followed by the "4D Wastewater Treatment and Discharge" which accounted for 22.0% and emitted both CH_4 and N_2O (Figure 3-11).

3.2.3 Analysis of emissions by gas

UNFCCC Guidelines (UNFCCC, 2003) recommended that emissions of the other gases such as NO_x, CO, NMVOC which are precursors of troposphere ozone and SO_2, an aerosol precursor, should be estimated and reported.

In 2000, DPR Korea has emitted CO_2, CH_4, N_2O and PFCs, GHGs, and NO_x, CO, NMVOC and SO_2, precursors.

CO_2

CO_2 is the most important GHG emitted in DPR Korea in 2000 and total net CO_2 emissions were 52,108Gg, which amounted to 79.3% of the total national GHG emissions (Table 3-3).

Considering sectoral CO_2 emissions, energy sector was the largest emission source with 64,226Gg, followed by IPPU sector with 4,477Gg and the smallest was the waste sector with 38Gg (Figure 3-12). And, CO_2 removals from AFOLU sector were 16,633Gg.

In 2000, main CO_2 emission sources in DPR Korea were fuel combustion activities in energy sector (64,226Gg), metal industry in IPPU (1,965Gg), mineral industry (1,658Gg) and chemical industry (853Gg).

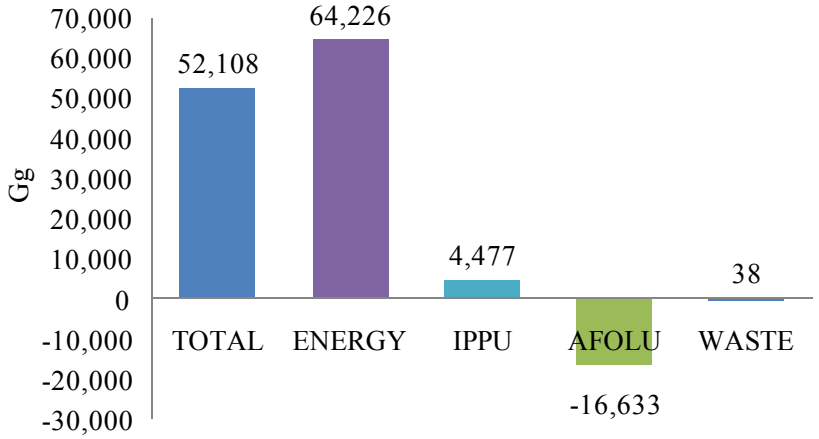


Figure 3-12 CO_2 emissions/removals by sector in 2000

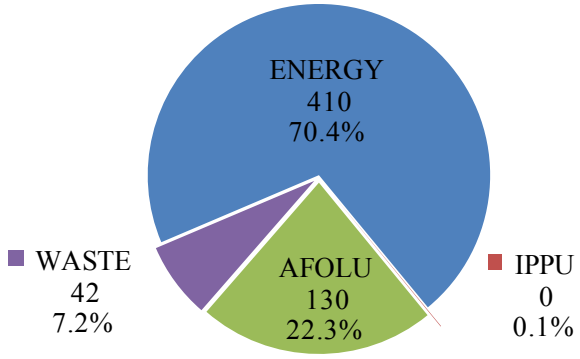


Figure 3-13 CH_4 emissions by sector in 2000 (Gg)

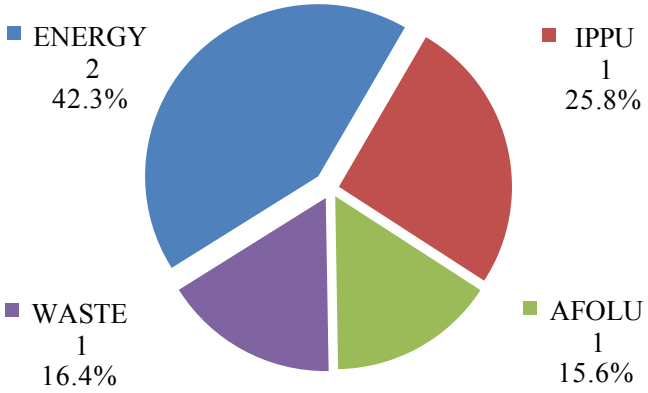


Figure 3-14 N_2O emissions by sector in 2000 (Gg)

CH_4

CH_4 with 18.6% of the total national GHG emissions in CO_2 equivalent emissions in DPR Korea in 2000 is the main GHG, and total CH_4 emissions amounted to 582Gg (12,227GgCO_2e) (Table 3-3).

In 2000, main CH_4 emission sources in DPR Korea were the fugitive emission from fuels (311Gg) under energy category, fuel combustion activities (99Gg), aggregate sources and non-CO_2 emissions sources on land (78Gg) under AFOLU sector, 3A Livestock (52Gg) and wastewater treatment and discharge (34Gg) under waste sector.

With regard to sectoral CH_4 emissions of the total national CH_4 emissions, energy sector accounted for 70.4%, AFOLU sector 22.3%, waste sector 7.2% and IPPU the other (Figure 3-13).

N_2O

In 2000, DPR Korea has emitted 4Gg of N_2O (1,376GgCO_2e), which accounted for 2.1% of the total national GHG emissions in CO_2e (Table 3-3).

The sector from which 42.3% of the total national N_2O emissions, the most part, was emitted was energy sector (Figure 3-14).

In details, fuel combustion activities (2Gg) in this sector was the most important N_2O emission source.

PFCs

IPPU sector in DPR Korea has emitted only 3GgCO_2e of PFCs in 2000.

Other gas

In 2000, 2,488Gg of NO_x, 161Gg of CO, 1,297Gg of NMVOC and 2,448Gg of SO_2 have been emitted in DPR Korea (Figure 3-15).

Main emission source of NO_x, CO and NMVOC was fuel combustion activities (Table 3-12).

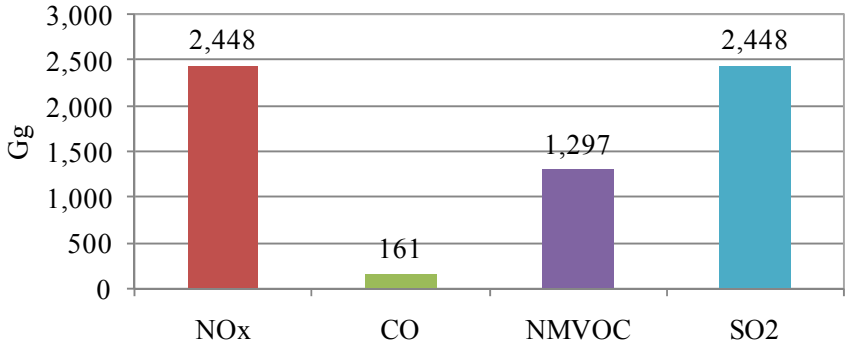


Figure 3-15 Other gases emissions in 2000

Table 3-12 Other gases emissions by sub-category in 2000 (Gg)

Categories	NO_x	CO	NMVOC	SO_2
1A Fuel Combustion Activities	136	1,332	161	1,297
2B Chemical Industry	2	1	1	0
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	31	1,115	0	0
Total	169	2,448	162	1,297

Source: CHOE Song Chol, 2011

3.2.4 Key category analysis

Identification of key categories in national inventory makes it possible to give priority to available limited sources for preparing inventory.

Key categories mean the categories to be preferential in national inventory system for their estimation has significant effect on total national GHG inventory, trends of emissions and removals or uncertainties in absolute level.

Key categories in national GHG inventory were analyzed through using method 1 for IPCC key category identification (IPCC, 2006) and tools for key category analysis of IPCC 2006 Software.

The key categories identified by level assessment and trend assessment (95% of accumulation contribution) according to the method 1 of IPCC are 17 sources of emissions and removals as follows (Table 3-13).

- 1A1 Energy Industries - Solid Fuels
- 3B1a Forest land Remaining Forest land
- 1A2 Manufacturing Industries and Construction - Solid Fuels
- 1A4 Other Sectors - Solid Fuels
- 1B1 Solid Fuels
- 1A5 Non-Specified - Solid Fuels
- 3B2b Land Converted to Cropland
- 2C1 Iron and Steel Production
- 3C7 Rice cultivations
- 1A5 Non-Specified - Liquid Fuels
- 1A1 Energy Industries - Liquid Fuels
- 1A4 Other Sectors - Biomass
- 1A2 Manufacturing Industries and Construction - Liquid Fuels
- 2A1 Cement production
- 1A3b Road Transportation
- 3A1 Enteric Fermentation
- 4D Wastewater Treatment and Discharge

As shown in Table 3-13, of 17 key categories identified, 9 are subcategories under fuel combustion activities in energy sector.

Table 3-13 Summary of key category analysis by Approach 1 for national GHG inventory

A IPCC category code	B IPCC category	C Greenhouse gas	D Identification criteria	E Comments
1A1	Energy Industries - Solid Fuels	CO_2	L1,T1	
3B1a	Forest land Remaining Forest land	CO_2	L1,T1	
1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	L1,T1	
1A4	Other Sectors - Solid Fuels	CO_2	L1,T1	
1B1	Solid Fuels	CH_4	L1,T1	
1A5	Non-Specified - Solid Fuels	CO_2	L1,T1	
3B2b	Land Converted to Cropland	CO_2	L1,T1	
2C1	Iron and Steel Production	CO_2	L1,T1	
3C7	Rice cultivations	CH_4	L1,T1	
1A5	Non-Specified - Liquid Fuels	CO_2	L1,T1	
1A1	Energy Industries - Liquid Fuels	CO_2	L1,T1	
1A4	Other Sectors - Biomass	CH_4	L1,T1	
1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	L1,T1	
2A1	Cement production	CO_2	L1,T1	
1A3b	Road Transportation	CO_2	L1,T1	
3A1	Enteric Fermentation	CH_4	L1,T1	
4D	Wastewater Treatment and Discharge	CH_4	L1,T1	

L1 - key category according to Approach 1 level assessment
T1 - key category according to Approach 1 trend assessment

Source: CHOE Song Chol, 2011

Table 3-14 Summary of uncertainty analysis for 1990 and 2000 national GHG inventories and emissions trends

Classification	1990	2000
Total GHG emissions ($GgCO_2e$)	193,489	65,714
Uncertainty in total inventory (%)	25.8	9.8
Total GHG emissions with uncertainty ($GgCO_2e$)	193,489 ± 49,920	65,714 ± 6,440
Trend uncertainty (%)	2.9	
Emissions reduction trend for 1990-2000 (%)	66.0 ± 2.9	

Source: CHOE Song Chol, 2011

3.2.5 Uncertainty analysis

Uncertainty analysis is a mean to be preferential national efforts for decreasing uncertainties in further inventories and support decisions.

For uncertainty analysis of the national greenhouse inventory, method 1 for uncertainty calculation of the IPCC (IPCC, 2006) and tools for uncertainty analysis of the IPCC 2006 Software have been used.

Result from uncertainty analysis shows that the total national GHG emissions in 2000 were 65,714$GgCO_2e$, uncertainty of the total emissions was ±9.8% and 95% of probability range corresponding to this is 59,274 to 72,154$GgCO_2e$ (Table 3-14).

And, it is shown that average trends for the period 1990-2000 were decrease in

emissions by 66.0%, total trends uncertainty was ±2.9% and 95% of probability range corresponding to this was decrease by 63.1 to 68.9% relating to the emissions in 1990 (Table 3-14).

3.3 GHG Emissions Trends for 1990-2002

3.3.1 Summary of inventories for 1990-2002

Regarding the trend of the total national GHG emissions[3] for the period 1990-2002, it systematically decreased in the 1990's and increased to some extent in the early 2000's, but was still in far low level in 2002 compared with 1990 (Figure 3-16).

This is because the national economy declined by economic difficulty in the 1990's has entered the recovery stage in the 2000's, but has not reached the level of the 1990's.

The total GHG emissions amounted to 209,598GgCO_2e in 1991 when extremely much GHG has been emitted.

In 2002, the total national GHG emissions amounted to 71,036GgCO_2e, representing decrease by 63.3% compared to 1990 and increase by 8.1% compared to the level in 2000 (Table 3-15).

Meanwhile, CO_2 removals by sinks in AFOLU (woodland, grassland, wetland, settlements, and harvested wood product) sector in 2002 had the increasing trends compared to the level in the 1990's (Table 3-15).

In details, CO_2 removals by sinks in 2002 amounted to 19,309Gg, representing increase by 17.4% compared with 1990 and increase by 1.2% compared with 2000.

With respect to the sectoral emission trends, energy sector had kept the largest proportion in the total national GHG emissions for the period 1990-2002 (Figure 3-17).

But, emission proportion from IPPU systematically has been decreased.

In 2002, emissions from energy and IPPU sector have decreased by 56.4% and 75.6% and that from waste sector increased by 10.9% compared to the level in 1990 respectively (Table 3-16).

And, emissions from energy, IPPU and waste sector have increased by 6.1%, 20.0% and 1.4% compared to the level in 2000 respectively.

Considering the emission trends by gas, net CO_2 emissions have kept the largest proportion, followed by CH_4 in proportion by gas in the total national GHG emissions for the period 1990-2002 (Figure 3-18).

In 2002, net CO_2, CH_4 and N_2O emissions have decreased by 62.1%, 36.5% and 38.0% compared to the level in 1990, whereas increased by 8.8%, 2.8% and 3.0% compared to the level in 2000 (Table 3-17). Emission proportion of PFCs was so small that it could be neglected. In 2002, net CO_2, CH_4 and N_2O emissions have decreased by 65.5%, 49.1% and 59.1% compared to 1990 and increased by 9.2%, 3.2% and 9.8% compared to 2000 respectively (Table 3-17).

Meanwhile, per capita GHG emissions significantly have decreased and GHG emissions per GDP also decreased, regarding the change trends of the main GHG emission indicators for the period 1990-2002.

In 2002, GHG emissions per capita and per GDP were 3.0tCO_2e/person and 6.2tCO_2e/US$ 1,000 respectively, representing decrease by 67.0% and 26.3% compared to the level in 1990 (Table 3-1)

But, GHG emissions per capita increased by 6.5% and that per GDP decreased by 0.8% in comparison with the level in 2000.

3.3.2 Emissions trends by sector

ENERGY

In emission trend from energy sector with the largest proportion in the total national GHG emissions for the period 1990-2002, CO_2 has been emitted most much for the corresponding period (Figure 3-20).

[3] National total calculated by summing up emissions and removals for each gas expressed in CO_2e

In 2002, CO_2 emission proportion from energy sector accounted for 87.8% of the total emissions from energy sector.

And, CO_2, CH_4 and N_2O emissions amounted to 68,391Gg, 8,910GgCO_2 and 622GgCO_2 that year, representing decrease by 56.4%, 57.0% and 39.5% compared to the level in 1990 and increase by 6.5%, 3.5% and 7.0% compared to the level in 2000.

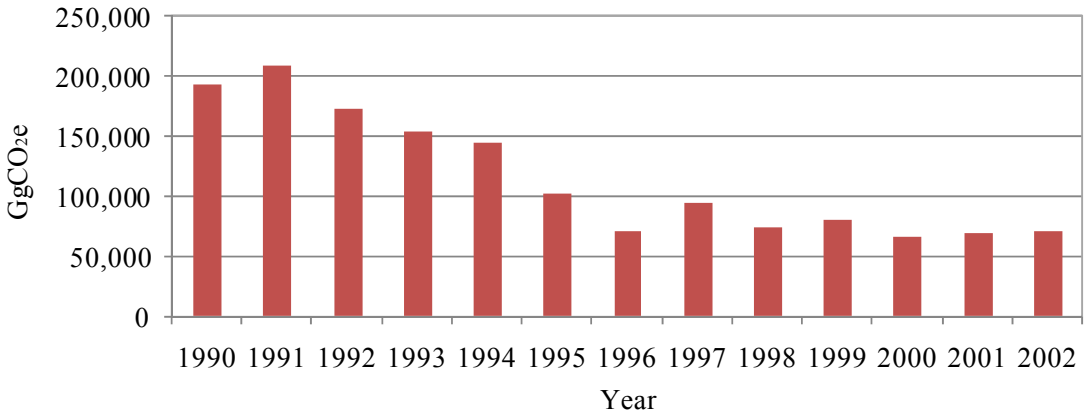


Figure 3-16 Total national GHG emissions for the period 1990-2002

Table 3-15 Total national GHG emissions and CO_2 removals for the period 1990-2002

Classification	1990	1992	1994	1996	1998	2000	2002
Total GHG emissions[1] ($GgCO_2e$)	193,489	172,987	143,983	70,299	74,427	65,714	71,036
CO_2 Removals[2] (Gg)	-16,443	-16,270	-16,125	-15,980	-13,744	-19,087	-19,309

[1] National total calculated by summing up emissions and removals for each gas expressed in CO_2e[1]
[2] CO_2 removals by sinks in AFOLU sector

Source: CHOE Song Chol, 2011

Table 3-16 Emissions by sector for the period 1990-2002 ($GgCO_2e$)

Sector	1990	1992	1994	1996	1998	2000	2002
ENERGY	178,730	156,394	135,504	66,690	73,117	73,417	77,923
IPPU	23,792	25,189	17,414	13,336	8,644	4,840	5,809
AFOLU	-10,078	-9,655	-10,016	-10,834	-8,461	-13,686	-13,856
WASTE	1,045	1,059	1,080	1,108	1,126	1,143	1,159

Source: CHOE Song Chol, 2011

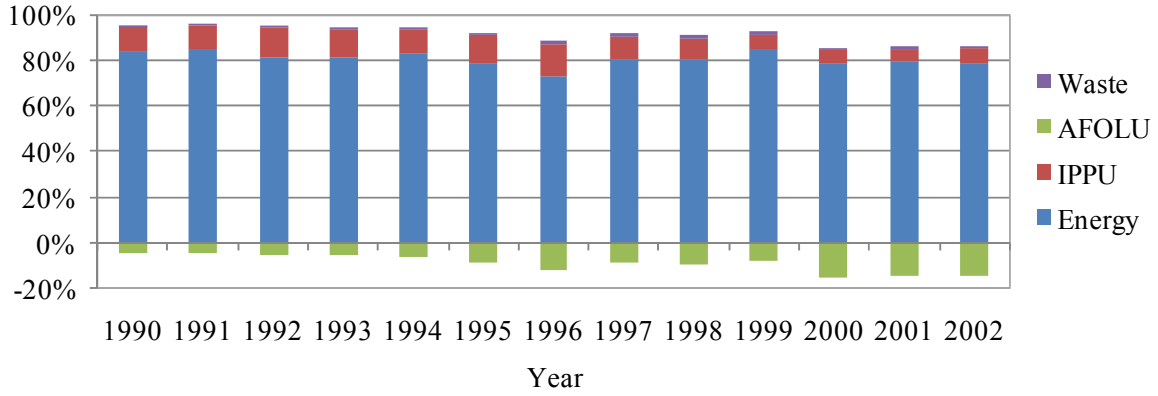


Figure 3-17 Share of emissions by sector in total national GHG emissions (1990-2002)

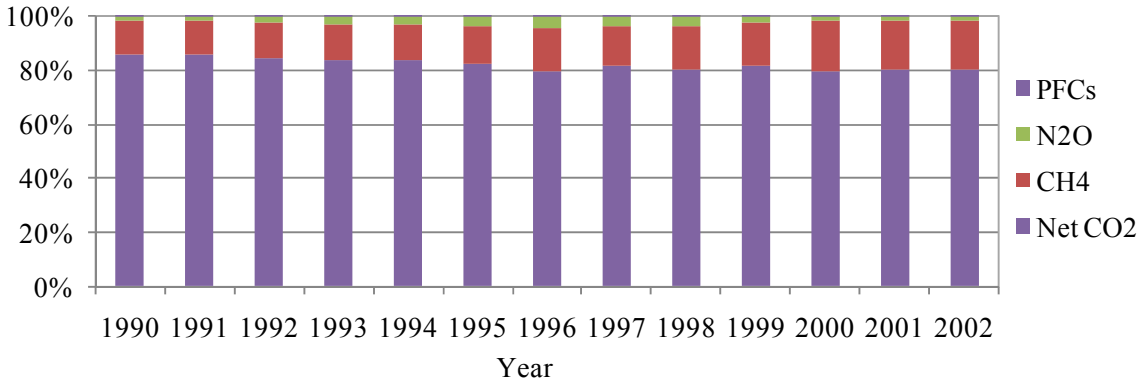


Figure 3-18 Share of emissions by gas in total national GHG emissions (1990-2002)

Table 3-17 Emissions by gas for the period 1990-2002 ($GgCO_2e$)

Gas	1990	1992	1994	1996	1998	2000	2002
Net CO_2	164,989	145,562	119,978	55,760	59,403	52,108	56,897
CH_4	24,805	22,213	19,504	11,039	11,901	12,227	12,618
N_2O	3,695	5,212	4,501	3,491	3,120	1,376	1,511
PFCs	0	0	0	9	4	3	10
Total	193,489	172,987	143,983	70,299	74,427	65,714	71,036

Source: CHOE Song Chol, 2011

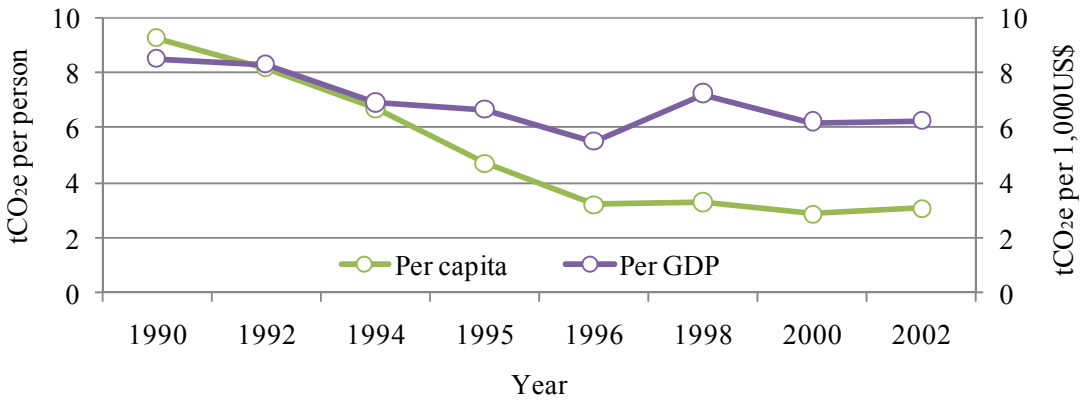


Figure 3-19 Per capita and per GDP GHG emissions for the period 1990-2002

Considering the emission trend by category in energy sector, GHG emissions from fuel combustion activities were almost all of proportion for the period 1990-2002 (Figure 3-21).

In 2002, GHG emissions from fuel combustion activities amounted to 71,166$GgCO_2e$, which accounted for 91.3% of the GHG emissions from energy sector.

Considering emission trend by fuel type in fuel combustion activities category, GHG emission by solid fuels was almost all in subcategories from the country's feature using domestic coal as fuel for the period 1990-2002 (Figure 3-22).

In 2002, GHG emissions by solid fuels accounted for 91.3% of the GHG emissions from the fuel combustion activities category.

Regarding trend by subcategory in energy sector, GHG emissions from 1A1 Energy Industries, 1A2 Manufacturing Industries and Construction and 1A4 Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing/Fish Farms) were almost all of the GHG emissions from energy sector for the period 1990-2002 (Figure 3-23).

In 2002, GHG emissions from 1A1

Energy Industries, 1A2 Manufacturing Industries and Construction and 1A4 Other Sectors, subcategories, totally amounted to 64,741GgCO_2e, which accounted for 83.1% of the GHG emissions from energy sector.

IPPU

Considering the trends by gas in IPPU sector, CO_2 has been emitted most much, followed by N_2O for the period 1990-2002 (Figure 3-24).

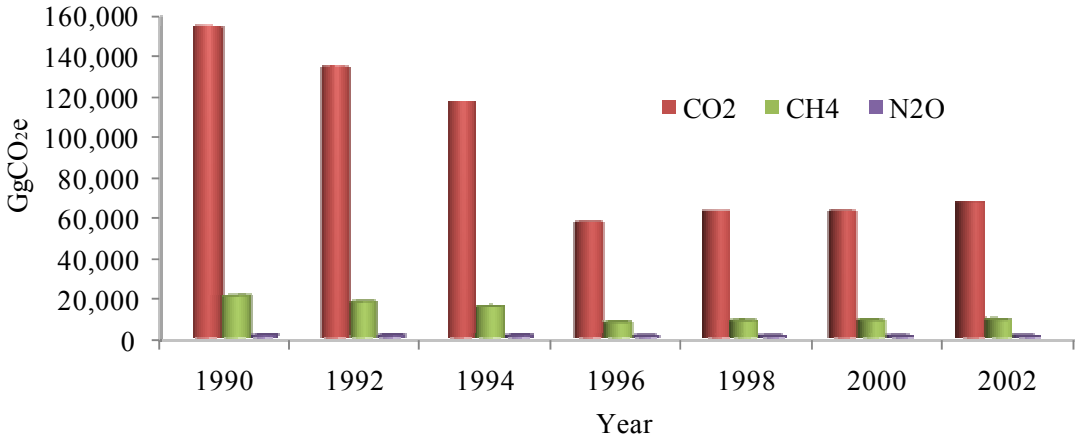


Figure 3-20 Emissions by gas in energy sector for the period 1990-2002

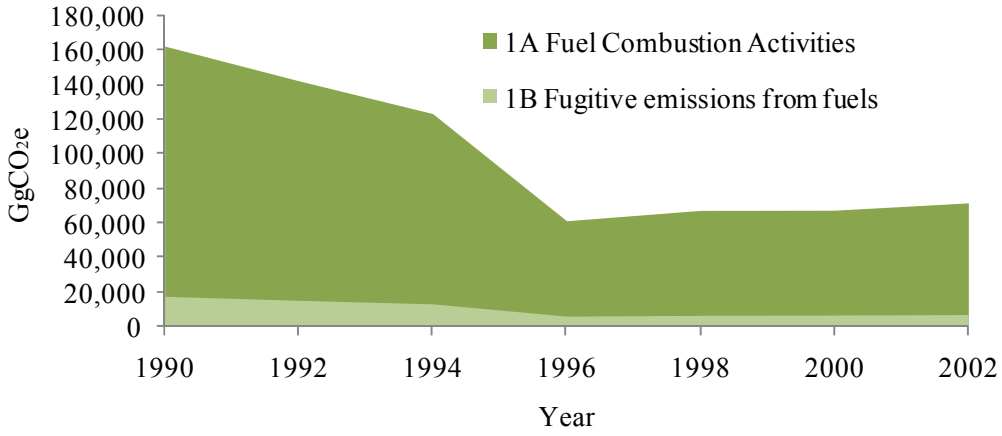


Figure 3-21 Emissions by category in energy sector for the period 1990-2002

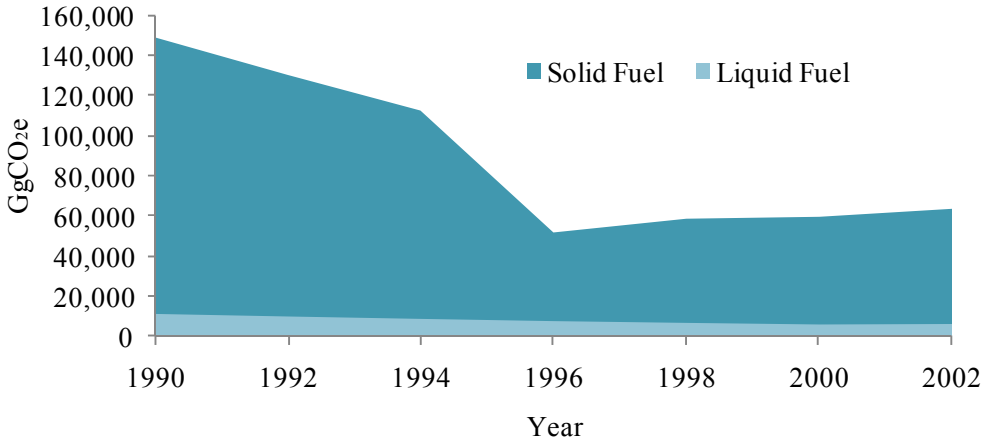


Figure 3-22 Emissions by fuel type in fuel combustion activities for the period 1990-2002

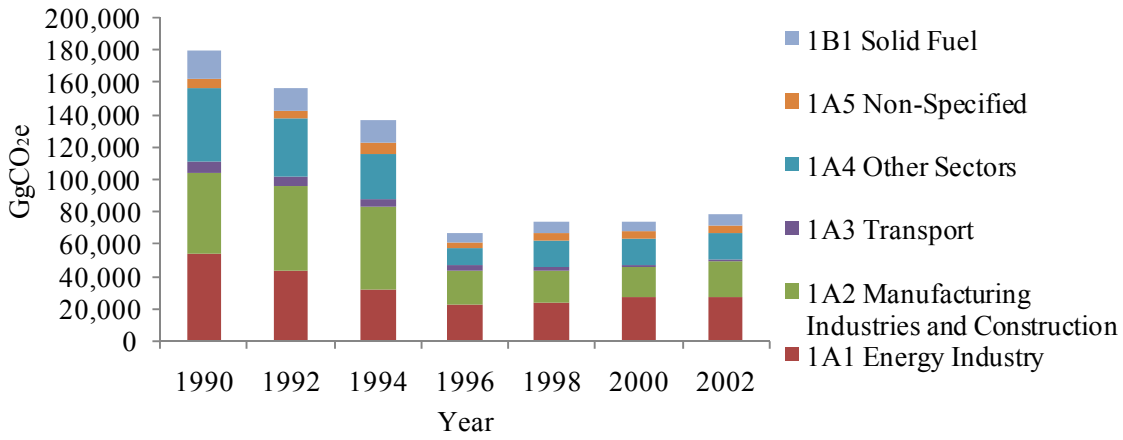


Figure 3-23 Emissions by sub-category in energy sector for the period 1990-2002

Comparing with CO_2 and N_2O emissions, CH_4 and PFCs emissions were so small that they could be neglected.

In 2002, CO_2 emissions from IPPU sector accounted for 92.0% of the GHG emissions from the sector.

Emissions by category in IPPU sector systematically have been decreased for the period 1990-2002 (Figure 3-25).

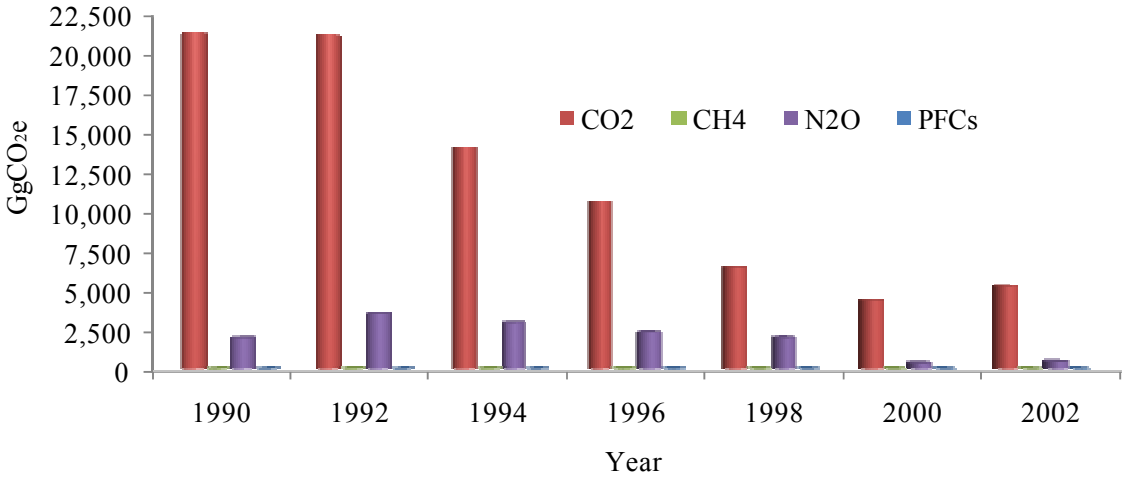


Figure 3-24 Emissions by gas in IPPU sector for the period 1990-2002

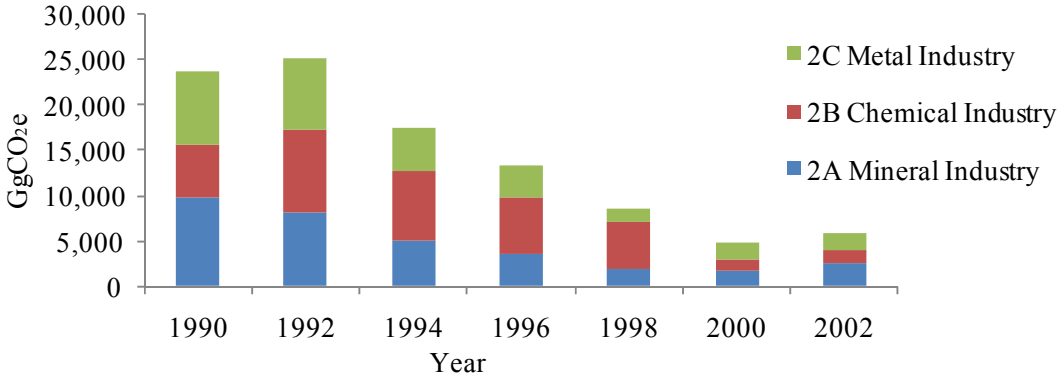


Figure 3-25 Emissions by category in IPPU sector for the period 1990-2002

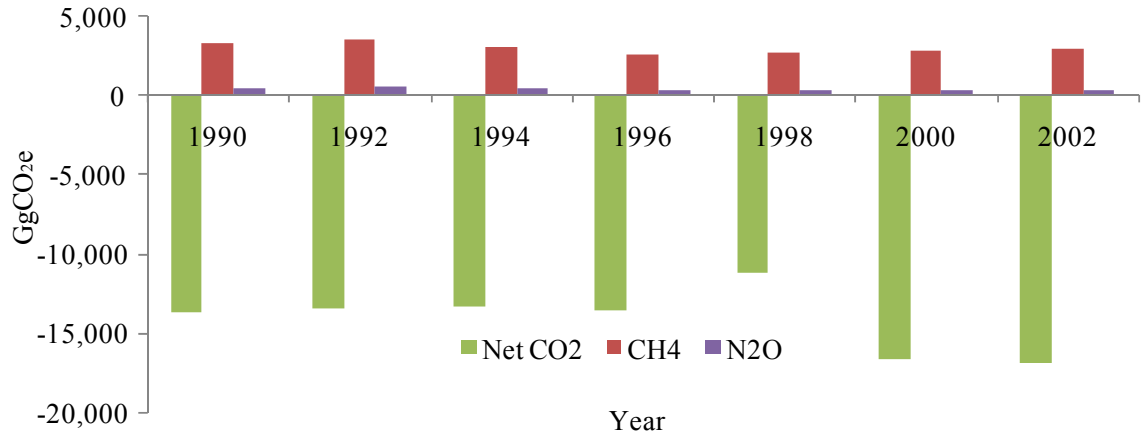


Figure 3-26 Emissions by gas in AFOLU sector for the period 1990-2002

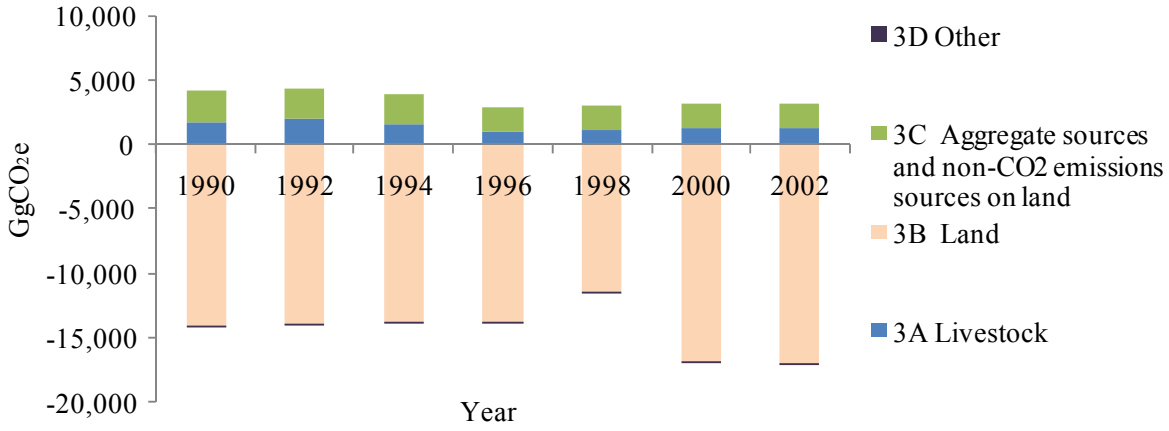


Figure 3-27 Emissions by category in AFOLU sector for the period 1990-2002

In 2002, GHG emissions from mineral industry, chemical industry and metal industry amounted to 2,522GgCO_2e, 1,370GgCO_2e and 1,917GgCO_2e respectively, representing decrease by 74.2%, 76.2% and 76.7% compared to the level in 1990, increase by 52.1% and 12.8% for mineral industry and chemical industry and decrease by 2.5% for metal industry compared to the level in 2000.

AFOLU

In AFOLU sector, net CO_2 and N_2O emissions for the period 1990-2002 systematically have decreased and slightly increased, but CH_4 emissions were of insignificant change (Figure 3-26).

Considering emission trends by category, emissions from aggregate sources and non-CO_2 emissions sources on land were the largest portion, followed by livestock category for the period 1990-2002 (Figure 3-27).

CO_2 removal in land category is of gradually increasing trend.

In CO_2 removals by sinks in AFOLU sector for the period 1990-2002, forest land took the foremost place, and accounted for almost all of proportion.

WASTE

CH_4 has been emitted most much from waste sector and its trend had insignificant change for the period 1990-2002 (Figure 3-29).

Comparing with CH_4 emissions, CO_2 emissions were so small that it could be neglected.

Wastewater treatment and discharge took the foremost place, followed by solid waste disposal in emissions by category for the period 1990-2002 (Figure 3-30).

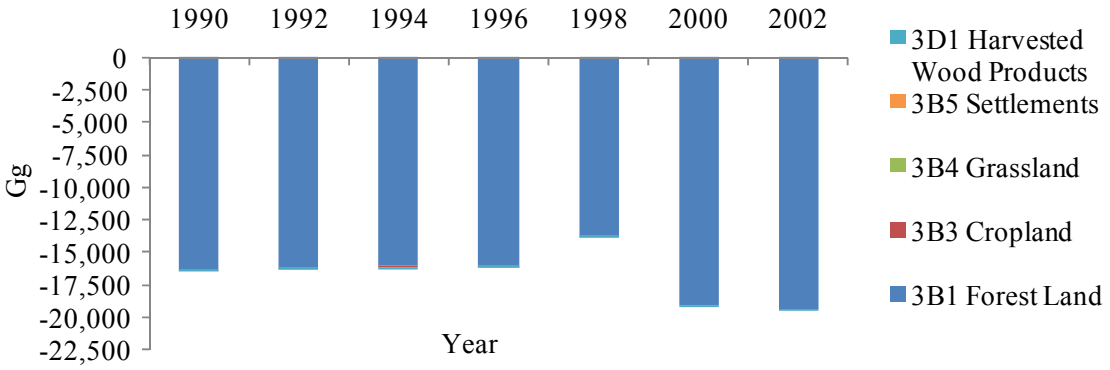


Figure 3-28 CO_2 removals by sinks in AFOLU sector for the period 1990-2002

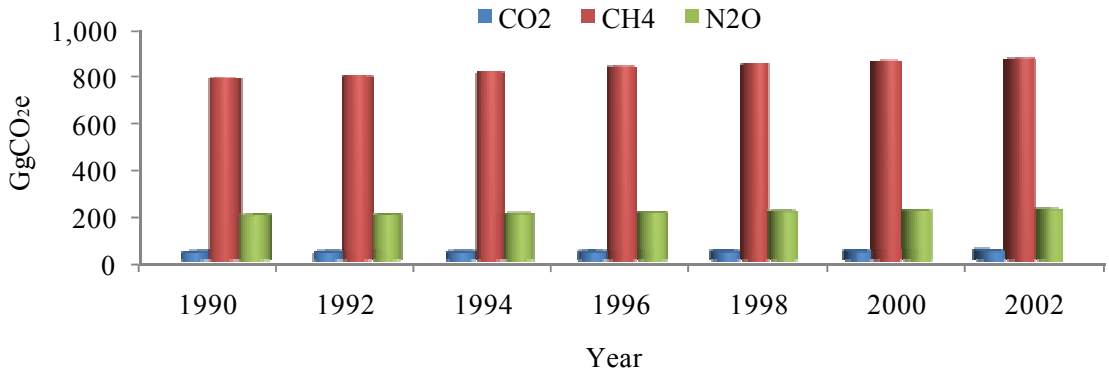


Figure 3-29 Emissions by gas in waste sector for the period 1990-2002

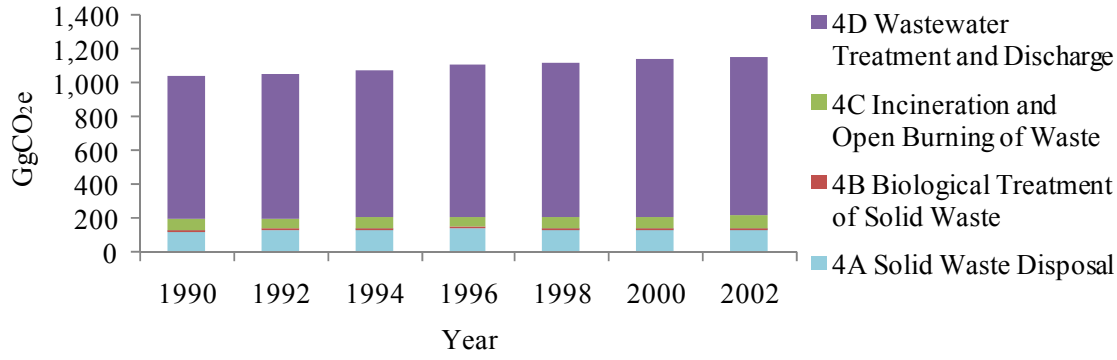


Figure 3-30 Emissions by category in waste sector for the period 1990-2002

3.3.3 Emissions trends by gas

CO_2

Energy sector has emitted most much CO_2 with the largest proportion of the total national GHG emissions and waste sector emitted very small CO_2 to a negligible degree for the period 1990-2002 (Figure 3-31).

Meanwhile, net CO_2 removals in AFOLU sector have increased for the same period.

CH_4

Energy sector took the foremost place in CH_4 emissions, followed by AFOLU sector (Figure 3-32).

Meanwhile, CH_4 emissions from IPPU sector were so small that it could be neglected for the period 1990-2002.

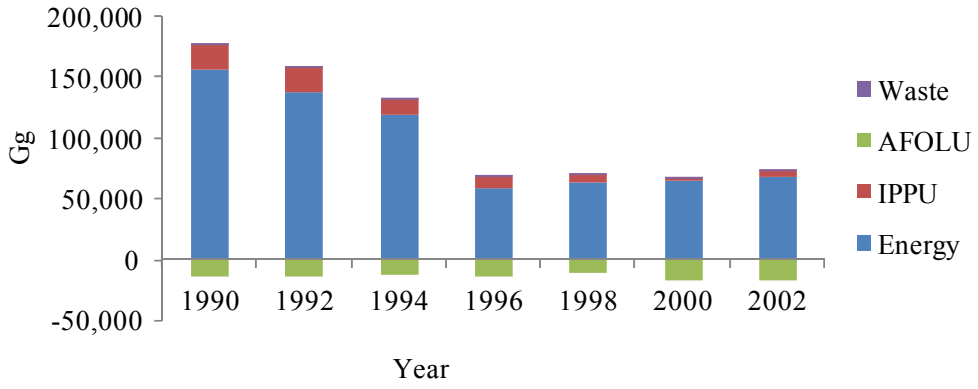


Figure 3-31 Net CO_2 emissions/removals by sector for the period 1990-2002

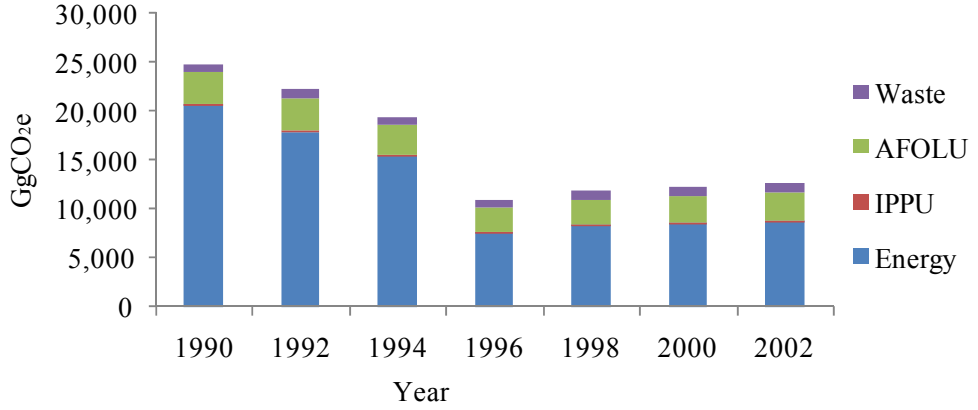


Figure 3-32 CH_4 emissions by sector for the period 1990-2002

N_2O

Energy and IPPU sector have contributed to most much N_2O emissions for the period 1990-2002 (Figure 3-33).

Attaining the year 2000, N_2O emissions from other sectors also accounted for fixed proportion.

PFCs

PFCs has been emitted only from IPPU sector for the period 1990-2002 and its quantity was very small (Figure 3-34).

PFCs emissions have been decreased since the latter half of the 1990's and exceeded the level of the year 1996 in 2002.

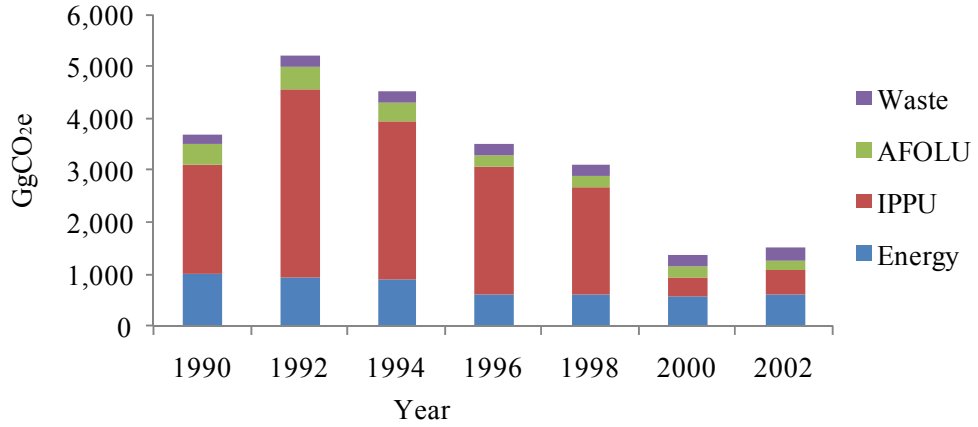


Figure 3-33 N_2O emissions by sector for the period 1990-2002

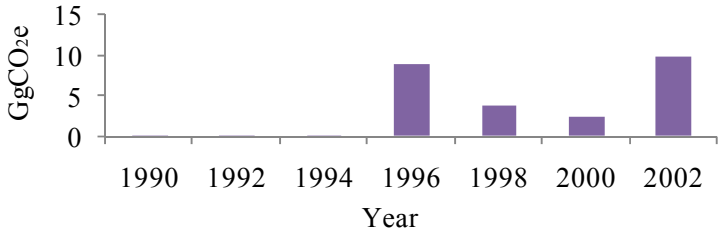


Figure 3-34 PFCs emissions for the period 1990-2002

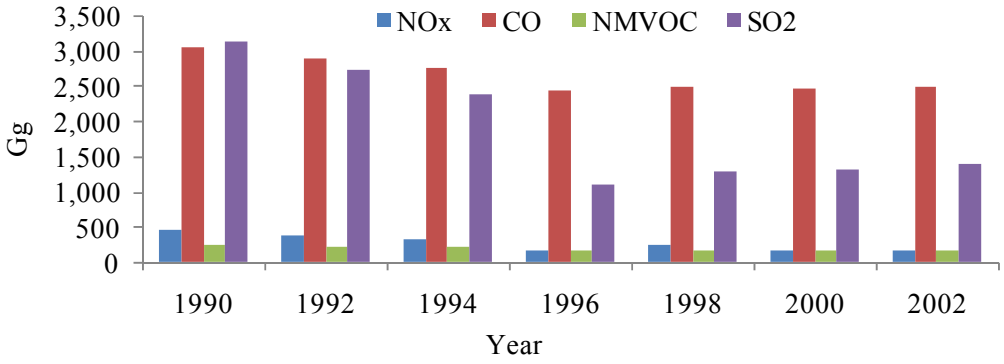


Figure 3-35 Other gases emissions for the period 1990-2002

Other gas

Emissions of the other gases such as NO_x, CO, NMVOC and SO_2, precursors, for the period 1990-2002 gradually have decreased and begun to increase attaining the year 2000 (Figure 3-35).

For this period, SO_2 has been emitted most much, followed by NO_x.

3.4 QA/QC, Inventory Improvement

3.4.1 QA/QC

In the process of preparation of the national GHG inventory under the SNC project, plan for QA/QC was made and the following activities in every stage of inventory compilation were conducted.

- Audit of estimation methodology
- Check up of completeness
- Verification of activity data (verification of activity data by possible various sources, cross-comparison of statistical data with results from LEAP energy balances, etc)
- Appropriate documentation on activity data and emission factors
- Check up of errors in data input of statistic software
- Check up of accuracy of emission estimations (cross-comparison of IPCC 2006 software with estimated results from Non-Annex I GHG inventory software, etc)

And, related experts not took part in the process to prepare GHG inventory and members of GHG inventory group have conducted perfect external/internal audit on the national inventory.

And then, report on the national inventory was made and all information used for preparation of the national inventory was stored.

3.4.2 Inventory improvement

Recalculation

The previous GHG inventory for the year 1990 developed under the FNC project has been recalculated through the process of preparation of the national GHG inventory under the SNC project (Table 3-18).

Table 3-18 Summary of recalculation for 1990 GHG inventory [1]

Classification	Energy	Industrial Processes	Agriculture	Land-Use Change and Forestry	Waste	Total GHG emissions
FNC ($GgCO_2e$)	178,945	9,855	11,648	-14,621	1,482	187,309
SNC ($GgCO_2e$)	178,730	23,792	4,010	-14,089	1,045	193,489
Difference (%)	- 0.1	141.4	- 65.6	- 3.6	- 29.4	3.3

[1] Use of the category according to Table 1 contained in the annex to decision 17/CP.8

Source: CHOE Song Chol, 2011

This is because new methodologies and emission factors described in the IPCC 2006 Guidelines were used for preparation of the national GHG inventory.

And, this is because activity data and subcategories were supplemented by category and some country-specific emission factors were used

According to the recalculation results, the total national GHG emissions in 1990 amounted to 199,426$GgCO_2e$, representing increase by 6.5% over that in the previous inventory.

Needs for inventory improvement

National GHG inventory, in accordance with decision 17/CP.8 and decision of COP16, should be updated and submitted to COP biennially.

And, despite of many improvements and progresses were made in the process of preparation of the national GHG inventory under the SNC project, there also exist many problems requiring further improvement.

Priority needs for periodic update of the national GHG inventory in sustainable manner in future are as follows.

- Development of GHG inventory strategy Maintenance of the members involved in GHG inventory
- Capacity building including hands-on training in all aspects related to GHG inventory
- Confirmation, duty assignment and institutional capacity building of the institutions responsible for preparation of GHG inventory
- Awareness raising on the importance of GHG inventory among stakeholders
- Allotment of efforts and sources to main source categories
- Systematic collection of activity data by sources and sinks
- Development of effective data management system
- Development of country-specific estimation methodologies and emission factors Development of integrated QA/QC procedures.
- Preparation of biennial GHG inventory and report on periodic national GHG inventory.
- Development and implementation of the projects related to GHG inventory.

CHAPTER 4 CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

Chapter 4 Climate Change Impacts and Adaptation Measures

With the global warming, many impacts of climate change become unavoidable.

IPCC Fourth Assessment Report concluded that "new evidences show that climate change has affected many sectors in Asia" (IPCC, 2007b).

DPR Korea has already experienced impacts of climate change in various ways, too.

One of the most urgent challenges of sustainable development is to reduce impacts of climate change through impact assessment and adaptation.

In this chapter, research results on the present and future climate change, and impact of climate change affecting on water resources, agriculture, forest, ecosystem, coastal area and public health, and adaptation measures were described.

4.1 Current and Future Climate Change

4.1.1 Current climate change

Temperature

During the period 1918 to 2000, annual mean temperature in DPR Korea has increased by 0.019℃ per year (Figure 4-1). Namely, warming rate in the country in the 20th century was 0.19℃/10years, which was over 3 times compared with global warming rate (0.06℃/10years during the period 1901-2000, IPCC, 2007a), and greater than that in other countries in the east Asia (SONG Kyong Ran, 2007). And then, during the same period, average temperature in winter has increased by 4.9℃ and that in summer by 2.4℃, and rising rate of monthly average lowest temperature in winter when most severe warming occurs was greater by over 1.5 times than that of monthly average highest temperature (MLEP, 2012).

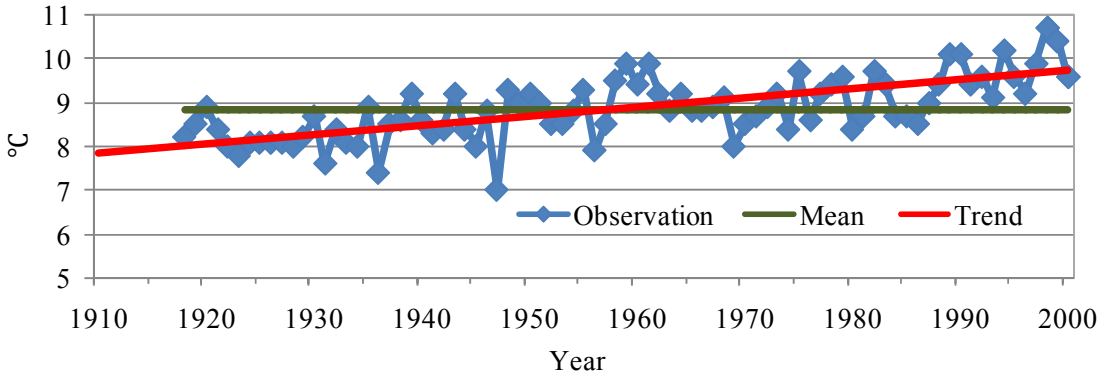


Figure 4-1 Variation in annual mean temperature in DPR Korea (1918-2000)

Source: CHOE Pong Chol *et al.*, 2008

Meanwhile, during the period from 1971 to 2005, annual mean temperature in the country has increased by 0.035℃ per year, that is, 0.35℃/10years (RIM Sang Don *et al.*, 2007). In other words, warming in the country has happened severely in the latter half of the 20th century, in particular since the 1970's and annual mean temperature in the 1990's when temperature was highest since the observation has reached 8.58℃, which is 0.38℃ higher than the average (average from 1971 to 2000) (SONG Kyong Ran, 2007).

Winter has become short, while spring and summer have become longer in change of season of the country by the impact of

warming. In case of Pyongyang, spring in the 2000's has been set in 24 days earlier than in the 1930's and 6 days earlier than in the 1990's, while summer earlier by 10 days and 6 days, respectively. In addition, winter has set in later by 5 days and 2 days, respectively. In particular, winter time has decreased by 27 days, while summer and spring time have increased by 16 days and 12 days, respectively (RIM Sang Don *et al.*, 2012).

Precipitation

Unlike temperature, annual precipitation during the period from 1918 to 2000 had no systematic variation trend (Figure 4-2). The time when annual precipitation was smallest during the corresponding period was the 1990's and severe water shortage events have appeared in almost all seasons of the year for 10 years.

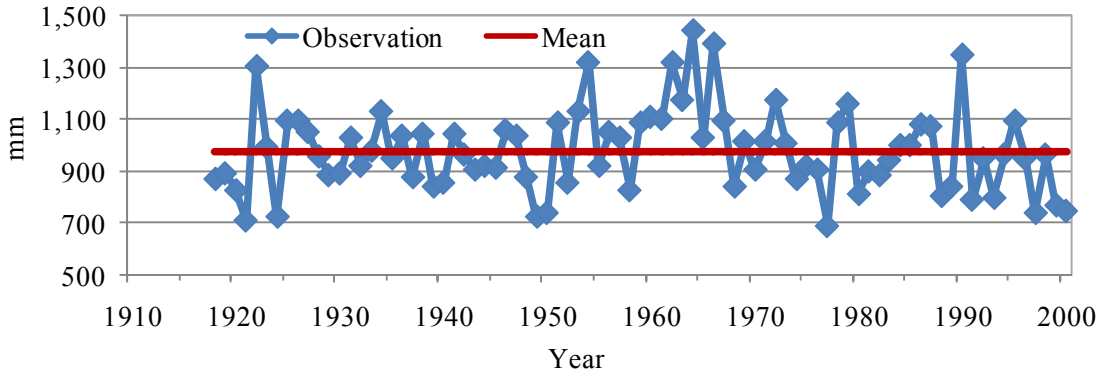


Figure 4-2 Variation in annual precipitation in DPR Korea (1918-2000)

Source: CHOE Pong Chol *et al.*, 2008

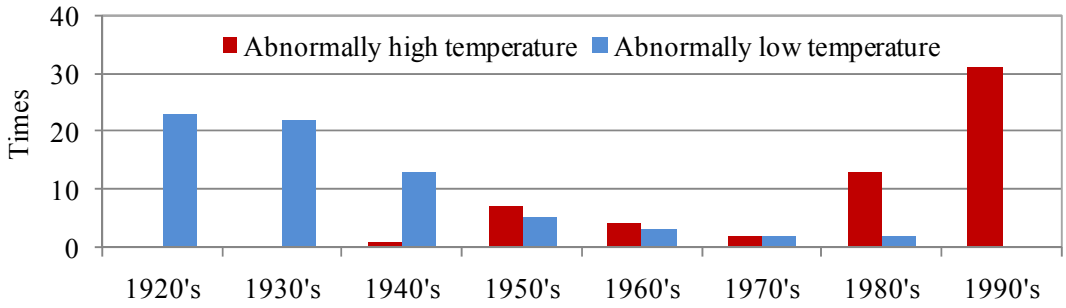


Figure 4-3 Emergence frequency of abnormally high and low temperature events in 1920-1990's

Source: CHOE Pong Chol *et al.*, 2008

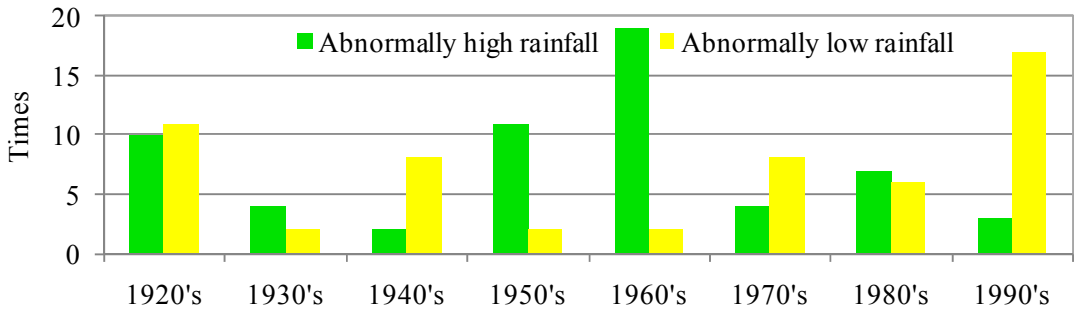


Figure 4-4 Emergence frequency of abnormally high and low rainfall events in 1920-1990's

Source: CHOE Pong Chol *et al.*, 2008

Abnormal climate

Abnormal temperature: Arriving at the 1990's, abnormal high temperature has appeared 31 times as climate is warmed, but abnormal low temperature has appeared at no time (Figure 4-3).

Abnormal precipitation: Annual abnormal much rain has appeared frequently in the 1950's and 1960's, while annual abnormal pattering rain has frequently appeared in the 1920's and 1990's (Figure 4-4).

Features of recent climate

Firstly, it is that climate warming is lasting.

Annual mean temperature for the period 2001-2005 was 8.7℃, which was 0.1℃ greater than that in the 1990's when temperature was highest in the 20th century (SONG Kyong Ran, 2007). Spring and summer have set in about 4 to 9 days earlier and summertime has increased by about 5 to 13 days. Centre of warming in the 20th century was the northern inland area covering Chagang Province and Ryanggang Province, and warming appeared with winter and spring as its centre, but warming process in the early years of the 21th century appeared rather smoothly without significant regional difference and warming was advanced by rise in temperature in spring, summer and autumn. In addition, the highest temperature phenomenon in meteorological observation has appeared in most coastal zones of the West Sea as average temperature at the beginning of August, 2012 was 28.2℃ in Pyongyang, 28.9℃ in Haeju, 28.1℃ in Sariwon and 28.5℃ in Kaesong.

Secondly, it is that precipitation gradually is increasing.

Annual precipitation from the time of much rain in the 1960's to the late 1990's and to the early years of the 21th century systematically was decreased, but precipitation began to increase from 2003 on and exceeded the annual in 2004 and 2005 (SONG Kyong Ran, 2007). But the average precipitation for 5 years from 2001 to 2005 was 888.3mm, which was smaller by 38.8mm than the annual average precipitation.

Thirdly, it is that coldness phenomenon is appearing insignificantly in the East Sea coastal regions.

During the period from 1971 to 2000, severe coldness in the East Sea coastal region occurred 5 times in 1974, 1980 and 1993, etc., (once per 6 years on average) and gave great damages to agricultural production, but after that, severe coldness has not been observed for nearly 13 years till 2006 (SONG Kyong Ran, 2007).

Finally, it is that disastrous abnormal climate phenomena frequently are occurring.

Heavy rain: Following heavy rain in Tosan on August 4, 1994 (416mm), heavy rain in Jongju on August 5, 1994 (418mm) and flood in Unjon on July 25, 1999 (555mm), heavy rain phenomenon frequently has occured in the 21st century (CHAE Son Suk *et al.*, 2005).

Heavy rain, the severest in observation, fell in Wonsan on October 10, 2001 (SONG Kyong Ran, 2007). At this time, the first greatest value from 1905 up to now was recorded as 174mm for 3 hours and 347mm for 12 hours in Wonsan. In and around the city of Wonsan suffered a great deal of damage from occurring tidal flood with this heavy rain. On June 30, 2005, strong heavy rain has fallen in Dokchon and Pukchang, and at this time, great deal of damage was raised from over 100mm of heavy rain with strong wind in short time. The heavy rain observed in Yangdok, Sinyang and Songchon from 14 to 16 July 2006 was for the first time in the regions. The precipitation over 3 days from 14 to 16 July was 448mm, that over 2 days from 14 to 15 July 431mm, and 320mm, that on July 14, was the greatest value since observation and at the same time, could occur once per 10000 year in that places.

Heavy rain also fell in most regions including basins of Chongchon River and Taedong River in July 2012. 418mm of heavy rain in Nyongbyon for 12 hours and about 374mm to 504mm of heavy rain in

Pakchon, Anju and Kaechon for 24 hours fell between 29 and 30 of July, which was never seen since observation in that places.

Biting cold: By warming of winter climate, extreme cold event in wintertime has not appeared significantly for about 15 years from the latter half of the 1980's, but extreme cold event has appeared frequently in the 21st century (SONG Kyong Ran, 2007). The lowest temperature in Pyongyang on January 16, 2001 was -26.5℃, which was the lowest value since the 1950's. Several sectors of the national economy suffered great damage from the extreme cold. Extreme cold also has struck on around the 20th of December, 2004 and continued long in existence, and a great deal of freezing damage was given to the winter crop such as wheat and barley.

Severe drought: Severe drought events have appeared ten times from 1998 to 2001. In particular, severe drought event whose period is one thousand year has appeared over about 100 days from March to the 20th of June in 2001 in the 21st century after record-breaking severe drought event between spring and summer in 1997 (CHAE Son Suk *et al.*, 2005, RI Ho *et al.*, 2009, KANG Song Gi *et al.*, 2010).

Sea-level

Sea-level in the Korean East Sea and West Sea has increased by 1.5mm per year every year over 1963 to 2000 period (KWAK Il Hwan, 2002, PAK Jin Gil *et al.*, 2000).

4.1.2 Future climate change

Projection of climate change in DPR Korea in the 21st century is of great significance in drawing prospective long-term plan and ensuring sustainable development in several sectors including agriculture.

Temperature

In the late 21st century, annual mean temperature in DPR Korea is expected to rise by 2.8℃ to 4.7℃ compared to the average (8.2℃, 1971-2000).

Variation trend of annual mean temperature is projected 0.037℃/year and 0.026℃/year on A2 and A3 of IPCC SRES GHG emission scenario over the period 1961 to 2100, respectively, estimating by using the results from GCMs (CGCM2 A2, B2), data observed during the period 1961 to 2007 and SDSM (Figure 4-5).

Annual mean temperature is projected to increase by 1.8 to 2.5℃ in the 2050's and 2.8 to 4.7℃ in the 2090's compared to the average (8.2℃) (Table 4-1).

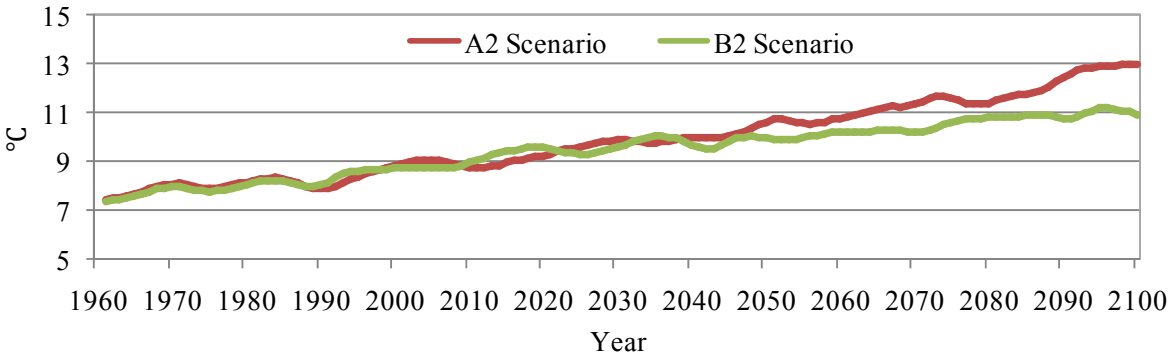


Figure 4-5 Prediction of annual mean temperature to 2100

Source: CHOE Pong Chol *et al.*, 2008

Table 4-1 Deviation of annual mean temperature by decade in the 21st century (℃, average 8.2℃)

Scenario	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's
A2	1.4	1.7	2.0	2.5	2.9	3.3	3.7	4.7

B2	1.2	1.7	1.6	1.8	2.1	2.4	2.7	2.8

Source: CHOE Pong Chol *et al.*, 2008

Considering by regions, rise in temperature will be fastest in middle inland regions, and smallest in northern regions in the East Sea coast.

Average monthly temperature will increase in spring and summer over the whole 21st century most significantly. Annual mean highest temperature is projected to increase by 2 to 2.7℃ in the 2050's and by 3.1 to 5℃ in the 2090's compared to the average (14℃), while annual mean lowest temperature is projected to increase by 1.9 to 2.5℃ in the 2050's and by 3 to 4.8℃ in the 2090's compared to the average (3.2℃) (CHOE Pong Chol *et al.*, 2008).

Meanwhile, highest temperature in summer, by another estimation, is projected to increase by 2.73℃, 1.60℃ and 0.69℃ in 2050 and by 6.84℃, 2.99℃ and 1.04℃ in 2100 on SRES A1F1, A1B and B1 compared to the baseline (25.24℃ over 1960 to 1990 period), respectively (MLEP, 2012).

Precipitation

In the late 21st century, annual precipitation in DPR Korea is expected to increase by 10.7 to 15.2% compared to the average (927mm, 1971-2000).

Annual precipitation is projected to increase by 1.3 to 5.6% in the 2050's and by 10.7 to 15.2% in the 2090's compared to the average (927mm), estimating by using the results from GCMs (CGCM2 A2, B2), data observed during the period 1961 to 2007 and SDSM (Figure 4-6, Table 4-2).

Monthly precipitation probably will have the trend increasing in summer and autumn, and decreasing in winter and spring, in particular, increasing significantly in September and November (CHOE Pong Chol *et al.*, 2008).

Annual precipitation whose increase centre is in the middle inland region around Yangdok will have the trend increasing in the northern in the East Sea coast, and decreasing in the northern inland and south of Pyonggang, Kangwon Province.

Meanwhile, annual precipitation, by another estimation, is projected to increase by 12.56%, 7.36% and 3.18% in 2050 and by 31.49, 13.75 and 4.74% in 2100 on SRES A1F1, A1B and B1 compared to the baseline (over 1960 to 1990 period), respectively (MLEP, 2012).

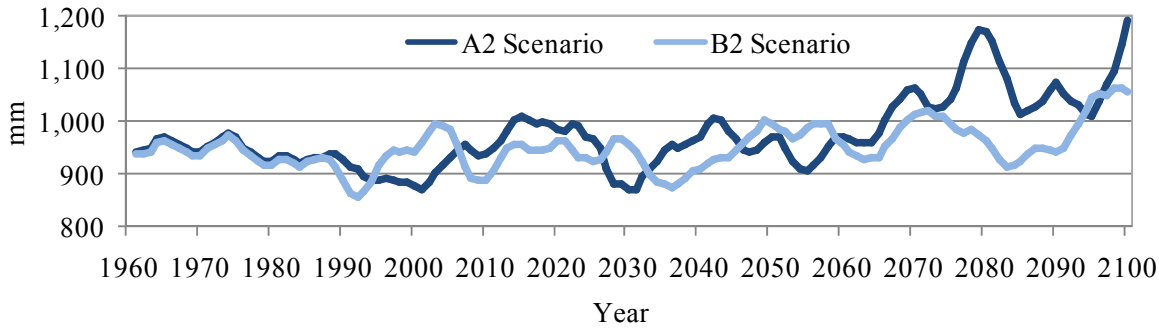


Figure 4-6 Prediction of annual precipitation to 2100

Source: CHOE Pong Chol *et al.*, 2008

Table 4-2 Deviation of annual precipitation by decade in the 21st century (%, average 927mm)

Scenario	2020's	2030's	2040's	2050's	2060's	2070's	2080's	2090's
A2	1.4	0.7	4.8	1.3	8.1	16.9	14.4	15.2
B2	2.0	-3.0	3.1	5.6	3.5	7.1	0.9	10.7

Source: CHOE Pong Chol *et al.*, 2008

Table 4-3 Sea-level rise in the 21st century (m, base year 2000)

Year	2020	2030	2040	2050	2060	2070	2080	2090	2100
A2 Scenario	0.09	0.16	0.23	0.32	0.41	0.52	0.63	0.76	0.89
B2 Scenario	0.09	0.14	0.20	0.27	0.34	0.42	0.50	0.59	0.67

Source: PAK Chang Il, 2011

Sea-level

By 2100, sea-level in DPR Korea is expected to rise by 0.67m to 0.89m compared to that in 2000.

Sea-level is projected to rise by 0.27 to 0.32m in 2050 and 0.67 to 0.89m in 2100 compared to that in 2000, the base year, estimating by the A2 and B2 scenarios using DIVA (Table 4-3).

Meanwhile, through the research using sea-level rise model by the global temperature, sea-level is projected to rise by 0.05 to 0.11m in the Korean East Sea in 2020, 0.07 to 0.12m in the Korean West Sea in 2020, 0.18 to 0.41m in the Korean East Sea in 2050, 0.22 to 0.49m in the Korean West Sea in 2050, 0.38 to 0.75m in the Korean East Sea in 2100 and 0.40 to 0.83m in the Korean West Sea in 2100 (KWAK Il Hwan, 2002).

Besides, sea-level in accordance with the research of sea-level variation after the small ice age is promised to rise by 0.50m in the latter 21st century (RIM Kwon Muk *et al.*, 2009).

4.2 Climate Change Impacts

4.2.1 Impacts on water resources

Impacts on water availability

In the late 21st century, water resources (surface water) in DPR Korea are expected to be almost the same as the average (1971-2000) or decrease by 7.9%.

In the 20th century, quantity of water resources in the country systematically has decreased (Table 4-4). Considering annual average water resource quantity over last 30 years (from 1971 to 2000) as 100%, quantity of water resources in the 1990's has decreased by 15% compared to that in the 1970's, and water resource per capita in the 1990's has decreased by 3.4 times compared to that in the 1950's for climate change and population growth (Table 4-4).

Through estimating the variation in water resources in the country in accordance with the simulation of hydrological processes by using the VIC model based on A2 and B2 scenarios, precipitation would increase in the latter 21th century, but quantity of water resources would be the same as the average (over the period 1971 to 2000), or decrease by 7.9% compared to the average for increase of loss by evaporation due to increase in temperature (Table 4-5).

Annual variation and regional differences in water resources would be great.

Seasonal variation in water resources is significant in DPR Korea. 60% of annual precipitation is concentrated over the period July to September, the time of much rain, and precipitation from October to the next March accounts for only 15% of annual precipitation (SONG Hak Chol, 2011b).

Table 4-4 Variation in water resources by decade in the 20th century (average 1971-2000) and per capita water resources

Classification	1920's	1930's	1940's	1950's	1960's	1970's	1980's	1990's	Average
Variation in water resources (%)	117	114	104	122	148	106	102	92	100
Per capita water resources (m^3 per person)	-	-	-	9,044	-	4,159	-	2,669	2,756

Source: SONG Hak Chol, 2011a

Table 4-5 Variation in water resources by province in the 21st century (%, average 1971-2000)

Classification	A2 Scenario			B2 Scenario		
	2001-2030	2021-2050	2071-2100	2001-2030	2021-2050	2071-2100
Pyongyang City	53.3	40.3	8.4	57.8	60.0	67.3
South Phyongan Province	141.8	126.8	115.2	119.5	112.4	107.3
North Phyongan Province	93.4	85.0	61.7	56.0	60.4	58.0
Chagang Province	160.8	146.9	140.0	145.2	130.8	122.5
Nampho City	5.2	3.3	0.4	3.2	3.0	6.4
North Hwanghae Province	83.4	77.7	47.8	72.4	78.0	76.4
South Hwanghae Province	47.9	41.2	11.9	23.4	33.6	36.4
Ryanggang Province	142.6	139.9	125.7	119.6	130.1	118.4
South Hamgyong Province	135.9	125.9	104.8	119.5	134.9	111.3
North Hamgyong Province	85.0	73.7	45.2	119.6	133.3	108.3
Kaesong City	96.4	94.2	58.7	46.1	70.3	65.1
Kangwon Province	118.9	120.2	106.8	116.5	132.2	121.4
Country	118.5	110.3	92.1	105.1	110.4	100.3

Source: SONG Hak Chol, 2011b

Following the 20th century, annual variation in water resources will increase by 1.3 to 1.5 times compared to the average and difference by regions will be over 2 times compared to the present due to the impacts of climat change in future (SONG Hak Chol, 2012). Quantity of water resources in the northern inlands and East Sea coast will increase over the average and that in the West Sea coast significantly will decrease as a whole (Table 4-5). Considering by basins of rivers, quantity of water resources will decrease in the basin of Chongchon River, Songchon River, Taedong River, Kumjin River, Rimjin River and Ryesong River in the latter 21st century (Table 4-6).

It is expected that severe shortage of water will appear in urban regions and main agricultural areas in the West Sea coast.

The portion of quantity of water use in quantity of water resources has increased from 11.2% in the 1990's to 18.6% in 2008 for economic development and growth of population (Figure 4-7). Portion of water use in 2008 was 30% for industry, 62% for agriculture and 8% for life (CBS, 2011).

Table 4-6 Per capita water resources in the 21st century (m^3 per person)

Year	2030	2050	2100
A2 Scenario	2,760	2,280	1,600
B2 Scenario	2,560	2,510	2,330

Source: SONG Hak Chol, 2011b

Quantity of water resources per capita is projected to decrease and quantity of water use per capita to increase in future (Table 4-7, 4-8). Quantity of water resources, in particular, is projected to significantly decrease in lowland in the West Sea coast with the urban areas densely populated such as Pyongyang City and Nampho City (Table 4-5), and on the contrary, water need continues to increase for growth of population and economic development, thus water problem in the urban areas in the West Sea coast is projected to be most serious.

Especially in spring, severe water shortage event is projected to appear in

North and South Hwanghae Province and South and North Phyongan Province, main agricultural area because of seasonal variation in water resources and increase in irrigation water by rise in temperature.

Impacts on water quality

Warmer water temperature and great seasonal variation in water resources will deteriorate water quality.

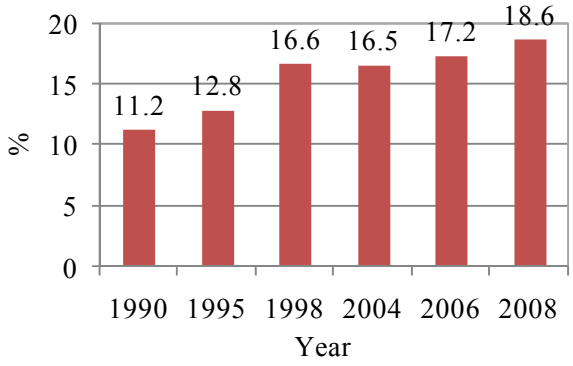


Figure 4-7 Share of water use in water resources

Source: CBS, 2011

Table 4-7 Variation in water resources by river basin in the 21st century (%, average 1971-2000)

Classification	A2 Scenario			B2 Scenario		
	2001-2030	2021-2050	2071-2100	2001-2030	2021-2050	2071-2100
Amnok River	150.0	139.5	127.0	126.3	120.3	109.9
Tuman River	92.1	87.1	68.3	117.9	124.1	117.0
Chongchon River	107.1	99.8	85.3	78.4	80.8	77.7
Songchon River	110.4	100.5	73.1	80.6	99.7	79.0
Taedong River	116.9	105.2	88.2	100.7	97.4	94.0
Kumjin River	119.0	116.4	94.9	75.5	107.5	74.1
Kum River	127.3	123.0	110.8	93.2	109.5	86.4
Dokji River	117.9	118.4	103.0	128.2	139.0	127.3
Rimjin River	109.2	108.5	93.0	89.5	104.9	97.3
North Han River	114.9	115.7	106.3	108.8	119.2	117.8
Ryesong River	85.6	81.3	45.1	69.4	80.5	81.2

Source: SONG Hak Chol, 2011b

Table 4-8 Variation in annual water use and per capita water use in the 21st century (%, base year 2000)

Year		2020	2030	2040	2050	2060	2070	2080	2090	2100
Annual water use	A2	109.4	115.8	123.7	133.8	146.8	162.6	180.6	202.9	228.1
	B2	106.5	112.9	120.1	128.1	137.4	147.5	158.3	169.8	182.7
Per capita water use	A2	93.8	92.9	93.4	95.5	99.6	105.6	113.4	124.5	136.8
	B2	93.8	94.6	96.9	100.6	107.2	114.2	122.6	134.4	146.5

Source: SONG Hak Chol, 2011b

Consecutive heavy rains and floods caused by the impact of climate change, and untreated industrial wastewater and domestic sewage flowing into rivers and streams have extremely deteriorated the water quality in main rivers and streams including Taedong River (Table 4-9). At present, to improve water quality in urban rivers and streams, the Government lets water flow down from upper lakes once or twice per year artificially with economic losses (SONG Hak Chol, 2011b). In future, rise in temperature and severe seasonal variation in water resources caused by climate change will give serious negative impacts on use of drinking water and other water through rising water temperature and

polluting water seriously, causing various diseases.

Table 4-9 Water quality indicators for the Taedong River (1999 and 2008)

Indicator	1999	2008	Environmental Standard
COD (mg/ℓ)	1.25	2.15	3.00
NH_4-N (mg/ℓ)	0.35	0.22	below 0.3
Cl^- (mg/ℓ)	8.70	11.49	below 30
Coliform (no./ ℓ)	96,828	33,689	below 10,000

Source: MLEP, 2012

Water pollution will be more serious issues with variation in hydrological conditions and strengthening of activities for development of water resources.

10 to 15% of total volume disappeared by sediments in the lakes built in various places for hydropower generation, agricultural irrigation and living water, and in particular, sedimentary rate was increased by 2 to 3 times by reckless deforestation and forest clearing for recent 20 years (SONG Hak Chol, 2011b). And sedimentation in reserviors comes into being various problems such as increase of flooding events by rise of riverbed and rapid change in water quality caused by concentration of organic materials attendant upon the construction of many hydraulic structures like dams (SONG Hak Chol, 2012).

Water pollution, in future, will be raised as a serious issue for long retention time and recycling period of water according to change in hydrologic condition by climate change and intense activity to develop water resources like building of water control structures such as man-made lakes, waterways and barrages.

Impacts on frequency and intensity of flood, drought and landslide

In future, it is expected that severer flood than the present will appear during rainy season, severe drought than the present will appear in spring.

Several times of flood and drought events happened over the recent period 1990 to 2011 have brought forth enormous economic losses, as well as loss of life.

The damage from the floods in 1995 and 1996 was estimated at 15 billions of US$ and 2.2 billions of US$, respectively (SONG Hak Chol, 2011b). 4,961 persons have injured and 244,175ha of cropland was flooded and buried from the flood in 2007 (MLEP, 2012). About 3,400 homes were broken and 15,000ha of cropland were flooded, and 700km of road, about 30 places of bunds and 13 places of irrigation canals suffers damage from the flood in July 2010 (SONG Hak Chol, 2011b). Hundreds of thousands ha of cropland in South Hwanghae Province suffered damage from the flood in July 2011 (SONG Hak Chol, 2011b).

In addition, the drought with 20 to 30 years of the probability period has appeared per 2 to 3 year continuously and frequently, and drought event has appeared covering almost whole area of the country simultaneously, and severe drought event with 1,000 years of the period has appeared in 2001, bringing forth a great deal of damages.

According to the runoff model, A2 and B2 scenarios, larger flood in rainy season is projected to appear and more extreme drought in spring is projected to appear than in the present in future (SONG Hak Chol, 2011b).

Food production in flat areas in the West Sea coast is projected to get significant threat from flood and drought.

Considerable area of arable land is buried and washed out from flood events caused by heavy rain in rainy season every year. In particular, several hundreds of thousands hectares of arable land, which was located in the downstream regions of Amnok, Chongchon, Taedong and Huayang River in the West Sea coast constantly suffer damage from flood. Food production in the lowland area in the West Sea coast, most vulnerable region to flood and drought, is projected to get significant threat from flood and drought in future (SONG Hak Chol, 2011c).

Flood-frequency will increase, and as a result, disaster will become larger in middle mountainous regions.

Over recent 20 years, middle mountainous regions had recorded extremely many damages from flood events. At present, ten thousand places and several hundred square kilometers of middle mountainous regions are constant dangerous regions from flood event. Infrastructure such as road, bridge and, in particular dam and embankment built in the past against flood, as not built considering flood enough, are vulnerable to flood (SONG Hak Chol, 2011b).

In the middle mountainous regions, which are very sensitive and almost not adaptable to flood, frequency of floods occurring in hills and valleys in a moment is projected to increase as heavy rain and its intensity become larger by climate change in future, thus inviting greater disasters.

In inland mountainous regions, more frequent landslides could occur.

Following the landslide caused in the region of Wonsan and Anbyon in Kwangwon Province in the early 2000, landslide caused in the region of Sinphyong in North Hwanghae Province in 2005 and landslide caused in the region of Hoechang in 2006, landslide events also have been caused in several regions in the country in 2007 (SONG Hak Chol, 2011b).

More frequent landslides are projected to be caused by anthropogenic topographical transformation and climate change in inland mountainous regions in the country in future, but accurate forecast system for landslides is not established yet and adaptation capacity to landslides is poor.

By increase of flood, landslide and drought events, loss in land resources and land degradation will be accelerated.

At present, area of the regions at risk, which bring about enormous damages, causing natural disasters with soil erosion and accelerating sedimentation in rivers and lakes, runs into several hundreds of thousands hectares (SONG Hak Chol, 2011b). Destruction of forest resources and disafforestation by repeated natural disasters and economic difficulty over recent 10 years make soil erosion accelerate further in DPR Korea.

Loss in land resources and land degradation are projected to be accelerated as the area of regions at constant risk of soil erosion increases by 15 to 30% and total erosion of basins is multiplied by times according to increase in precipitation intensity for the topographic condition of the country and concentration of precipitation in future (SONG Hak Chol *et al.*, 2010).

4.2.2 Impacts on agriculture

Impacts on Agrometeorological indeces

The accumulated temperature by bounds and its duration days will systematically be increased.

Over the past period 1918 to 2000, accumulated temperature above 0℃, 5℃, 10℃ and 15℃ has increased by 200℃ to 300℃ and number of duration days of accumulated temperature above 0℃, 10℃ and 15℃ by 18 to 26, 9 to 13 and 11 to 16 respectively (SONG Kyong Ran, 2007).

During the period 2001 to 2005, accumulated temperature over 0℃, 5℃, 10℃ and 15℃ has increased by 150 to 300℃ compared to the average and number of duration days in accumulated temperature by 3 to 13.

In the late 21st century, accumulated temperature over 0℃, 5℃, 10℃ and 15℃ is projected to increase by 200 to 300℃ and number of duration days of accumulated temperature over 5℃, 10℃ and 15℃ by 18 to 26, 9 to 13 and 11 to 16 compared to that in 2000, respectively (PAK Jae Su, 2009).

Percentage of sunshine will significantly vary, too.

Over the past 35 years (1971 to 2005), percentage of sunshine systematically decreased, and significantly decreased for every season over a decade since the latter half of the 1990's (RI Chon Gi, 2010). For example, at present percentage of annual average sunshine in Wonsan is 48%, which is the decreased value by 7% compared to the average (55%) (KIM Won Guk *et al.*, 2011).

Percentage of sunshine, an important factor for agricultural production, also is projected to significantly vary by impact of climate change in future.

Impacts on crop culture

The current cultivated boundary line of crops will move 150 to 250km northwards and rise above 150 to 200m in height of sea-level.

In DPR Korea, at present, warmth and hotness resources able to realize multiple cropping by layer culture, as well as double cropping of grain to grain, in the northern inland regions such as Chagang Province where double cropping has been acknowledged to be impossible in the past are provided (KIM Won Guk *et al.*, 2011). Planting wheat, barley, potato and others as an earlier crop in several agricultural production regions in North and South Hwanghae Province like Yonan County has brought about high yields of earlier crops.

In future, limiting line for crop culture of the present may be found at elevations of 150 to 200m and moves 150 to 250km northwards for increase in accumulated temperature and number of duration days of accumulated temperature causing by climatic warming. Therefore, limiting line able to realize multiple cropping, as well as one-crop system, is projected to move northwards and to also raise double cropping index in the regions with increase in precipitation. Culture of paddy rice is projected to be possible in the regions of the country as a whole, and the kindly region for culture of autumn wheat to move northwards and the regions appropriate to culture of spring wheat to decrease.

Moreover, the regions able to safely culture the crops such as sugar cane and cotton whose culture is possible in temperate regions also are projected to increase.

Impacts on crop output

By 2100, per ha yield for main crops will increase by 18 to 27% for paddy rice, by 11 to 26% for maize and by 4 to 23% for bean.

According to estimation based on DSSAT software (UNFCCC, 2006), growing period of paddy rice, maize, wheat, barley and bean is projected to become fast overall, and per ha yield is projected to increase by 18 to 27% for paddy rice and by 11 to 26% for maize (Table 4-10, 4-11). And, per ha yield for wheat and barley is projected to increase or decline by place of life, and that for bean to increase by 4 to 23% (Table 4-11).

Table 4-10 Variation in growing period and yield of paddy rice and maize by main place of life (base year 2000)

Spot	Year	Variation in growing period (days)				Variation in per ha yield (%)	
		Earing of paddy rice	Tasseling of maize	Ripening of paddy rice	Ripening of maize	Paddy rice	Maize
Pyongyang	2050	-1 to -15	-5 to -11	-2 to -16	-5 to -12	115.4	116.9
	2100	-1 to -25	-6 to -13	-1 to -26	-6 to -13	119.6	123.8
Chongju	2050	-1 to -17	-5 to -15	-1 to -17	-5 to -10	121.0	110.0
	2100	-2 to -29	-6 to -18	-1 to -29	-8 to -19	126.5	117.8
Haeju	2050	-1 to -16	-3 to -10	-1 to -16	-6 to -20	115.5	115.6
	2100	-2 to -27	-5 to -14	-2 to -27	-6 to -22	119.5	125.5
Wonsan	2050	-1 to -19	-4 to -10	-1 to -23	-6 to -12	119.4	114.8
	2100	-3 to -32	-5 to -12	-2 to -34	-6 to -17	126.2	124.4
Hamhung	2050	-2 to -21	-5 to -13	-2 to -21	-7 to -15	121.4	107.8
	2100	-3 to -34	-7 to -15	-1 to -35	-8 to -20	117.9	110.7

Source: PAK Jae Su, 2009

Table 4-11 Variation in growing period and yield of wheat, barley and bean by main place of life (base year 2000)

Spot	Year	Variation in growing period (days)						Variation in per ha yield (%)		
		Earing			Ripening					
		Wheat	Barley	Bean	Wheat	Barley	Bean	Wheat	Barley	Bean
Pyongyang	2050	-4 to -11	-4 to -11	-2 to -10	-3 to -15	-3 to -15	-3 to -16	103.8	105.3	130.5
	2100	-5 to -25	-5 to -25	-3 to -21	-2 to -27	-2 to -27	-4 to -26	97.3	101.5	123.0
Chongju	2050	-5 to -17	-5 to -17	-3 to -17	-3 to -17	-3 to -17	-3 to -17	100.0	104.1	118.1
	2100	-6 to -29	-6 to -29	-5 to -29	-3 to -29	-3 to -29	-5 to -29	90.8	100.0	114.3
Haeju	2050	-3 to -16	-3 to -16	-5 to -16	-3 to -16	-3 to -16	-5 to -16	102.3	91.9	126.3
	2100	-5 to -27	-5 to -27	-7 to -27	-5 to -27	-5 to -27	-7 to -27	89.6	89.3	108.6
Wonsan	2050	-4 to -18	-4 to -18	-4 to -18	-4 to -23	-4 to -23	-4 to -25	99.1	93.0	110.0
	2100	-7 to -30	-7 to -30	-5 to -32	-6 to -34	-6 to -34	-6 to -34	90.8	82.4	104.2
Hamhung	2050	-4 to -21	-4 to -21	-5 to -21	-4 to -21	-4 to -21	-5 to -22	103.9	107.1	104.6
	2100	-6 to -34	-6 to -34	-6 to -34	-5 to -35	-5 to -35	-7 to -35	107.2	110.3	108.3

Source: PAK Jae Su, 2009

Impacts on crop growth

Crop production including maize, kaoliang, bean, rice and cotton would all suffer damage from high temperature.

If rise in temperature exceed upper threshold in critical temperature of crop, crop production is subject to restriction and the higher temperature brings forth damage from high temperature, thus all crop production including maize, kaoliang, bean, rice and cotton is adversely affected (KIM Won Guk *et al.*, 2011).

And then, if climatic warming occurs, moisture condition of soil becomes worse by drought, and therefore growing of wheat and barley is projected to get adverse effect.

Impacts on fruit culture

Arable areas for some fruit trees including apple would be less suited to culture.

Some fruit growing areas like apple may be unsuitable for culture by climate change. At present, rise in temperature in night and day in winter gives adverse impact on flower bud differentiation and blooming of fruit trees originated in the temperate zone such as apple and apricot, suitable land for culture gradually moves northwards and to higher elevation areas (PAK Je Un *et al.*, 2011). For example, apple tree suitable for culture only in the south of Kilju is able to culture to Myonggan County, North Hamgyong Province, and short apple tree suitable for culture only in the south of Pukchong to Kilju (PAK Jae Su, 2009).

Impacts on development of harmful insects

While first generation period of harmful insects will be fast and the number of breeding generations of insects of the year will increase, crop damages will be increase.

In recent years, the first infancy and zenith of harmful insects such as Asiatic rice borer (Chilo suppressalis) and corn borer have become earlier by 5 to 7days over the last 1960's (PAK Jae Su, 2009). Every year, grain loss by harmful insects accounts for 10 to 25%, whose majority is for rice bacterial leaf blight, rice borer and corn borer.

If temperature rises in future, in particular in winter, image of the 3rd generation of corn borer may be bred, and corn borer and rice borer that did breed once a year in the north of Hamhung also may breed twice a year. And then, more much damages are projected to be brought forth as harmful insects that could not pass the winter also may pass the winter, the first infancy may be fast and number of generations may increase.

Many harmful insects could develop and the development range would increase due

to improvement of the cultural conditions and the extension of cultural regions of crops.

In recent years (1991-2010), many rice leaf roller and caterpillars have developed due to increase in temperature (1991-2010) (KANG Hyon Jong, 2011).

Many rice leaf roller and caterpillars are projected to develop by climate change in future and wheat plant louse to be ubiquitous by improvement of the cultural condition in the main northern regions suitable for culturing winter wheat. And, white muscardine of wheat may be extensively disseminated if the proper precipitation is provided with increase in temperature (CHOE Hak Kwon, 2012). Meanwhile, development range of the harmful insects developed with the crops also is projected to change for the present land suitable to culture the crops may move northwards and some changes may be made in their wintering.

Tropical or subtropical harmful insects may bring forth as a result of increase in double cropping areas and change of agricultural species.

Tropical or subtropical harmful insects which are unquestioned now are projected to bring forth for the change in agricultural species may be made and double cropping areas also be extended northwards by climate change in future. This could be well seen from the fact that the rice virus disease existing only in tropical regions also has been developed in the country in 2009 (PAK Jae Su, 2009).

4.2.3 Impacts on coastal zone

Inundated area and damages from coastal flooding will be increased further.

Accumulation accelerated by sea-level rise will easily bring forth inundation in estuary, thus resulting in great deal of damages in future.

And, with sea-level rise, flood-ridden area in tidal rivers in the West Sea coast will be expanded (PAK Chang Il, 2011).

Saltwater intrusion will lead to the hurdle of freshwater use.

Negative impacts will be given to irrigation of croplands and drinking water supply around rivers as saltwater reversely flows up toward upper stream by sea-level rise (KWAK Il Hwan, 2002).

And, sea-level rise could make it impossible not only to culture crops by rise in underground water level and salification of underground water in coastal areas, but to supply freshwater (PAK Chang Il, 2011).

Coastlines in East and West Sea may retreat by 67 to 89m and 670 to 890m over 100 years in future, respectively.

Sea-level is projected to rise by 0.67 to 0.89m for 100 years, and without protective structures, the coastlines in the East and West Sea are projected to retreat by 67 to 89m and 670 to 890m, respectively as bed slopes in most coast are usually about 1/100 and 1/1,000 in Korean East and West Sea (KWAK Il Hwan, 2002).

Damages from sea-level rise will increase.

Table 4-12 Damages due to sea-level rise in the 21st century (base year 2000)

Classification	2030		2050		2100	
	A2	B2	A2	B2	A2	B2
Flood area (km^2)	222	205	449	387	1,027	857
Population of flood area (1,000 persons)	458	260	812	327	1,864	437
Decrease in wetland area (%)	9.8	9.8	17.4	17.2	35.3	28.7

Source: PAK Chang Il, 2011

Area and population of flooded regions in the coast are projected to increase to 857 to 1,027km^2 and by 440,000 to 1,860,000 especially, and area of wetland to decrease by 29 to 35% by sea-level rise for 100 years

in future (Table 4-12).

In particular, approximately 20% of cropland is of possibility to be flooded and, moreover, risk possibility is very great as high yield farms in South Hwanghae and South Phyongan Province, main grain-producing centre, mostly were located in coastal areas.

And, as densely populated with concentrated industrial parks, a huge amount of funds is projected to be needed for reinforcement of coastal protective structures such as breakwater, tideland dyke and river dyke, and for redistribution of population and economic activity in flooded regions, and as a result, much of economic loss is projected to be brought forth in coastal regions in the country.

4.2.4 Impacts on human health

The loss of life may increase by natural disasters such as flood, typhoon and high temperature.

In recent years (1990 to 2011), natural disastrous events such as flood, typhoon and high temperature have appeared several times and as a result, many loss of life has been brought forth. Number of dead from floods reached 116 in 1996 (KIM Kwang Phil, 2012b), and numbers of dead and missing from floods in the country were 454 and 156 in 2007 (MLEP, 2012).

Numbers of dead and missing from floods were 26 and 4 in 2011, respectively, and number of dead from typhoon in June and August was 4, respectively (KIM Jong Ho, 2012).

Loss of life from natural disasters is projected to increase as floods and droughts whose intensity is greater than the present and high temperature events are projected to frequently appear in rainy season in future.

Incidence of infectious diseases such as malaria, cholera and acute diarrhea and various maladies may increase.

In the last mid-1990's, various diseases such as cholera, acute diarrhea and malaria never seen in the country in the past have appeared by natural disasters such as heavy rain and flood, and as a result, much of negative impacts has been given to human health and life (CBS, 2011). Outbreak rate of malaria spread out since the late 1990's has been fixed at a relatively low level as a result of strengthening of prevention and hygienic propaganda since 2003 (Figure 4-8). Malaria which is prevalent in DPR Korea is vivax malaria, and unlike tropical malaria, there is no dead by the malaria.

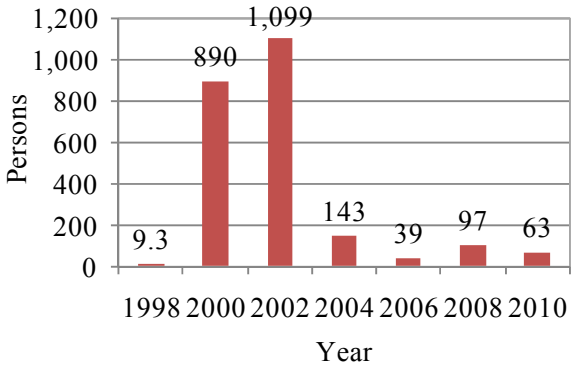


Figure 4-8 Case rate of malaria per 100,000 persons

Source: CBS, 2011

In view of rise in temperature and frequent occurrence of disastrous climatic events in future, incidence of various epidemics and diseases such as tropical malaria, cholera and acute diarrhea is projected.

4.2.5 Impacts on ecosystem

Impacts on forest ecosystem

The land area suitable to culture major forest tree species will decrease and the productivity will decline.

At present, forest zone in the country rises, while Abies nephrolepis-Picea jezoensis forest zone gradually decreases and many species including Taxus cuspidate become extinct regionally (KIM Kwang Chol, 2008). Over the last 40 years, limiting line of forest in the area of Mt. Paektu has been widened by 50m vertically and by 1,000m in the east part horizontally. And, according to the survey on forest plant cover over the last 30 years, forest zone located in the lower part in form of Pinaceae forest-Quercus acutissima forest-coniferous and broad leaved mixed forest-Abies nephrolepis-Picea jezoensis forest-eurya

japonica/Betula eramii forest-subalpine shrubbery forest-alpine meadow had the trend rising up.

According to the assessment using the empirical-statistical bioclimatic model (UNEP, 1998), productivity and area of land appropriate to culture Larix lepolepis tree, Larix olgensis/larch tree, pine-nut/Pinus koraiensis tree, oak/Quercus acutissima tree, pine/Pinus densiflora and Korean poplar/Populus Maximowiczii tree are projected to gradually decrease. Productivity of main forest tree species is projected to significantly decline in South and North Hwanghae Province, Kwangwon Province and South Phyongan Province regionally, and by tree species, productivity of Abies nephrolepis-Picea jezoensis and Korean poplar/ Populus Maximowiczii species is projected to largely decline. In case of Larix lepolepis tree, area of suitable land is projected to decrease, moving to northern highland area and productivity to gradually decline in the region of South Phyongan Province, Kwangwon Province and North Hamgyong Province.
In case of larch/Larix olgensis tree, productivity is projected to significantly decline in the regions of lower than 200m high above the sea-level and to gradually decline in the regions of up to 800m high above the sea-level, and in case of pine-nut/Pinus koraiensis tree, productivity to gradually decrease only in the regions of lower than 200m high above the sea-level.

Forest damages from flood, landslide and forest fire, etc. would increase.

In recent years, much of forest has been destructed and degraded from repeated natural disasters. Over the period 1996 to 2005, area of woodland has been decreased by 5.8% and forest accumulation decreased (MLEP, 2012). And, much of interruption has been given to the activity for afforestation owing to the destruction of over 30% of tree nurseries by soil erosion, landslide and deposition (KIM Kwang Chol, 2008). Several hundreds of thousands hectares of forest suffered damage from heavy rain and flood in 1995 and 1996. Destruction and degradation of forest decrease the overall productivity and environment protection capacity of forest, increase disastrous events such as flood and landslide, reduce habitats, speed up washing out of bio-species and destruction of ecosystem and also give negative impacts on diversity of fluvial and coastal ecosystem. Meanwhile, damages from forest fire by continued drought also increase. Forest fire events have occured 365 times, area of forest fire occurrence regions was 128,000 000ha, accumulation of forest has decreased by 21,000m^3 and 16,000m^3 by damages from forest fires in all in 2000 and 2002, respectively.

As flood, landslide and forest fire events are projected to be more frequent and intensive by climate change in future, thus forest damages also are projected to increase.

Forest pests would explosively frequent generate.

In recent years, forest pests frequently have appeared, and damages from them increased in the country (KIM Kwang Chol, 2008, MLEP, 2006a).

About 32,000 hectares of forest suffered damage from forest pests by the incidence of various forest pests such as larch caterpillar all over the country in 2002. Caterpillar never seen in the 1990's has appeared in the 2000's and explosively increased since 2005, and been expanded to the East Sea coast such as Kangwon and South Hamgyong Province.

Pine leaf black fly appeared in the early 1960's and periodically increased over the period 1970's to 1990's had the decrease trend in the early months of the year 2000 and was increased in reoccurrence stage since 2005, and has given heavy loss to Pyongyang City, South Phyongan Province, North Hwanghae Province, South Hwanghae Province and Kangwon Province in the end of May, 2008.

Korean pine sawfly developed in the mid-1990's and disseminated across the country in the late 1990's had the decrease trend in 2005 and again, was spread, and

pine cottony-cushion scale appeared for the first time in North Phyongan Province in 1970 has been decreased in the latter half of the 1990's and was increased again since 2005.

It is expected that forest pests explosively appear more frequent as favorable condition for incidence of forest pests is provided by climatic warming.

Impacts on economic plants

The land suitable to culture and the cultivated boundary line of economic plants originated in subtropical zone including persimmon tree will continue to rise northwards.

Continuous culture line of persimmon tree which was possible to culture only in the south regions of Pyongyang in the past has moved from Munchon in Kwangwon Province to Jongphyong in South Hamgyong Province in the East Sea coast over the last 30 years (1981 to 2009) (PAK Je Un *et al.*, 2011). And, at present, economic plants which are relatively stable in culture in Wonsan are persimmon tree/Diospyros Kaki, trifoliate orange/Poncirus trifoliate, perennial ampelopsis, hydrangea, Cedrus deodara, and it could be seen that trifoliate orange/Poncirus trifoliate and Cedrus deodara are completely acclimatized to the climatic and soil condition in Wonsan region. Meanwhile, fig tree/Ficus carica tree, subtropic fruit tree, is cultivated in the south region of Sariwon.

If annual mean temperature in the middle East Sea coast regions such as Kosong, Wonsan and Hongwon increases to above 12℃ by climatic warming in future, the regions will be most suitable land for culture of persimmon tree, and persimmon tree could be cultured up to the southern regions in North Hamgyong Province widely. And, the species with relative strong resistance to cold such as bamboo, giant tara vine and perennial ampelopsis could be possible in culture in coastal regions in South Hamgyong Province. Orange tree/Citrus nobilis and tea tree/Thea sinensis which are cultured in Anpyon, Wonsan and Chonnae in Kwangwon Province on trial at present, are possible to industrially culture and, and thus will be broadly cultured in coastal regions in Kwangwon Province, if annual mean temperature rises above 12℃.

Impacts on biodiversity

The number of plant species and the range of plant community will vary.

According to the survey in 2005, endangered higher plants was 153 species, and typical endangered and rare plants were Viola websteri, Echinosophora koreensis, Pentactina rupicola, Keumkangsania asiatica, Panax Schinseng, Gastrodia elata, blue Gastrodia elata, Forsythia ovate and Forsythia densiflora, etc (Table 4-13).

Meanwhile, zone of plant distribution regions in the country has the tendency climbing up (KIM Kwang Chol, 2008). According to the recent survey, 4 heteromorphisms, 19 varieties, 27 species, 8 genera, 1 family newly were included in plant catalog in Ryanggang Province and 1 heteromorphism, 10 varieties, 16 species, 2 genera in plant catalog in North Hamgyong Province.

Table 4-13 Numbers of species of endangered animals and plants (2005)

Classif-ication	Numbers of endangered species (species)				
	Critically endang-ered	Enda-ngered	Vuln-erable	Near threat-ened	Total
Plant	16	31	51	55	153
Animal	2	8	46	105	161

Source: CBS, 2011

And, lespedeza robuta, acer ginnala, cynanchum atratum, white angelica, hispid mountain maple, etc. which have grown only in the south of the middle region in the past newly have moved to the range of the northern plants.

And, subalpine plant zones in the region of Puktaebong mountain range and Masikryong mountain range gradually decrease and, in particular, range of subalpine plants decrease while subalpine plants gradually decrease by other broad leaved trees in the subalpine areas in the

southern part of South Phyongan and Kwangwon Province.

According to the estimation using climate cover method (UNEP, 1998), range of Abies nephrolepsis-Picea jezoensis forest community, Abies nephrolepsis-Picea jezoensis-larch/Larix olgensis forest community, Abies nephrolepsis-Picea jezoensis-eurya japonica/Betula eramii forest community, larch/Larix olgensis-eurya japonica/Betula eramii forest community and alpine plants community gradually decrese, and that of larch/ Larix olgensis-mongolian oak/Quercus mongolica forest, mongolian oak/Quercus mongolica-linden/Tilia amurensis forest, pine/Pinus densiflora-Q.acutissima forest, Larix lepolepis forest, pine/Pinus densiflora forest, Q. acutissima forest, white birch/Betula platyphylla forest, aspen/Poplus davidiana forest, Korean poplar/Populus Maximowiczii forest and eurya japonica/Betula eramii forest also are projected to gradually decrease by 2100 in future. And, all replacement of subalpine plant community distributed by half point and in process of shifting of community, at present, with subarticle and temperate plant community is projected in the middle 21st century. Besides, range of tidal plant community and sandy beach plant community is projected to overall move to land.

The number of animal species and their range will vary, too.

In the country, Japanese crested ibis/Nipponia nippon and crested Sheldrake/Tadorna cristata already have not been seen since the late 1970's (KIM Kwang Chol, 2008) and, according to the survey in 2005, number of species of animals affected by climate change was 161, and typical endangered and rare species were tiger, leopard, wolf, otter, deer, antelope, musk deer and others (Table 4-13). Meanwhile, hooppoe, redstart, great spotted woodpecker with red belly, narcissus flycatcher, stilt, wood sandpiper and others living only in warm or low regions fly into the shore of Lake Chonji of Mt. Paektu in recent years (KIM Kwang Chol, 2008).

Rise in temperature in winter season and serious loss of habitats will give very unfavorable effects on inhabitation of migratory birds.

At present, white crane with a red crest/Manchurian crane and blackfaced spoonbill/Platalea leucorodia which are the rare species in the country suffer threat from habitat decrease (KIM Kwang Chol, 2008). Cholwon region in Kwangwon Province in the country is the wintering place for white crane with a red crest/Manchurian crane, one of the typical endangered and rare species. If temperature in winter in the middle East Sea coastal regions in the northern part of Cholwon rises in future, range of wintering places also is of possibility moving northwards or expanding gradually. Meanwhile, severe decrease in area of wetland in the estuaries of Amnok, Chongchon and Taedong River by sea-level rise in the West Sea coastal zone in the country will give very unfavorable effect on the habitat of migratory birds.

Many exotic species will settle down, which will bring much of damages.

60 species of exotic plants have been settled down up to now (KIM Kwang Chol, 2008). Typical exotic plants are Amorpha fruticosa, Dactylis glomerata, white sweet clover and rag weed, etc. In particular, damages from rag weed destructing biodiversity and giving negative impacts on human life are raised here. Besides, 30 species of weeds are the main object for plant quarantine in connection with negative impacts on farmland ecosystem.

Impacts on coastal and marine ecosystem

In the Korean East Sea, aestival migratory fish resources will increase, hydric habitat of seaweeds will move northwards and their harvest time will be moved up.

In recent years, annual average water temperature in the Korean East Sea systematically rises, and that after the 1990's was increased by 1.0 to 1.1℃ than in the 1960's (Table 4-14). And, many aestival migratory fish (anchovy, saury and squid,

etc.,) migrate to the open sea of the country and habitats of seaweeds (seaweed and tangleweed) rise up northwards with advancement of harvest time by sea variation in the open sea of the Korean East Sea, which will be accelerated by climate change in future (RI Kwang Il, 2009)

Table 4-14 Average water temperature in the Korean East Sea coast in recent years (℃)

Classifi-cation	1960's	1970's	1980's	1990's	2001-2008
Average water temperature	11.1	11.6	11.5	12.2	12.1

Source: RI Kwang Il *et al.*, 2009

In Korean West Sea, resources of non-migratory and migratory fish living in warm water will increase, and seaweeds will be bred on a large scale in coastal region in North Phyongan Province.

In recent years, water temperature rapidly rises in the northern of Korean West Sea. Water temperature in 1967 was 10.9℃ and that in 1998 12.4℃, which means that temperature raised 0.05℃ on average every year (RI Sol Yong *et al.*, 2002). Spring in 1998 has started earlier by 20 days than the average and that in 1999 earlier by 25 days, and flowering time of springtime floating plants also earlier by about 20 days. And, wintertime ice rapidly decreases and no icy regions also increase in the north of Korean West Sea. The year with little or no ice was the year 1989, the year 1992, the year 1998 and the year 1999. Marine climate zone in Korean West Sea has moved northwards by about 100km by global warming for recent 10 years. Recent variation in marine eco-environment simultaneously appearing in the north of Korean West Sea and Korean West Sea gives favorable condition for maintenance and increase of non-migratory fish living in warm water and migratory fish resources.

Also, marine eco-environment condition able to culture seaweeds such as sea tangle in coastal regions in North Phyongan Province on a large scale is being formed.

4.3 Adaptation Measures to Climate Change

Climate change in DPR Korea in the 21st century is projected to significantly affect on sustainable development of the country and people's living, in particular on water resources, agriculture, forest, ecosystem, coastal regions and public health. Therefore, reducing negative impacts of climate change through development and implementation of adaptation strategy and measures to climate change presents itself as a most important problem.

4.3.1 Adaptation strategy

Overall goal

The overall goal of adaptation strategy to climate change is to recover degraded natural eco-environment, improve its function, establish economic, social and environmental structure coping with climate change, and raise up responding capacity to negative impacts of climate change into the advanced level (KIM Jong Ho, 2012).

In details

- To recover severely degraded ecosystem and strengthen its resistance to rapidly changing climate condition, while to reduce negative impacts of climate change affecting socio-economic sectors through ecology building and development of technology.
- To reflect adaptation measures to climate change to the important national policies, strategies and mid or long term development program, strengthen legal and systematic environment for its implementation, establish political, institutional and social framework for stable and sustainable development of the country by establishing adaptation technologies and measures to climate change in all domains and fields.
- To make living condition and life environment environmentally stable in the whole society by minimizing damages from natural disasters through establishment of scientific and rapid early

warning system for natural disasters occurring by climate change and bringing ex ante adaptation measures in step.

Sectoral goals

Water resources

- To minimize damages from flood events and protect ecosystem and environment in basins by building management capacity of basins in rivers, streams and lakes and establishing early warning system, and to rebuild and modernize production processes by modern technologies and processes of low level in water consumption in main fields of the national economy, establish rational water distribution and consumption system based on scientific analysis on water needs and meet the people's need for clean water.

Agriculture

- To decisively raise fertility of soil in rice paddies and dry fields by systematic and sustainable management of rice paddies and dry fields, increase grain output and secure food safety by establishing development and dissemination system of advanced agricultural technologies and integrated management system for harmful insects and weeds for coping with climate change, raise up fruit production to the advanced level and realize varieties of fruit species by breeding and introducing high-yield fruit species with resistance to harmful insects and good quality.

Coastal region

- To minimize damages from various disastrous events through establishment of national system to protect coastal ecosystem, and by reconstruction and modernization of infrastructure in coastal regions such as reinforcement of sea dyke and establishment of information communication network, and to make favorable environment to sustainable development of social economy in coastal regions by realizing integrated management of coastal regions to protect and increase coastal resources.

Public health

- To establish database for various infectious diseases related to climate change and monitoring system, and to rise up level of medical science and technology and medical service to the advanced level, with establishment of the whole social environment and hygiene management spirit.

Ecosystem

- To prevent forest destruction and degradation, recover degraded forest and improve service function to eco-environment and its productivity, and to make favorable eco-environment to the conservation of biodiversity through establishment of monitoring and forecast system for various disastrous events and rational and sustainable use of forest resources, as well as contribution to socio-economic development of the country.

Basic direction of the strategy

First, to establish in the entire society an approach for adaptation to climate change through strengthening public awareness and technology dissemination, and through supplementing and completing laws, regulations, institutions and management systems related to adaptation to climate change.

Second, to carry out adaptation measures to minimize negative impacts of climate change, reflecting them to the national strategy for development of science and technology, energy and agriculture, etc.

Third, to ensure investment for the work to minimize loss of life and property, and build the national capacity for prevention of disastrous events through establishment of the national real-time monitoring system, early warning system and enhancement of corresponding capacity of central and Government bodies to natural disasters such as flood, drought, forest fire, landslide, typhoon and tidal wave, etc., caused by climate change.

Forth, to build research and development capacity related to adaptation to climate

change. To train technicians and experts through various opportunities and processes such as university education, training course and practice, etc., and to contribute to improvement of people's living and sustainable development of the country through concentration on research, development and introduction of advanced adaptation technologies and methods.

Fifth, to establish the system for efficient water resources management, scientific agricultural production and advanced medical care corresponding to negative impacts of climate change.

Sixth, to encourage every member of the society to the work to effectively cope with negative impacts of climate change, and to actively accelerate bilateral and multi-lateral cooperation with international organizations and other countries.

4.3.2 Adaptation measures

Water resources

Measures taken

The Government of DPR Korea has enacted laws and regulations such as Law on Water Resources, Law of Rivers and Streams, Law on Barrage, Law on Waterway, Law on Pollution Protection in Taedong River, Law on Sewer, Law on Organic Industry and Law on Meteorology related to protection and sustainable management of water resources (Table 2-9).

It accelerates the work to use water resources in effective and sustainable manner, attaching significant importance on it. Many barrages including West Sea Barrage, large and small dams including dams of Taechon, Nyongwon and Huichon hydropower plant and various facilities were built and contribute to meet the water needs of the national economy, preventing damages from floods.

The Government of DPR Korea concentrates on protection and management of water resources according to the growth of population, development of industry and improvement of people's material and cultural life. It organizes and develops river improvement, repair and governance work according to river improvement plan by year through mass mobilization for land administration. Construction and technical reconstruction of sewage treatment plants are also accelerated, and water purification technology by reversed osmosis method is introduced as well. ("Rodongsinmun" 4 December, 2011) The Government of DPR Korea also strengthens its legal control over river polluting by means of the "Principle on polluter's payment" (KIM Kwang Pil, 2012a).

Non-permanent commissions for flood prevention measures are organized and come into operation over the period July to September, flood period, every year and the State Hydro Meteorological Administration keeps service for flood forecast.

The Government of DPR Korea raises public concerns on conservation of water resources by means of mass media such as TV, radios, newspapers, magazines and others, and actively takes part in bilateral and multi-lateral cooperation with international organizations and other countries for conservation and management of water resources.

Adaptation measures

- Establishment of national system for assessment, monitoring and early warning of disastrous events.
- Prevention of water pollution and introduction of efficient water purification technology.
- Establishment of system for rational distribution and consumption of water resources.
- Building the management capacity of lakes and rivers.
- Establishment of integrated and sustainable watershed management system.
- Establishment of the strategy for long-term development and use of water resources.
- Securing underground water resources and constructing small reservoirs.
- Establishment of sustainable and stable

drinking water supply system.

- Pricing of water resources.
- Raising of public awareness and improvement of water consumption manner.
- Conservation of drinking water resource and treatment of household wastewater.

Agriculture

Measures taken

The Government of DPR Korea, consistently adhering to the agriculture-first principle, has enacted laws and regulations such as Law on Agriculture, Law on Fruit Culture, Law on Land, Law on Tideland, Law on Livestock Industry (Table 2-9), put forwards the green revolution policy, double cropping policy, policy on radical turn in potato farming and bean growing policy and put forward the development of agricultural science and technology focused on food production as the basic strategy to solve food problem. The Government of DPR Korea actively contributes to realization of action plan of the World Summit Conference for Food Safety and the UN MDGs by developing the Juche methods of farming to ensure stable yield through the scientific and technical farming appropriate to climatic and soil condition of the country, biological features of crops and geographical characteristics of the field, and by strengthening material and technical support to rural areas.

The Government of DPR Korea takes active measures such as construction of gravity waterways, reclamation of tideland, land rezoning, river improvement, afforestation for erosion control, planting of windbreak forest, field terracing projects, soil fertility improvement, reclamation of cold and humidity land, protection of land and others in order to solve food problem by one's own efforts through increase of agricultural production.

From 1998 up to now, 100 000 hectares of land only in South Hwanghae Province and several hundreds of thousands hectares of land all over the country were rezoned into large scale standardized fields, and over the last decade, vast tideland such as the Taegyedo and Kumsong Tideland was reclaimed and turned into fertile land. Area of tideland-turned rice field which was 1.8% of total area of rice field in the country has become 2.3%, with yearly increase (CBS, 2011). And with the construction of the large scale Kaechon-Taesong waterway in October 2002, and after that, about 10 000 km of gravity waterways such as the Paekma-Cholsan waterway and Miru waterway all over the country, sufficient irrigation water is now available for several hundreds of thousands hectares of farmland. ("Rodongsinmun" 2 March, 2012)

Adaptation measures

- To accelerate development and dissemination of advanced agricultural technologies coping with climate change.
- To establish integrated and sustainable management system of fields.
- To establish integrated system for prevention of harmful insects and weeds management.
- To breed and introduce good varieties of grain and fruit with great harvest.
- To establish forecast system for growth and yield of crops.
- To distribute crops and varieties according to the principle "Right crop into right soil, right crop at right time" and to improve methods and technologies for crop cultivation
- To introduce technology for integrated close planting cultivation with great harvest.
- To breed the crops resistant to heat and drought and good breed of livestock.
- To establish cycling production system combining agricultural production with livestock.
- To introduce organic farming method, in particular, conservation agriculture.
- To secure arable land by reclamation of tideland.

Coastal zone

Measures taken

The Government of DPR Korea has laid

legal basis for economic development in coastal regions and protection of eco-environment and resources in all coastal regions of the country by means of enactment of the laws and regulations such as Law on Fishery, Law on Prevention of Sea Pollution, Law on Tideland, Law on Pisciculture and other regulations (Table 2-9).

Sea dykes and seawalls have been constructed in dangerous regions in order to prevent coastal erosion, and the tidelands in the West Sea such as Taegyedo Tideland are built with a far-reaching plan.

National attention is paid to the development of coastal cultivating industry. Fish farms and breeding facilities built up in all parts of the country such as the downstream of Amnok River yield a great result and the work to culture seaweeds such as brown seaweed and sea tangle is actively undertaken.

Adaptation measures

- To build the capacity for integrated management of coastal regions.
- To construct infrastructures such as seawalls and protective facilities in coastal regions.
- To reallocate population and economic activities.
- To introduce the crops resistant to salt.
- To establish the system for assessment of dangerous regions to coastal disaster appearance and early warning to coastal disaster.
- Scientific management of population in coastal zone.
- Setting up windbreak forest.
- Protection and development of fishery resources

Public health

Measures taken

The Government of DPR Korea has enacted laws and regulations such as Law on Public Health, Law on Public Hygiene, Law for Prevention of Epidemics, Law on Medicine Management and Law on City Management while consistently keeping up the preventive medical care policy and initiating an active hygienic and anti-epidemic work and hygienic communication work in order to protect human life with the improvement of public health (Table 2-9).

Great success is achieved in the work to prevent various infectious diseases such as malaria through improvement of medical care environment and material and technical condition in public health institutions.

With increase in production of medicine such as basic and reserve medicine, and establishment of distant medical care service system, campaign to develop medical science and technology up to the advanced level is actively conducted.

Activities for public awareness raising and training on dangerousness, incidence of diseases and measures to climate change are actively undertaken, with the strengthening of the forecast work for disastrous events caused by climate change by means of the mass media.

Adaptation measures

- To strengthen the hygienic and anti-epidemic work.
- To strengthen the medical service related diseases caused by hot climate.
- To establish database for various infectious diseases and sustainable monitoring system for disease.
- To establish system for medical meteorology forecast on fatal epidemics and diseases.
- To strengthen the education on public health and training of experts.
- To improve people's hygienic amenity.
- To realize urban afforestation.

Ecosystem

Adaptation measures

The Government of DPR Korea has laid a legal basis to protect and use biodiversity in sustainable manner, and to strengthen creation, protection and management of forest ecosystem and resources as enacted laws and regulations like Law on Protection of Scenic Spot and Living Monument, Law on Nature Reserve, Law on Plantation, Law

on Forest, Protection Law of Useful Animals, Law on Veterinary Inspection, Law on Management of Veterinary Medicine and Law on Border Inspection of Animals and Plants (Table 2-9).

DPR Korea, as the Party of the UN Convention on Biodiversity, makes and implements the national strategy and action plan for biodiversity and the national framework for biosafety, and focusing on protection, sustainable development and use of bioresources with great expanded reproductivity, detailed plans to protect various ecosystem and variety of species, in particular gene resources.

DPR Korea protects and multiplies anima resources, setting March to July as the period for protection of useful animals and plants with newly renovated preservation areas in keeping with the requirement of the new century.

At present, there are 2 biosphere preservation areas (Mt. Paektu and Mt. Kuwol), 80 nature parks (Mt. Kumgang, Mt. Chilbo, etc), 4 nature reserves (Mt. Oga, Mt. Rangrim, Kyongsong and Kuanmo Hill), 25 plant preservation areas (Jangsan Point, Mt. Suyang, etc), 50 animal preservation areas (Mt. Danga, Mt. Suryong, etc), 26 fishery preservation areas (11 in the East Sea, 4 in the West Sea and 11 in internal water regions), 4 resource preservation areas, 36 living momument preservation areas already settled in the country (RI Ho et al, 2009). Preservation areas which reached 5.7% of total area of the national land before the 1990s increased to 6.1% in 2000 and above 7% in 2009 (CBS, 2011).

Explanation, communication and dissemination work to raise public concerns about nature and biodiversity preservation are actively undertaken by means of newspapers, magazines, TVs and radios, and takes part in bilateral and multi-lateral cooperation for preservation and sustainable use of nature and biodiversity.

Adaptation measures

- To control outbreak of forest pests caused by climate change and realize integrated management of forest pests.
- To recover degraded forest areas and manage firewoods in residential areas.
- To improve the system for protection of ecosystem in coastal regions in Korean West Sea.
- To improve control system of existing nature preservation areas.
- To introduce method for sustainable forest management.
- To increase the production of healthy sapling and improve tree species of forest.
- To develop and implement the national REDD+ program.
- To create the seed bank for endangered, rare and special species.
- To prevent infectious diseases of transboundary animals.

Cross-cutting sector

Adaptation measures

- To improve the information service on climate in DPR Korea.
- To improve the observation network in DPR Korea.
- To build the capacity to realize integrated control of water resources in the basin of Taedong River.
- Capacity building for improvement of disaster management system based on residential areas.
- To establish the agricultural production system based on efficient use of water resources.
- To strengthen the education and public awareness related to climate change.
- Planning of spectacle eco-city management and implementation of the model.
- To build the Government bodies' capacity coping with various disasters.

4.3.3 Priority adaptation options

Priority adaptation options in sectoral adaptation measures to climate change for sustainable development of the country are presented in Table 4-15.

Table 4-15 Climate change impacts and priority adaptation options by sector

Sector	Impacts	Priority adaptation options
Cross-cutting	• Increase in damages from natural disasters	• Improvement of climate information service in DPR Korea. • Improvement of observation network in DPR Korea. • Capacity building for integrated water resources management in the Taedong River basin. • Capacity building for improving the community-based disaster management system.
Water resources	• Decrease in water availability • Deterioration of water quality • Increase in frequency and intensity of floods, droughts and landslides.	• Introduction of technologies for water pollution prevention and efficient water purification. • Establishment of systems for rational distribution and consumption of water resources. • Capacity building for management of reservoirs and rivers.
Agriculture	• Changes in regions suitable for cultivation. • Changes in the length of growing season • Decline in crop productivity • Increase in damages from harmful insects.	• Promotion of developmet and dissemination of advanced agricultural technologies coping with climate change. • Establishment of integrated and sustainable management system of arable soil. • Establishment of integrated system for prevention of harmful insects and weed management.
Coastal zone	• Coastal flooding • Retreat of coastline • Salt water intrusion • Increase in damages from flood.	• Capacity building for integrated management of coastal zone. • Construction of infrastructures such as seawalls and protective facilities in coastal zones. • Rearrangement of population and economic activities.
Public health	• Increase in incidence of infectious diseases.	• Strengthening of hygienic and anti-epidemic work. • Strengthening of medical services related to the diseases caused by hot weather. • Establishment of database for various infectious diseases and sustainable monitoring system for dieseases.
Ecosystems	• Shift in the structure of biological communities • Changes in the number and range of species • Loss of habitats for species • Increase in damages from forest pests.	• Recovery of degraded forest and firewood forest management in community areas. • Control of forest pests outbreaks by climate change and integrated forest pest management. • Improvement of ecosystem conservation system in coastal zone of the Korean West Sea. • Improvement of management system for existing nature reserves.

Source: KIM Jong Ho, 2012

CHAPTER 5 CLIMATE CHANGE MITIGATION STEPS AND MEASURES

Chapter 5 Climate Change Mitigation Steps and Measures

DPR Korea as NON-Annex I party of the Convention has no responsibility for mandatory GHG emission reductions by the Convention and Kyoto protocol. But DPR Korea systematically proceeds with policies and measures for mitigation to climate change in order to achieve the goal of the Convention.

This is a summary of the information on that according to the Paragraph 1(b), Article 12 of the Convention.

5.1 Mitigation Policies and Measures

DPR Korea attaches great significance to environment protection in building powerful nation.

In 1999, DPR Korea has developed the following least-cost GHG abatement strategy through implementation of "Asia Least-Cost GHG Abatement Strategy" (ALGAS) (1995 to 1999) under the cooperation of the UNDP/GEF (KIM Su Hong *et al.*, 2000).

- Making and implementing basic national policies related to environment protection,
- Improvement in energy efficiency and decrease in energy consumption,
- Extension and development of alternative energy use,
- Active development and conservation of forest resources,
- Development of GHG mitigation technologies in agricultural sector,
- Strengthening of international cooperation to protect global environment and climate.

Arriving at the new century, DPR Korea has revised and supplemented the Law on Environment Protection with the contents related to global warming in accordance with the requirements of the developing situation, and enacted the Law for Environment Impact Assessment to prevent environment destruction and keep environment clean in 2005 (Table 2-9).

And, DPR Korea has raised the authority of the MLEP, and is bringing new turn in the works for environment protection.

Besides, the Government has pointed environment protection as an important development strategy to achieve goals of the MDGs by the year 2015, and rate of forest area, CO_2 emissions per capita, consumption of ozone destruction materials and proportion of degraded land in total land area, etc., as achievement indices (CBS, 2011).

5.1.1 Mitigation policies and measures by sector

DPR Korea has newly enacted, revised and supplemented sectoral laws and regulations contributable to the prevention of global warming while achieving sustainable development (Table 2-9), and is making good headway strategies, policies and measures for GHG mitigation for each sector (Table 5-1).

Energy supply

Energy industry in the country is the main sector related to sustainable development, people's living and environment protection of the country, and at the same time the largest GHG emission source.

Enactment and enforcement of laws and regulations related to energy

DPR Korea puts forward the sufficiency of increasing energy demand and guarantee of stability in energy supply as the energy policy in order to develop the national economy and improve people's living.

In recent years, Law on Coal (2009), Law on Mid or Small Power Plant (2007), Law

on Cruid Oil (2007) and Law on Thermal and Pressure Equipment Supervision (2007) newly have been enacted, and Law on Electric Power, Law on Energy Management and Law on Underground Resource Management were revised and supplemented.

Energy strategy

DPR Korea has established the energy strategy to sustainably provide energy necessary for building of powerful nation, energy saving and environment protection, and vigorously carries on the struggle to realize that (KIM Kwang Il, 2006).

The energy strategy has been revised and completed in 2012 (SPC, 2012).

Table 5-1 GHG mitigation strategy, policy and measure by sector

Sector	Strategy	Policies and measures
Energy supply	Technical modernization, and development and utilization of renewable and new energy resources	• Enactment and enforcement of laws and regulations related to energy. • Energy strategy. • Modernization of existing thermal power plants. • Creation of hydropower generation capacity. • Development of new energy resources including atomic energy. • Introduction of clean coal combustion technology. • Improvement of the network for transmission and distribution of electricity. • Promotion of development and implementation of CDM projects.
Transport	Modernization and improvement of transport management	• Introduction of heavy rails and modernization of railway. • Introduction of modernized, heavy-duty and high-speed road. • Car service by date of the week and control of loadless trucks. • Encouragement of public transport facilities. • Encouragement of walking and bicycle use. • Improvement of transport organization and control, and vehicles.
Buildings	Improvement of energy efficiency	• Introduction of efficient lighting and card type watt-hour meter. • Saving of residential fuel. • Supply of cooking, heating and hot water by solar energy. • Heating and cooling of buildings by geothermal energy. • Improvement of heat insulation of buildings. • Energy efficiency standards and labeling.
Industry	Modernization and energy saving	• Clean production and improvement of energy efficiency. • Energy saving. • Introduction of high temperature air combustion technology.
Agriculture	Sustainable development of agriculture	• Development strategy in agricultural sector. • Establishment of naturally flowing irrigation system. • Methanization in rural households. • Introduction of advanced farming methods including organic farming method. • Effective use of fertilizer and irrigation.
Forestry/ forests	Forestation and landscape-orientation of the whole country	• Enactment and enforcement of laws and regulations related to forestation, and forest conservation and management. • Scientification, industrialization and intensification of sapling production.

Sector	Strategy	Policies and measures
		• All-people campaign for planting trees. • Innovation of forestation, and forest conservation and management work. • Sustainable forest management.
Waste management	Sustainable waste management	• Enactment and enforcement of laws and regulations for waste management. • Integrated solid waste management. • Composting of organic waste. • Recycling of waste. • Controlled waste water treatment.

Source: KWAK Man Su, 2012

Modernization of existing thermal power plants

Over the period 1997 to 2007, aerial pulverizer, heat pipe-type air preheater and optimum operating system for power plants have been introduced and generation facilities have been updated by the modernization measures for existing thermal power plants, and in recent years, the work to improve efficiency and capacity through further maintenance, reinforcement and modernization of generation facilities in accordance with the modernization strategy of the national economy was accelerated (KWAK Man Su, 2012).

Creation of hydropower generation capacity

In recent years, modernization of hydropower stations was propelled activley in the country, and large, middle and small hydropower stations such as Huichon power plant, Wonsan youth power plant, Nyongwon power plant, Ryesonggang power plant, Paekdusan songun youth power plant, Orangchon power plant, Wonsan kunmin power plant and Kumyagang power plant, etc., have been constructed or under construction.

Hydropower generation accounted for 64.8% of the total electricity output of the country in 2009 (CBS, 2011).

Huichon power plant with several hundreds of thousands kW of generation capacity constructed by the peculiar way of hydropower generation has come into operation in April 2012.

Development of new energy resources including atomic energy

DPR Korea has put forward the active development and use of new energy resources such as nuclear energy, solar energy, tidal power, geothermal energy, wind energy and biomass energy, etc., as important requirement for building of powerful nation (PAK Myong Ok, 2004).

Peaceful use of nuclear energy whose raw material resource is abundant in the country is the most promising way to ease the strain on the power. DPR Korea, in 1992, has enacted Law on Atomic energy to build self-reliant atomic energy industry, and after that, revised and supplemented it several times, and decided to build hard water reactor by one's own efforts according to the national strategy for economic development on condition that hard water reactor power plant to be provided by the outside had no prospect able to be realized.

As of the end of the year 2011, construction of hard water reactor for test and production of low enriched uraium to supply fuel were accelerated at high speed.

Besides, technologies for small wind turbine and small electricity generation by rice husk gasification have been developed and introduced into several units, and technology for tidal power generation has been developed on trial (KWAK Man Su, 2012).

Introduction of clean coal combustion technology

In accordance with the national measures

encouraging introduction of clean combustion technology, the work to modify old pulverized-coal fired boilers such as large hot water boiler in the Pyongyang thermal power plant and pulverized-coal fired boilers in the 2.8 vinalon complex to circulating fluidized bed boilers in several units successfully has been accelerated (KWAK Man Su, 2012). Meanwhile, technology for coal gasification in place in small power plant with 2MW capacity was developed on experimental basis.

Improvement of the network for transmission and distribution of electricity

DPR Korea also has taken measures to make an effective use of electricity by improving and completing the network of transmission and distribution of the country, and by carefully stagger alternative production and dispatch command.

In recent years, the constructions to make the main grid more stable and build new substations were completed or under completing in Pyongyang City, South Phyongan Province, South Hwanghae Province and North Hwanghae Province, and load auto-control system was introduced into network of transmission and distribution in several counties.

Transport

DPR Korea, in order to achieve sustainable development of the transport sector, has revised and supplemented the Law on Railway, Law on Road and Law on Automobile Traffic in recent years, and newly enacted the Law on Road Traffic regulating no thoroughfare for the vehicles which doesn't meet exhaust gas criteria and public order for bicycle use, etc., in 2004.

DPR Korea also has taken several measures such as rational completion of the overall road net of the country, modernization, making weight-duty, making high speed, use by date of the week of road and supervision of unloaded car service, etc.

At present, reconstruction and restoration work of the northern railway is in progress and the AC locomotives and AC trolleybuses using AC motors which are small in consumption of electricity instead of the DC motors are produced and introduced.

Over the last period 1996 to 2005, several thousand kilometers of road such as the Youth Hero Road newly have been constructed, several thousand kilometers of the existing road were reconstructed technically, and thus, road net of the country was made more rationally and technical state of road was improved remarkably (PAK Ho Yong, 2006).

And then, traffic of old vehicles emitting much exhaust gas has been prohibited in Pyongyang City since 2011, and measures to reduce number of cars as possible also have been taken (RI Myong Il, 2009).

And, April and October in the country have been stipulated as the period for intensive repair of road, and road repair and management are carried out with all people campaign.

Meanwhile, DPR Korea, where to afford convenience in people's everyday life and to ensure people's health are the top priority, actively encourages use of public means of transportation such as passenger train, tram-car, trolley bus and passenger bus, and bicycle and pedestrian exercise, and the corresponding national measures have been taken. Sunday is "Day for Pedestrian Exercise" in DPR Korea.

Buildings

Introduction of efficient lighting and card type watt-hour meter

In recent years, the work to install efficient CFLs or LEDs, instead of incandescent lamp, and introduce card type watt-hour meter into residential buildings and public building to reduce GHG emissions by decreasing domestic electricity consumption is being accelerated. To do so, the Government lets broad sections of masses voluntarily take part in this work by raising popular public awareness on electricity saving, and strengthens the legal control to waste of electricity.

Besides, CDM PoA project displacing incandescent lamp with CFLs is actively

accelerated to promote introduction of efficient lighting.

Saving of residential fuel

100 ways for fuel saving in households such as ignition briquette, biomass briquette, heat radiation insulation kitchen range and wood stove, etc., already have been developed, introduced and generalized on a national wide scope in the country (NEDC, 2005).

Fine view able to use coal of low-calorific value, fly ash from thermal power plant, meta-anthracite and low grade coal as fuel was opened through development of the additives for combustion coal of low-calorific value and meta-anthracite in recent years, and the works to introduce that everywhere are accelerated.

Besides, weathered gneiss coal briquette made by mixing weathered gneiss with biomass, lignite briquette and biomass fuel rod also have been developed and introduced actively.

Supply of cooking, heating and hot water by solar energy

In recent years, the work to introduce solar cauldron, solar water heater and passive solar heating system actively is accelerated in the country as a whole.

At present, solar cauldron has been introduced in several units such as North Phyongan Province tideland reclamation complex, Hongwon County, South Hamgyong Province and Phyongwon County, South Phyongan Province, and passive solar heating system able to save fuels for heating up to 50% also has been generalized in several units such as rural households in Sapyong-ri, Anphyon County, and Kangwon Province.

In particular, the centre for solar equipment production specializing in development, production and dissemination of solar equipment newly has been built in 2011. The centre with productivity of several thousand sets of complete glass vacuum tube-type solar water heater per year actively accelerates the work to produce and disseminate solar water heater on a large quantity in future, based on the experience already obtained at introduction of solar water heater into several buildings in Pyongyang City such as Mangyongdae district.

Besides, gravity thermal pipe-type solar water heater also has been developed and used for hot water supply for duck breeding in Tudan duck farm.

Cooling and heating of buildings by geothermal energy

DPR Korea attaches great significance to cooling and heating of buildings by geothermal energy providing convenient living conditions as well as saving energy to the utmost.

In recent years, following the introduction of air condition system by geotherm to the wide area of the buildings in Huichon Ryonhwa machine complex, the works to use geothermal energy in several units such as stadiums in Chongchun Street and Chongbangsan food complex are actively carried out, and Ryongsong machine complex has started to develop and produce geothermal equipment with large capacity in a serial way.

Industry

Clean production, energy efficiency improvement and energy saving

DPR Korea newly has enacted the Law on Organic Industry in 2005, and accelerates the work to observe requirements of the Law on Energy Management regulated to make an effective use of energy, save energy and improve efficiency of energy equipment for "May, month for electricity saving" and "October and November, months for saving of fuel and power".

In recent years, the work to modify production process with much electricity consumption into that with less electricity consumption or no electricity consumption in chemical industry and metal industry is accelerated, which is in line with the requirements of the Law on Electric Power as well as the Law on Energy Management.

Besides, the work to introduce the

technologies for steam saving such as steam trap into foodstuff factories and chemical factories and the work to introduce floating calcinations kiln into cement factories are conducted.

Introduction of high temperature air combustion technology

With the acceleration of the policy requiring the introduction of high temperature air combustion technology into furnaces in the country in recent years, sure prospect able to increase by over 30% in heat efficiency in furnaces was open.

Typically, high temperature air combustion technologies were introduced into forging heating furnace in Hwanghae iron manufacturing complex in 2009 and glazed kiln in Hoeryong glazed earthenware factory in 2011 and rolling heating furnace in Kim Chaek iron manufacturing complex in 2012.

Agriculture

DPR Korea has enacted the Law on Agriculture regulating protection of agricultural resources, improvement of irrigation way, utilization of organic fertilizer, farming land improvement, prevention of damages from pests and others in 1998, and attaining to the new century, revised and supplemented to suit the requirements of the developing situation and newly enacted the Law on Livestock Industry in 2006.

Development strategy in agricultural sector

DPR Korea has singled agricultural production out as the mainstay of building of powerful state and laied down the development strategy in agricultural sector in order to epochally increase agricultural production with the general mobilization and concentration of all efforts to agricultural production (PYO Kwang Chol, 2008).

The important thing in the development strategy in agricultural sector, first of all, is to vigorously accelerate green revolution, holding fast to it as the main thing, and to place all farm works on a scientific and technological basis with the active introduction of advanced farming technologies and methods. What comes next in importance is to go on the implementation of radical turn in potato farming and double cropping policy while undertaking grain production as the main thing, and to concentrate efforts on bean growing. The next in importance is to drastically improve and strengthen the material service work to agriculture.

Establishment of naturally flowing irrigation system

DPR Korea has presented the policy to complete the irrigation system of the country in keeping with the requirements of the new century through construction of many naturally flowing-type waterways, and actively drives forward it.

Since the Kaechon-Taesong Waterway, for the first time, has been constructed as the sample of the naturally flowing-type waterway in October 2002, totally about 10,000km of naturally flowing waterway have been constructed over a decade past. With the construction of large or medium and small naturally flowing waterways never known in the country such as the Kaechon-Taesong Waterway, Paekma-Cholsan Waterway and Miru Waterway, sufficient irrigation water is now available for several hundreds of thousands hectares of cropland with the saving of 120,000kW of electricity through removal of about 1,000 sets of water pumps and motors.

The ground-breaking ceremony of new naturally flowing-type waterway able to supply sufficient irrigation water for several tens of thousands hectares of croplands and reclaimed tideland fields in several counties such as Ongjin, Kangryong and Pyoksong County in South Hwanghae Province with saving of several tens of thousands kW of electricity in January 2012.

Methanization in rural households

In recent years, good quality organic fertilizer is produced, as well as methane for cooking, from various animal manure, agricultural byproduct and domestic wastewater through introduction of

household biogas digesters into rural households in several cooperative farms all over the country such as Miegok cooperative farm in Sariwon City, North Hwanghae Province in accordance with the national policy on realization of methanization in rural households.

Introduction of advanced farming methods including organic farming method

Today, the work to introduce organic farming methods making no use of chemical fertilizers and agrochemicals actively is accelerated in DPR Korea.

Many cities and counties in various areas including Sariwon City and Sukchon county have built and run the organic compound fertilizer factories well by collecting and making good use of local raw material sources, resulting in great benefits.

Organic farming method by mud snail also is widespread at high speed. Area of croplands where mud snail has been introduced across the country in 2011 was several tens of thousands hectares, which was the increased value by over 4 times over the year before.

And, the work to introduce the protective farming method, one type of organic farming methods, that is, non-plowing culture which makes it possible to increase the fertility of soil, save fuels and prevent environmental pollution also is accelerated. Non-plowing culture in paddy fields and dry fields including non-plowing direct sowing and non-plowing rice-planting is being conducted an examination in several rural areas from some years.

Besides, the work to establish cyclic production system also has been accelerated. Several units including Unha cooperative farm in Unjon County have increased grain output with the use of little chemical fertilizer through the production of high quality organic fertilizer by the introduction of cyclic production system of agricultural production and livestock industry, and also significantly increased livestock products through the use of agricultural byproducts.

Forestry/forests

Enactment and enforcement of laws and regulations related to forestation, and forest conservation and management

Attaining new century, DPR Korea has revised and supplemented the Law on Forest and the Law on Land related to afforestation, conservancy, use of forest resources, forest management and protection of land resources on several occasions in keeping with the requirements of the developing situation. Besides, the country has newly enacted the Law on Land Planning related to land administration including land rezoning, afforestation, resource development and environment protection in 2002, Law on Nature Reserve in 2009 and Law on Plantation in 2010.

Scientification, industrialization and intensification of sapling production

DPR Korea has made the material and technical basis able to realize forestation and landscape-orientation of the whole country through the active acceleration of the work for scientification, industrialization and intensification of sapling production.

With about 100 hectares of the Central Plant Nursery organized under the MLEP and the production bases of saplings of good species strongly made at forest management office and cooperative farms in every province, city and county, about a billion trees of saplings were produced and afforestation is undertaken under a long range program.

All-people campaign for planting trees

DPR Korea holding fast to the principle of "One tree cut, ten trees replant" has actively accelerated afforestation/ reforestation of forest through tree planting movement of the whole masses during period of the spring and autumn general mobilization for land administration every year since 1996. As a result, area of degraded forest land significantly has been decreased by afforestation and covering of degraded forest every year.

Over the past period 1990 to 2005, area of firewood forest has increased from 1,944km^2 to 3,988km^2 (MLEP, 2012).

Over the period 1995 to 2005, above a ten billion trees have been planted in almost all impoverished mountains (PAK Ho Yong, 2006).

In recent years, the 10-year plan for afforestation (2001 to 2010) to newly afforest about 1.5 million ha of forest has been accelerated and planting good species of trees around high ways and railways changed the appearance of area along the road and railway (CHONG Jong Dok, 2008).

At present, DPR Korea accelerates the work to realize 500,000ha of afforestation and 150,000ha of agroforestry systems by the year 2015 (CBS, 2011).

Innovation of forestation, and forest conservation and management work

In order to apply a unified and efficient approach to the afforestation and protection and management of forest resources, DPR Korea has taken the measures to strengthen the authority and function of the department of forest management under the MLEP.

And, on condition that the real state of forest of the country is not particularly improved though many trees are planted in every spring and autumn, DPR Korea has taken a decisive measure to innovate the work for afforestation, protection and management of forest.

DPR Korea, defining the period from November to next March as the period for forest protection and the period from March to May as the Period for forest pest extermination, carries out the gigantic struggle to realize afforestation of the mountains bared by flood, drought and forest fire through an all-people campaign in accordance with the plan by year and long-range plan within a decade.

Waste management

DPR Korea has taken legal measure to prevent environment pollution and provide cultural, hygienic condition for living through establishing strict institution and order in discharging and treating wastes, industrial wastewater and domestic sewage. DPR Korea newly has enacted the Law on Wastes Handling in 2007 and Law on Sewage in 2009

And, inorganic wastes such as building waste are selected in corresponding discharge places, carried to entombment places and entombed for treatment while fertilizer factories for good harvest built in relevant places in circumjacent areas of the city treat domestic wastes, in particular organic wastes for production of fertilizer. In recent years, organic compound fertilizer factory producing high quality organic fertilizer by integrated treatment of sludge from Potong River, sediment from sewage treatment plants and slag has been built in Pyongyang City.

And, the Government of DPR Korea tightens the control of the factories which discharge organic wastewater so as to operate after the construction of wastewater treatment plants.

In recent years, the Government of DPR Korea lets high quality organic fertilizer produce through treatment of livestock wastewater from cattle farms and pig farms and organic wastewater from silk mills and chemical factories, and meanwhile anaerobic digestion systems and technologies developed to recover and use biogas have been introduced into several units and is in progress with CDM PoA project

5.1.2 CDM activity

DPR Korea has ratified the Kyoto Protocol on April 27, 2005, and actively is accelerating CDM project activities through building institutional and human capacity for development and implementation of CDM projects contributable to sustainable development of the country.

CDM institutional arrangements

On July 1st, 2008, DPR Korea has informed to the Secretariat of the UNFCCC that the secretariat of the NCCE acts as the DNA relating with CDM activity in the country.

The DNA plays the role issuing letter of approval of CDM project, as well as giving a unified coordination to all CDM activities

of the country (KWAK Man Su, 2012).

Besides, DPR Korea has set up the Cabinet non-permanent commission for CDM in February 2011, and taken national measure so that the General Bureau for Cooperation with International Organizations (GBCIO), Ministry of Foreign Trade plays a role as the secretariat in order to activate CDM activities.

Capacity building for CDM

DPR Korea, starting with the importance of CDM in sustainable development and technology transfer, actively has accelerated the national target "Research to modernize energy industry through CDM" over 2008 to 2012 (Table 6-1). The experiences able to accelerate CDM on a full scale were accumulated and the experts' capacity was improved through this process.

The Government of DPR Korea also has built the capacity by making experts attend on several CDM training courses, workshops and symposiums (Table 6-5), publishing and disseminating literatures on CDM such as "Application of CDM" and "CDM activity guideline" (Table 6-7) among several stakeholders.

In particular, national training course undertaken in July 2008 was good opportunity to make headway CDM activity in line with the situation of the country, and CDM international hands-on training undertaken in June 2009 made the country take an important step forward in the work to realize the first CDM project (Table 6-5).

CDM project development

Fields of applicable CDM projects possible in DPR Korea are hydropower generation, methane recovery from manure, CFLs introduction, methane recovery from coalmines, methane recovery from industrial wastewater, biomass and wind farm, etc.

DPR Korea has worked particularly hard in development of CDM projects by experts for mitigation analysis while directing mitigation analysis to development of CDM project carrying out mitigation analysis in CDM situation. As a result, the 1st CDM project in the country has registered to the CDM EB on May 16, 2012 (Table 5-2).

Table 5-2 CDM project activities in DPR Korea

№	Project title	Credit buyer	Status	Project Ref./ID	Emission reductions (tCO_2/yr)
1	Hamhung Hydropower Plant No.1	Czech Republic	Registered May 16, 2012	5887	23,738
2	Kumya Hydropower Plant	Czech Republic	Registered Jul 13, 2012	5888	19,874
3	Paekdusan Songun Youth 14 MW Hydropower Project No.2	Czech Republic	Registered Jul 13, 2012	5889	47,689
4	Ryesonggang Hydropower Plant No.4, DPR Korea	Czech Republic	Registered Jul 20, 2012	6721	32,719
5	Ryesonggang Hydropower Plant No.5, DPR Korea	Czech Republic	Registered Aug 22, 2012	7053	34,476
6	Ryesonggang Hydropower Plant No.3, DPR Korea	Czech Republic	Registered Oct 23, 2012	6949	34,979
7	Wonsan gunmin Hydropower Plant No.1 (20MW)	Czech Republic	At validation	CDM07997	67,260
8	Coal Mine Methane Utilization and Destruction Programme in DPR Korea (Kogonwon Coal Mine: CMM-DPRK-1)	UK	At validation	PoA0155.01	143,049
9	Methane Utilization and Destruction Programme from Industrial Wastewater in DPR Korea (Pulp	UK	At validation	PoA0217.01	41,164

	Wastewater Treatment at Sinuiju Chemical Fibre Factory: IWW-DPRK-1)				
10	Methane Utilization and Destruction Programme from Animal Waste Management System (AWMS) in DPR Korea. (Sokjong/SSCPA-AWMS 01/DPR Korea)	Czech Republic	At validation	PoA0240.01	9,563
11	CFL Lighting Scheme in Democratic People's Republic of Korea (DPRK) (CFL Lighting Scheme in DPRK: EDCSHP - CPA # 1)	Czech Republic	At validation	PoA0242.01	22,318

Source: www.cd4cdm.org

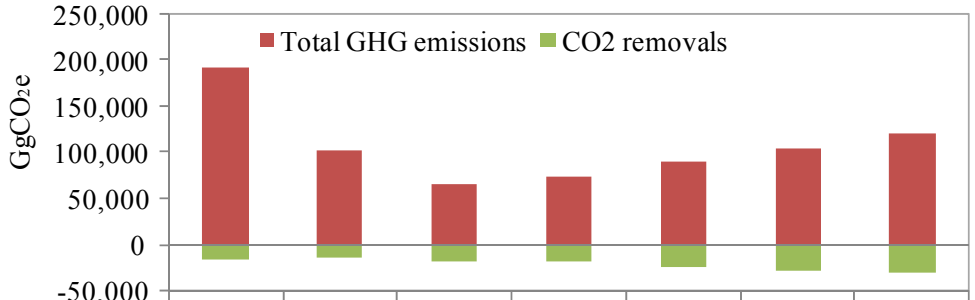
As of October 2012, 6 CDM projects were registered, and one CDM project and 4 CDM PoA projects were in validation (Table 5-2). But DPR Korea still is one of the countries whose registered CDM projects are less than 10.

5.2 Projection for GHG Emission Trends up to 2020

Summary of projection for emission trends

LEAP and IPCC 2006 software were used in order to project trend for GHG emission up to the year 2020.

In the mean time, the data used for preparation of the national GHG inventory for the period 1990-2002 and development strategy and goals for construction of economically powerful nation, and the national energy strategy were used. Emission trends in AFOLU and waste sector were projected based on the socio-economic development scenario and the former emission trends.



	1990	1995	2000	2005	2010	2015	2020
Total GHG emissions	193,489	102,680	65,714	72,468	89,649	104,544	121,203
CO2 removals	-16,443	-16,041	-19,087	-19,603	-24,723	-28,757	-32,442

Figure 5-1 Total national GHG emissions and CO_2 removals for the period 1990-2020

Table 5-3 Emissions by sector for the period 2000-2020 ($GgCO_2e$)

Sector	2000	2005	2010	2015	2020	Rate of change (%) (2000-2020)
ENERGY	73,417	80,023	98,270	114,922	131,982	3.0
IPPU	4,840	5,341	9,412	11,887	14,949	5.8
AFOLU	-13,686	-14,071	-19,246	-23,559	-27,124	3.5
WASTE	1,143	1,175	1,215	1,294	1,396	1.0
Total	65,714	72,468	89,649	104,544	121,203	3.1

Source: CHOE Song Chol, 2011, KWAK Man Su, 2012

By the trends for GHG emissions, total national GHG emissions are projected to continue increasing after 2000 on for recovery of the national economy declined in the early 1990's (Figure 5-1).

By 2020, the total national GHG emissions are projected to amount to 121,203GgCO_2e, which is the decreased value by 37.4% compared with 1990 and the increased value by 84.4% compared with 2000.

For the period 2000-2020, annual average growth rate of total GHG emissions will account for 3.1% (Table 5-3).

Meanwhile, CO_2 removals by sinks in the country in 2020 will amount to 32,442Gg and annual average growth rate will account for 2.7% (Figure 5-1).

For the period 2000-2020, emissions from energy, IPPU and waste sector will increase by 3.0%, 5.8% and 1.0% on annual average for population and economic growth, and that from AFOLU sector will decrease by 3.5% on annual average for increase of CO_2 removals by sinks (Table 5-3).

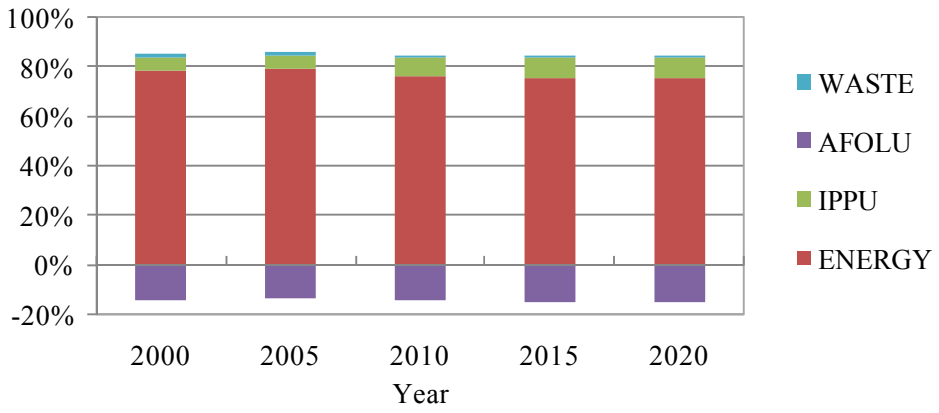


Figure 5-2 Share of emissions by sector in the total national GHG emissions for the period 2000-2020

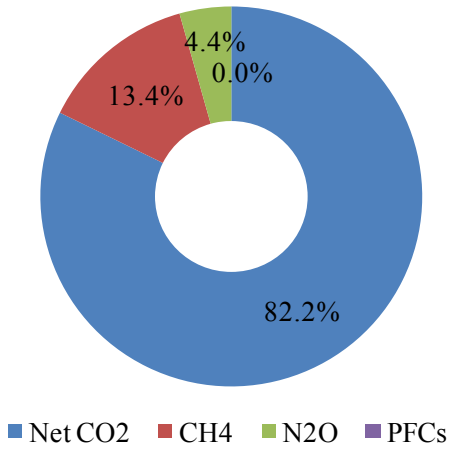


Figure 5-3 Share of emissions by gas in the total national GHG emissions in 2020

And, variation in proportion of energy, IPPU and AFOLU sector in the total national GHG emissions for the period 2000-2020 is projected to be insignificant (Figure 5-2).

Attaining 2020, energy sector is projected to be the largest emission source, accounting for 89.0% of the total national GHG emissions without consideration of CO_2 removals, and IPPU and waste sector to account for 10.1% and 0.9% respectively.

Meanwhile, net CO_2 emissions are projected to increase by 3.3% on annual average due to the increased consumption of

energy by economic growth for the period 2000-2020 (Table 5-4).

And, CH_4 and N_2O emissions are projected to increase by 2.1% and 4.0% on annual average and PFCs emissions to decrease by 13.4% on annual average.

Over the same period, net CO_2, CH_4 and N_2O proportions of the total national GHG emissions are projected to be of insignificant variation, accounting for 82.2%, 15.3% and 2.5% in 2020 (Figure 5-3, Figure 5-4).

And, PFCs emission proportion will be so small that it could be neglected.

Table 5-4 Emissions by gas for the period 2000-2020 ($GgCO_2e$)

Gas	2000	2005	2010	2015	2020	Rate of change (%) (2000-2020)
Net CO_2[(1)]	52,108	57,592	72,807	85,600	99,656	3.3
CH_4	12,227	13,185	14,597	16,358	18,544	2.1
N_2O	1,376	1,688	2,246	2,585	3,003	4.0
PFCs	3	3	0	0	0	-13.4
Total	65,714	72,468	89,649	104,544	121,203	3.1

Comment: [(1)] Net CO_2 emissions (emissions-removals)

Source: CHOE Song Chol, 2011, KWAK Man Su, 2012

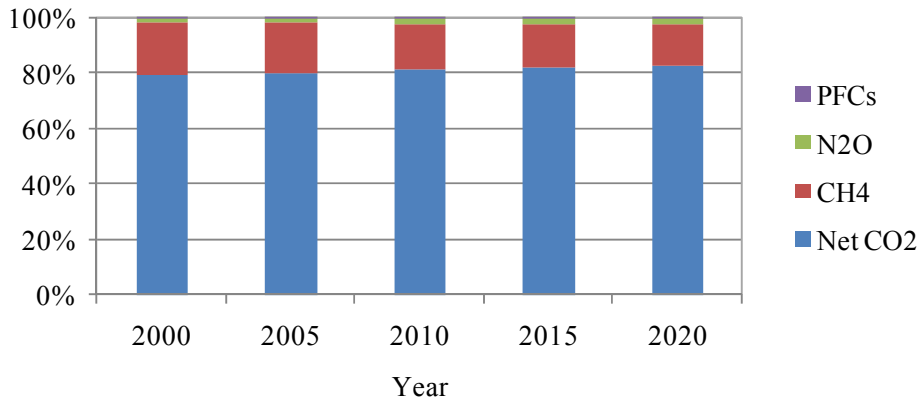


Figure 5-4 Share of emissions by gas in the total national GHG emissions (2000-2020)

Emission trends in energy sector

Here considers only emission trend in energy sector expected as the largest emission source in the country in future.

Energy consumption in the country also will increase for population and economic growth for the period 2000-2020.

In 2000, DPR Korea has relied on domestic coal for 60.3% of total primary energy supply and hydropower and imported crude oil for the rest.

Attaining 2020 in future, domestic coal in the country also will be in charge of 61.1% of total primary energy supply.

GHG emissions in energy sector for the increased consumption of energy for the period 2000-2020 are projected to increase by 3.0% on annual average and amount to 131,982$GgCO_2e$ by 2020, which is increased by 79.8% compared with 2000 (Figure 5-5).

For this period, GHG emissions from fuel combustion activities and fugitive emissions from fuels categories under energy sector are projected to increase 3.0% and 3.2% on annual average respectively (Figure 5-6).

Attaining to 2020, GHG emissions from fuel combustion activities category are projected to amount to 119,756$GgCO_2e$, accounting for 90.7% of the GHG emissions from energy sector.

That is to say, fuel combustion activities category will be the most important emission source in the country in future.

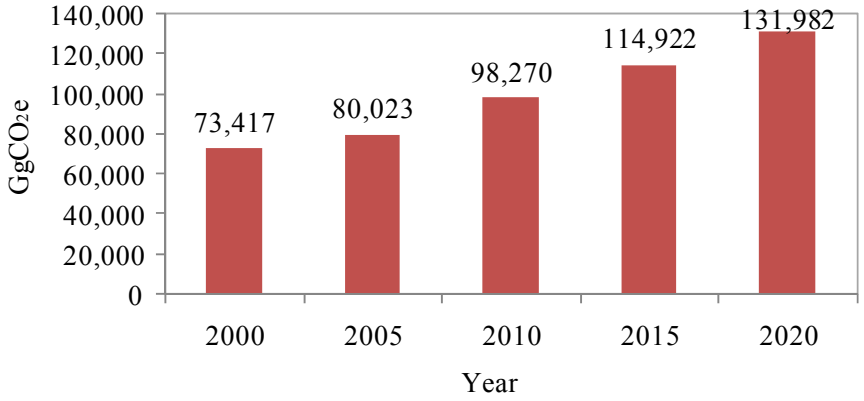
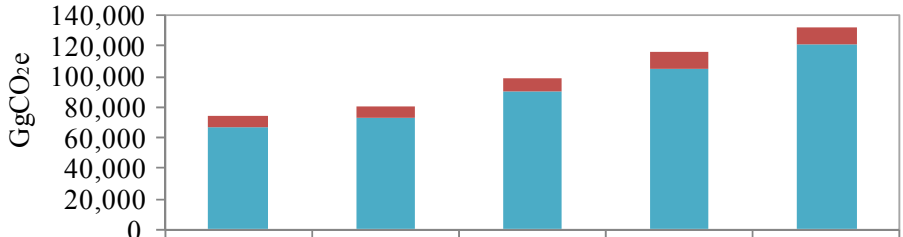


Figure 5-5 GHG emissions from energy sector for the period 2000-2020



	2000	2005	2010	2015	2020
1B Fugitive Emissions from Fuels	6,525	7,200	8,616	10,228	12,226
1A Fuel Combustion Activities	66,892	72,823	89,654	104,694	119,756

Figure 5-6 Emissions by category in energy sector for the period 2000-2020

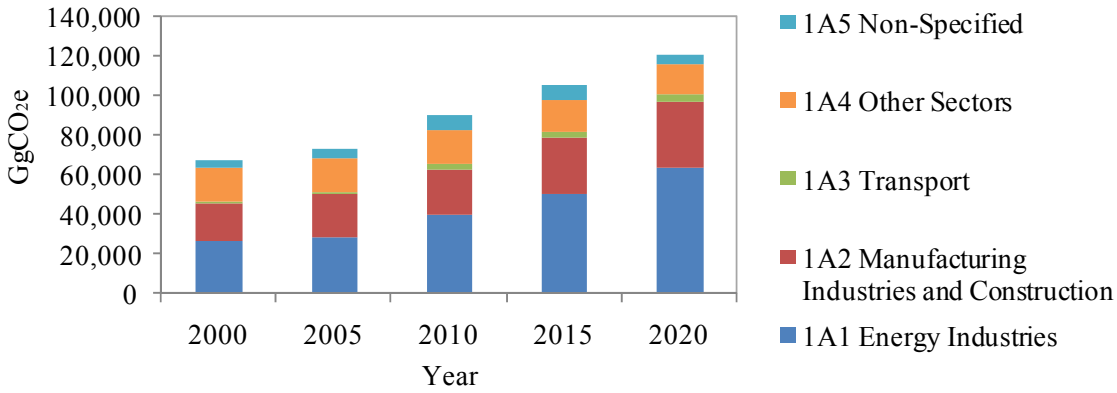


Figure 5-7 Emissions by sub-category in fuel combustion activities for the period 2000-2020

In details, emissions from 1A1 energy industries and 1A2 manufacturing industries and construction are projected to increase by 4.5% and 2.8% on annual average, and that from 1A4 other sectors (commercial/institutional, settlements, agriculture/forestry/fishing/fish farms) to decrease by 0.4% on annual average for the period 2000-2020, and total emissions from the subcategories are projected to amount to 111,503GgCO_2e in 2020, accounting for 84.5% of the emissions from energy sector (Figure 5-7).

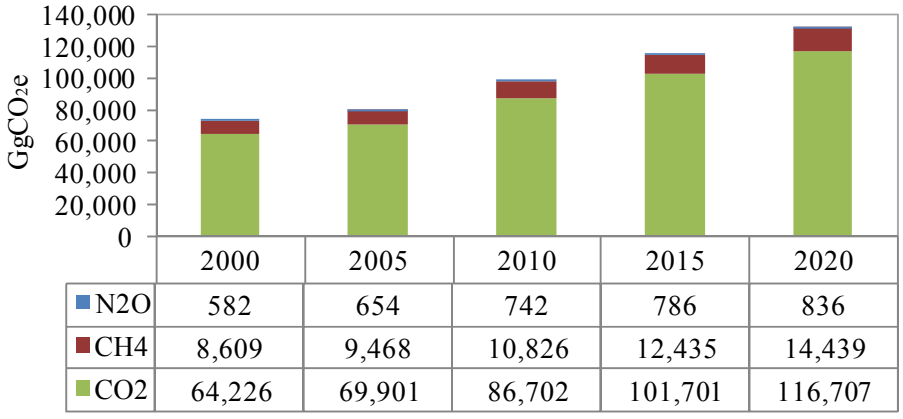
Meanwhile, CO_2 will be the GHG with the largest emission proportion in energy sector for the economic feature relying on domestic coal for the period 2000-2020 and CO_2 emissions, through increasing by 3.0% on annual average, will amount to 116,707Gg in 2020, accounting for 88.4% of

the emissions from energy sector (Figure 5-8).

With respect to proportions of subcategories in CO_2 emissions from energy sector for the same period, 1A1 energy industries will take the foremost place, following by 1A2 manufacturing industries and construction and 1A4 other sectors (Figure 5-9).

For the period 2000-2020, CH_4 will take the second place in emission proportion by gas in energy sector and CH_4 emissions will amount to 14,439GgCO_2e in 2020, accounting for 10.9% of the emissions from energy sector (Figure 5-8).

Regarding CH_4 emission proportion by subcategory in energy sector, 1B1 solid fuels will take the foremost place, following by 1A4 other sectors (Figure 5-10).



	2000	2005	2010	2015	2020
N2O	582	654	742	786	836
CH4	8,609	9,468	10,826	12,435	14,439
CO2	64,226	69,901	86,702	101,701	116,707

Figure 5-8 Emissions by gas in energy sector for the period 2000-2020

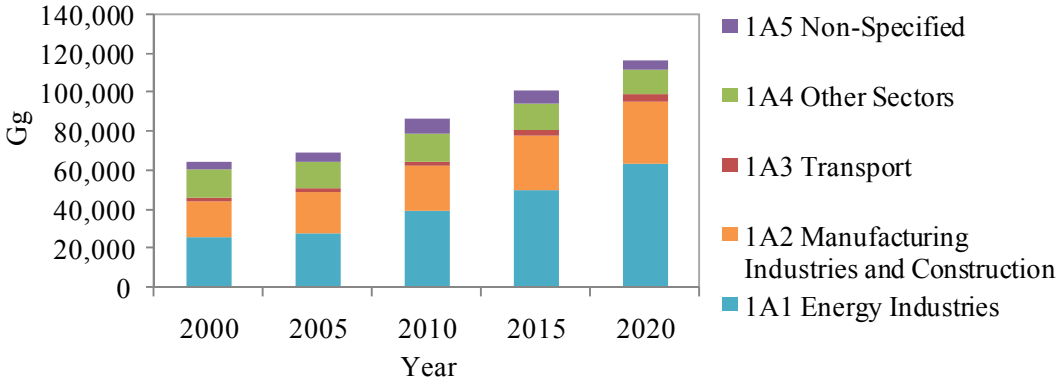


Figure 5-9 CO_2 emissions by sub-category in energy sector for the period 2000-2020

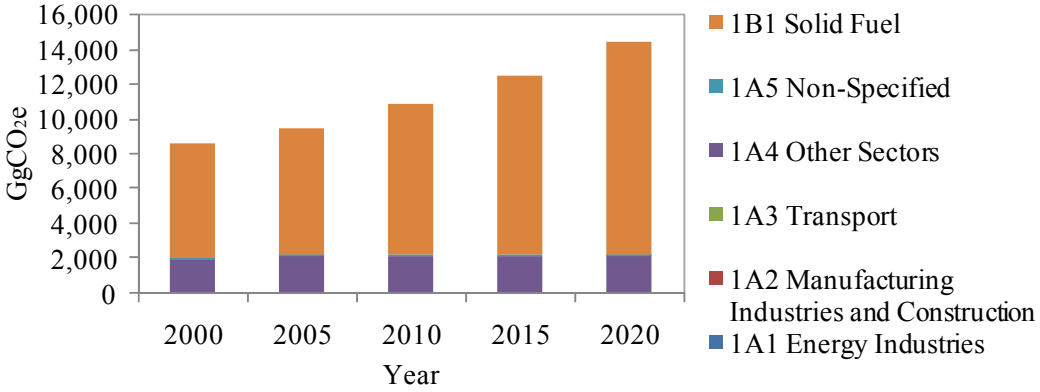


Figure 5-10 CH_4 emissions by sub-category in energy sector for the period 2000-2020

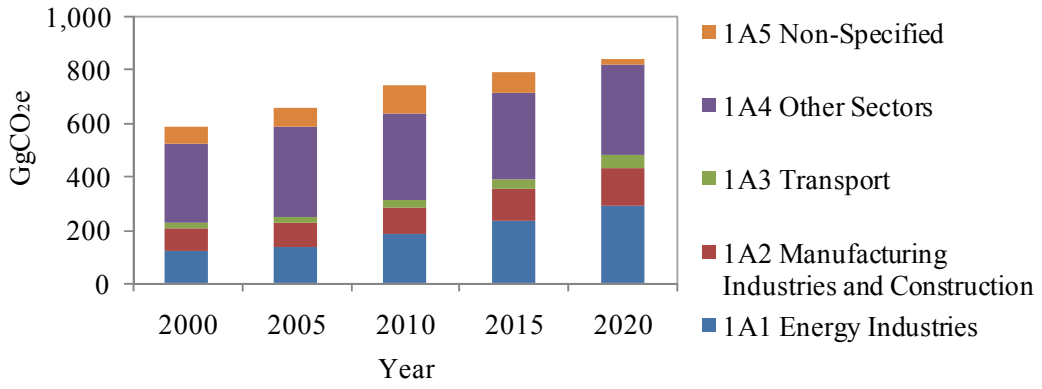


Figure 5-11 N_2O emissions by sub-category in energy sector for the period 2000-2020

And, regarding N_2O emission proportion by subcategory which may be neglected in emission proportion by gas in energy sector for the same period, 1A4 other sectors will take the foremost place, following by 1A1 energy industries.

5.3 GHG Mitigation Options

In future, DPR Korea will concentrate the national priority on the work to realize the magnificent objective for construction of the economically powerful nation, which leads to rapid economic growth

And, as mentioned above, total national GHG emissions contributable to global warming also are projected to increase for this fact.

DPR Korea considering the work for environment protection as the noble and patriotic work for the country and nation has identified the mitigation options including CDM projects and assessed annual GHG abatement potential and abatement cost for each option based on the projection results of trends for GHG emission in accordance with the BAU scenario up to 2020 for prevention of global warming.

As shown in the projection result from the trends for GHG emission up to 2020, the sector with the largest proportion of the total national GHG emissions is energy sector, following by IPPU and waste sector.

Therefore, mitigation options also have focused on these sectors.

Up to 2020, potential mitigation options including energy supply and residential sector are 15 options in all (Table 5-4).

LEAP and COMAP have been used for estimating GHG abatement cost for each mitigation option.

Abatement cost curve showing annual GHG abatement potentials and abatement costs for each option is presented in Figure 5-12.

In this curve, abatement cost increases by going from the left to the right and the options with negative costs mean that implementation of them brings forth economic profit.

According to the assessment on GHG abatement cost for each mitigation option, annual GHG abatement potential of available mitigation options in DPR Korea up to 2020 totally amounts to 35,740$GgCO_2e$/yr.

The options with great economic profit (i.e., with negative abatement cost) in mitigation options are 9 options and their priority order is as follows (Figure 5-12).

- Efficient lighting scheme (O8)
- Reduction in specific consumption of fuel of vehicles (O7)
- Efficient refrigerators (O9)
- Creation of new hydropower generation capacity (O3)
- Methane utilization and destruction programme from animal waste management system (O13)
- Coal mine methane utilization and destruction programme (O2)
- Modernization of existing thermal power plants (O1)
- Saving of residential fuel (O10)

Table 5-5 GHG abatement potentials and abatement costs for potential mitigation options up to 2020

Sector	Option	Scenario	Abatement potential ($GgCO_2e/yr$)	Abatement cost (US/tCO_2e$)
Energy Supply	Modernization of existing thermal power plants (O1)	Coal saving through increasing by 10% of efficiency of existing thermal power plants with capacity of 500MW	998	-4.0
	Coal mine methane utilization and destruction programme (O2)	Electricity and heat generation by capturing coal mine methane in coal mines (CDM project)	715	-9.0
	Creation of new hydropower generation capacity (O3)	Creation of new hydropower generation capacity of 1,000MW including hydropower CDM projects	6,985	-14.1
	Construction of solar thermal power plants (O4)	Construction of solar thermal power plants with capacity of 500MW substituting for coal fired power plants with capacity of 200MW	1,597	30.2
	Construction of wind farms (O5)	Construction of wind farms with capacity of 1,000MW substituting for coal fired power plants with capacity of 300MW	2,395	7.7
	Construction of atomic power station (O6)	Construction of atomic power station with capacity of 2,000MW substituting for coal fired power plants with same capacity	15,966	11.5
Transport	Reduction in specific consumption of fuel of vehicles (O7)	Fuel saving by reducing specific consumption of fuel of 30,000 vehicles with much specific consumption of fuel	2,694	-132.0
Buildings	Efficient lighting scheme (O8)	Replacement of ICLs through providing households connected to the grid of the whole country with CFLs (CDM project)	778	-248.0
	Efficient refrigerators (O9)	Electricity saving through replacing 0.5 million general refrigerators with efficient refrigerators	51	-84.7
	Saving of residential fuel (O10)	Coal saving through replacing traditional stoves with efficient coal stoves in households	379	-3.4
Industry	Efficiency improvement of electric motors (O11)	Electricity saving of annual 0.15TWh by improving efficiency of motors	51	29.3
Agriculture	Perfection of naturally flowing irrigation system (O12)	Electricity saving of 0.08 TWh for pumping by perfecting naturally flowing irrigation system	26	29.3
	Methane utilization and destruction programme from animal waste management system (O13)	Methane recovery and destruction by replacing traditional animal waste management systems with innovative anaerobic digestion technologies in livestock farms (CDM project)	150	-10.6

Forestry/Forest	Sustainable forest management (O14)	Enhancement of absorption capacity of forest through sustainable forest management	2,750	1.4
Waste Management	Methane utilization and destruction programme from industrial wastewater (O15)	Electricity and heat generation with methane recovered from organic wastewater through introducing anaerobic digesters in factories and enterprises (CDM project)	205	-1.7
Total	-	-	35,740	-

Source: KWAK Man Su, 2012

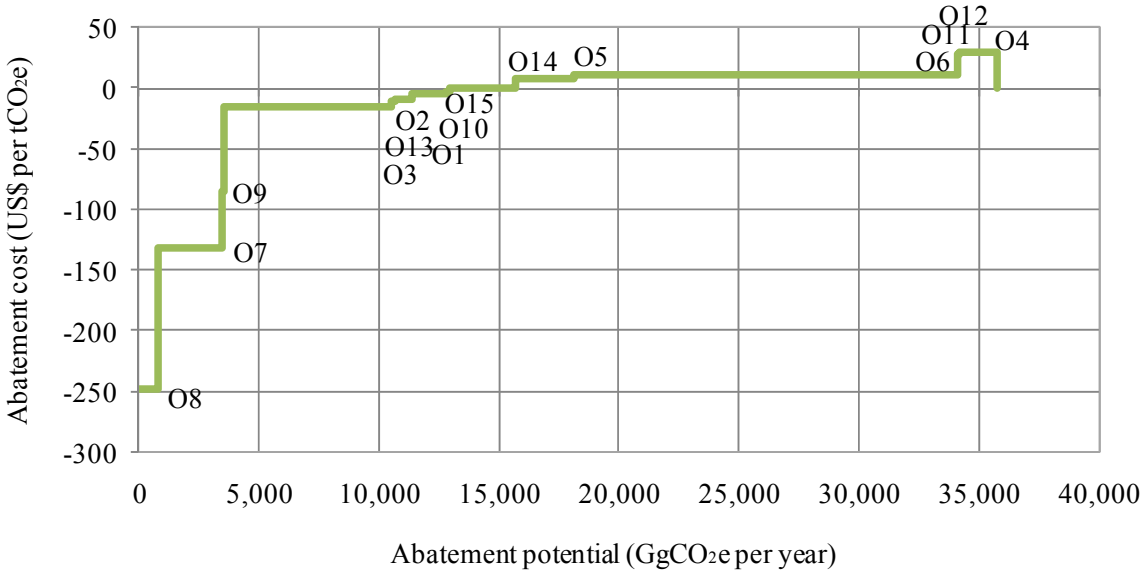


Figure 5-12 GHG abatement cost curve for potential mitigation options up to 2020

Source: KWAK Man Su, 2012

- Methane utilization and destruction programme from industrial wastewater (O15)

Annual GHG abatement potential by these 9 mitigation options with great economic profit totally is 12,955GgCO$_2$e, which amount to 36.2% of the total GHG abatement potential of available mitigation options.

Meanwhile, implementation of the options with positive abatement cost including "Sustainable forest management (O14)", "Construction of wind farms (O5), "Efficiency improvement of electric motors (O11)", "Perfection of naturally flowing irrigation system (O11)" and "Construction of solar thermal power plants (O4)" needs much investment.

Of mitigation options, the options being accelerated with CDM project now are "Coal mine methane utilization and destruction programme (O2)", "Creation of hydropower generation capacity (O3)", "Efficient lighting scheme (O8)", "Methane utilization and destruction programme from animal waste management system (O13)", "Methane utilization and destruction programme from industrial wastewater (O15)".

CHAPTER 6 OTHER INFORMATION

Chapter 6 Other Information

In this chapter, other information related to achievement of the aim of the Convention such as reflection of climate change, technology transfer, research and systematic observation, education and trainging, public awareness-raising and capacity building, etc., was presented.

6.1 Integration of Climate Change

It is important to correctly reflect the climate change issue correctly in socio-economic and environmental policies and actions acording to the Paragraph 1(f), Article 4 of the Convention in order to accomplish sustainable development of the country while meeting with negative impacts of climate change.

Topics on climate change were strongly reflected in the DPR Korea's National Strategy for Sustainable Development. The national strategy is carried out by the main policies as follows (DPR Korea, 2003).

- To consolidate the socialist economic system thorough implementation of the line of developing independent national economy in sustainable development and effective use of international cooperations.
- To build national capacity for sustainable development, in particular, to standardize establishment of system of laws, regulations and indices on strategic goals.
- To establish statistical and information service system on resource management system, ecological observation system and socio-economic development, and raise social awareness on the National Protocol-21.
- To elevate the level of forest resource management including information system and monitoring, and contribute to sustainable development by increase of forest area and accumulation through breeding and diffusion of new species of trees.
- To popularize sustainable agricultural technologies suitable to local climatic and soil conditions, and prepare basis to constantly increase agricultural production.
- To regulate structure and arrangement of industry so as to make use of resources in a sustainable and effective manner, and relieve the congestion of transport sector through acceleration of the corresponding substructure construction.
- To minimize the generation of wastes by popularization of clean production technology, encourage resource and energy savings and increase utilization efficiency.
- To develop and popularize basic technologies to control environmental pollution and regularly establish national monitoring and control system.
- To accelerate building of cultural dwelling houses and improve environment of residential districts.
- To strengthen the protection of water resources and sewage purification, protect and spread vegetation cover, increase productivity of soil and decrease natural disaster events.
- To contribute to the improvement of global environment through implemention of the international conventions including the UNFCCC, UN Convention on Biodiversity and Vienna Convention on the Protection of Ozone Layer, etc.

Topics on climate change have been reflected in the DPR Korea's Millenium Development Goals (MDG) as follows (CBS, 2011).

- Foodsecurity;
- Improvement of sustainable energy use;
- Termination of incidence of malaria and other diseases, and start of reversal;
- Decrease of biodiversity loss (proportion

of forest area, total CO_2 emissions per capita, consumption of ozone destruction materials, proportion of change in number of fish species, share of water use in water resouces, proportion of land protective regions, proportion of endangered and proportion of degraded land in total land area)

- Supply of safe drinking water and improvement of sanitary arrangements.

The DPR Korea's national strategy and actions plan on biodiversity, which was formulated in 1998, revised and supplemented in 2010, has specified the following long-term and present goals, stressing that decrease of biodiversity is organically linked with climate change (DPR Korea, 1998).

Long-term goals

- To elevate conservancy function of conservancy areas including nature reserves, form network of conservancy areas and complete national reserve system;
- To provide cultured and affluent life for all people and aftergenerations by benefits of biodiversity through establishment of sustainable utilization system for biodiversity structural elements while concentrating on protection of ecosystem and genetic resources.

Present goals

- To recover destructed ecosystem, prevent aggravation of ecoenvironment, loosen decrease velocity of biodiversity structural elements and improve overall ecoenvironment.
- To elevate management level of nature reserves in order to improve the function of nature reserve system.
- To simultaneously protect people's environmental and soci-economic benefits through protection of biodiversity and sustainable utilization by increase in biomass production, improvement in service function of ecosystem and establishment of sustainable utilization system of biological resources.

Strategic and present goals specified in the national action plan for prevention of soil desertification and degradation (2006-2010) were run thorough with overcoming of vulnerability to climate change and enhancement of adaptability (MLEP, 2006b).

Strategic goals

- To prepare and implement sustainable and rational programme for land use and management ensuring balance between forest, agriculture including livestock industry and water resources;
- To realize high level of social participation to improve ecological, economic and social value of overall land;
- To realize organic combination of recover of degraded land with sustainable development of rural areas;
- To build managerial and technical capacity related to monitoring and estimation of land degradation and sustainable land management;

Present goals

- To build up basis for integrated and sustainable land management in national and local level through the activities for capacity building;
- To decisively enhance effectiveness of land management practice and recover of degraded land through prevention of land degradation, active technology transfer and dissemination activity for sustainable land management;

"DPR Korea's Environment and Climate Change Prospect Review", which has assessed recent environment condition of the country, proposed the following projects to improve environment condition in consideration of topics on climate change (MLEP, 2012).

- Project 1: Capacity building for environment observation and early warning
- Project 2: Capacity building for implementation of CDM projects
- Project 3: Capacity building on legal and regulatory framework for environment management

- Project 4: Establishment of National Clean Production Centre (NCPC).
- Project 5: Capacity building for integrated solid waste management.
- Project 6: Production of energy, fuel and fertilizer with municipal solid waste.
- Project 7: Development of decision-making support system for environment management.
- Project 8: Improvement of national system for nature reserve and its management.
- Project 9: Preparation of action plan for recovery of wetland ecosystem.

6.2 Technology Transfer

6.2.1 Activities relating to technology transfer

Legal basis for development and transfer of evironmentally sound technology such as Law on Science and Technology, Law on Energy Management, Law for Technology Export and Import, Law on Joint Venture, Law for Foreign Enterprises, Law on Foreign Investment and others has been made in DPR Korea (Table 2-9).

In DPR Korea, development and introduction of environmentally sound technology are being accelerated by institutes under several ministries and central agencies such as the State Commission of Science and Technology, SAOS and Acaemy of Agriculture, and several universities such as Kim Il Sung University and Kimchaek University of Industry. During the period of the 3rd 5-year plan for development of science and technology (2008-2012), several national research targets related to development and introduction of mitigation and adaptation technology to climate change have been successfully obtained(Table 6-1). But, development level of mitigation and adaptation technologies to climate change was low and introduction was not actively accelerated for lack of finance and various barriers.

In the country, SCST, SAOS, KGFST, KNCU, GPSH, Bureau of Invention, Central Science and Tehnology Information Bureau play important role in dissemination and exchange of new technology.

National festivals of science and technology and national exhibition of invention and new technology are held every year, and certificate of inscription of production of science and technology, certificate of introduction of production of science and technology, patent and others are presented to quality presentations.

In recent years, national technical training course on production and use of methane (Grand People's Study House, 19-21 November 2008), workshop on cyclic production system of stockbreeding and agricultural production (Grand People's Study House, 22-23 February 2010) and workshop on cyclic production system in agricultural sector (Grand People's Study House, 29 November - 2 December 2011) were held under the sponsorship of the KGFST.

The Central Science and Tehnology Information Bureau contributing to dissemination of science and technology by preparation of study outline on science and technology has disseminated new technologies through preparation of several items of study syllabuses such as "On the cyclic production system" (August) and "On the high temperature air combustion technology and its utilization prospect" (November) in 2012.

Besides, several cooperation projects related to transfer of mitigation and adaptation technology to climate change were implemented or is under implementation, and international training courses were also conducted in the country (Table 6-2). Many officials and experts have built their capacity through taking part in the international training courses on production and use of biogas and use of solar energy, which are held in China every year since 1998.

6.2.2 Priority technology needs

DPR Korea has not yet implemented the

TNA project, but is willing to do it as a priority project in future (Appendix 1.A.3) and has assessed the technology needs based on the TNA guidances including the TNA handbook (UNDP, 2010) and technical papers (UNFCCC, 2007) in accordance with Prargraph 5, Article 4 of the Convention.

The priority technology needs identified by technology need assessment are presented in Table 6-3.

Table 6-1 Major projects of the 3rd 5-Year Plan for Development of Science and Technology (2008-2012)

№	Project title	Executive institutions
1	Study on modernization of energy industry by CDM.	ITE, SAOS
2	Study on energy saving by solar energy in rural households.	ITE, SAOS
3	Introduction of biomass energy technologies using agricultural by-products.	SAOS, SCST and KIM Chaek University of Technology
4	Study on use of meta-anthracite as residential fuel.	Institute of Meta-anthracite, Branch of Academy of Coal Sciences, SAOS
5	Study on recovery measure of destructed forest ecosystem.	Institute of Forest Management, MLEP
6	Study on effects of forest eco-environment conditions on development of major forest pests, and prediction and forecasting methods.	Institute of Forest Conservation, MLEP
7	Development and application of support system for basin water resources management.	KIM Il Sung University
8	Study on variation features in water pollution and for reducing pollutant loading in Taedong River.	Institute of Environment Protection, MLEP
9	Development of navigation intelligent system and coastal eco-environment information system.	KIM Il Sung University
10	Study on protection and sustainable use of endangered and rare species in the area of Mt. Paektu.	KIM Il Sung University
11	Study on assessment, protection and sustainable use of biodiversity in major wetlands in DPR Korea.	Branch of Biology, SAOS
12	Study on assessment system for forest fire risk by 3S technology.	IGEI, SAOS
13	Establishment of system for forest ecological monitoring by 3S technology.	IGEI, SAOS
14	Study on prediction method of seasonal climate and assessment of agricultural climate resources.	SHMA and KIM Il Sung University
15	Establishment and introduction of integrated agricultural production system for boosting grain production while doing farming by one's own efforts.	Institute of Crop Culture, AAS
16	Establishment of integrated agricultural production system with the main stress on organic fertilizer.	Institute of Crop Culture and Institute of Pedology, AAS

№	Project title	Executive institutions
17	Study on improvement and introduction of land protective farming method technology.	Institute of Pedology, AAS
18	Study and introduction of method for management and disposal of municipal solid waste.	Institute of City Management, SAOS

Table 6-2 Major projects and international trainings for technology transfer (1990-2012)

№	Project/international training	Description
1	Meteorological Satellite Receiving Office, SHMA (UNDP, completion in 27 August 1990).	Meteorological satellite receiving office for disastrous weather events and weather forecast.
2	Rice Breeding Modernization in Academy of Agricultural Sciences (UNDP, completion in 21 March 1991)	Artificial climate equipment with computer control
3	Strengthening of Institute of Pyongyang Vegetable Science (UNDP, completion in 21 March 1991).	Vegetable tissue culture equipment and various measuring apparatus.
4	Environment Health Risk Control Project (UNDP, completion in 5 October 1995).	Environment health risk control technology.
5	Cooperation on Technologies for Fruit Production and Storage (UNDP, completion in 28 November 1995).	Tissue culture technology and equipment for fruit sapling production, and technology and equipment for fruit storage.
6	Development of Circulating Fluidized Bed Boiler for Combustion of Coal of Low-calorific Value (UNDP, completion in 29 November 1995).	Hot experimental equipment of circulating fluidized bed boiler and introduction of circulating fluidized bed combustion technology into the 16t/h boiler.
7	Vegetable Culture in Non-soil Greenhouse (UNDP, completion in 15 July 1997).	Technology and equipment for vegetable culture in non-soil greenhouse.
8	Strengthening of Pyongyang Thermal Power Complex (UNDP, completion in 10 April 1998).	Administration and operation technology of thermal power complex by computer and modernization of generation plants.
9	Rational Use of Energy in End-Use Units (UNDP, 1993-1998).	Establishment of the CRUE, creation of pilot units for the CRUE and recovery and use of waste heat.
10	Pilot Project for Renewable Energy Development (Nautilus institute, USA, 1998-2001).	Installation of 7 wind turbines in a rural area in the West Sea coast.
11	Conservation of Biodiversity at Mount Myohyang in DPR Korea (UNDP, 2000-2004).	Conservation of biodiversity at Mt. Myohyang
12	Training for Designers for Protecting Drought Damage by Undertaking Effective Irrigation Construction (PGTF, October 2003).	Effective irrigation construction technology
13	Coastal Biodiversity Management of the DPR Korea's West Sea (UNDP, January 2003-2006).	Integrated coastal zone management in Mundok reserve.
14	Enhanced National Capacity for Disaster Mitigation and Preparedness through GIS/RIS (UNDP, 2003-2006).	Natural disaster mitigation technology

№	Project/international training	Description
15	Training of Experts of Construction and Operation of Small Hydropower stations (PGTF, August 2006).	Construction and operation of small hydropower plants
16	Training of Irrigation & Drainage Designers for Protection of Drought & Flood Damages (PGTF, August 2006).	Irrigation and drainage design
17	International Training Course on Environment (EEDP, 13-18 May 2010).	Organic farming technology.
18	Sustainable Rural Energy Development (SRED) (UNDP, July 2010.7, 24 months).	Renewable energy technologies (small hydropower, biomass, biogas, solar energy).
19	Small Wind Energy Development and Promotion in Rural Areas (SWEDPRA) (UNDP, August 2010, 32 months).	Wind power generation technology of 1-5kW.
20	Improved Seed Production for Sustainable Agriculture ((UNDP/FAO, March 2011, 36 months).	Technology for seed production of high grade.
21	Reduction of Post Harvest Losses for Food Security (RPHLFS) (UNDP/FAO, March 2011, 36 months).	Technology for grain treatment at post harvest.
22	Strengthening of Food and Agriculture Information System (SFAIS) (UNDP/FAO, March 2011, 36 months).	Integrated food and agriculture information system.
23	Training on 2012 Pyongyang International Wind Energy Technology (7-8 May 2012).	Wind power-solar energy hybrid street lamp system and power supply of mobile phone communication-relay station by wind power.
24	Biogas Seminar: Biogas Energy-Technology-Operation (Hanns Seidel Foundation, 17-18 September 2012).	Technology for biogas production and use.

Table 6-3 Priority technology needs

Sector	Priority technology needs
Climate Change Mitigation	
Energy supply	• Hydropower generation.
	• Modernization of thermal power plants: integrated coal gasification combined cycle, supercritical steam power plant.
Transport	• Encouragement of public vehicles.
Buildings	• Energy saving: efficient lighting, heat insulation of buildings.
	• Small combined heat and power (CHP).
Industry	• Improvement of energy efficiency.
Agriculture	• Animal waste management.
Forestry/forest	• Sustainable forest management.
	• Integrated forest pest management.
Waste management	• Municipal solid waste management.

Climate Change Adaptation	
Water resources	• Integrated water resources management.
Agriculture	• Advanced agricultural technologies.
Coastal zone	• Integrated management of coastal zones.
Public health	• Improvement of public awareness.
Ecosystems	• Recovery of forest and creation of firewood forest.

Source: KIM Hak Chol *et al.*, 2012

Table 6-4 Major research institutions and subjects related to climate change

Ministry/ Central Agency	Research institution	Subject
SHMA	Institute of Climate	Climate scenario.
	Central Institute of Meteorology	Meteorological observation and forecast.
	Institute of Hydrology	Flood forecast and variation in water resources.
	Institute of East Sea Marine	Climate change impacts and adaptation to East Sea coast.
	Institute of West Sea Marine	Climate change impacts and adaptation to West Sea coast.
SAOS	Institute of Thermal Engineering	National communication on climate change, estimation of GHG emissions from energy and IPPU sector, mitigation option assessment and technology needs assessment, etc.
	Institute of Global Environment Information	Impacts of climate change on water resources, coastal zone and ecosystem and vulnerability, and sea-level rise scenario.
	Institute of Science and Technology Development Issues	Socio-economic scenario and climate change adaptation strategy.
	Branch of Irrigation and Ocean Sciences	Water management and use.
MLEP	Institute of Environmental Protection	Atmospheric quality, variation in water quality, water purification and waste management.
	Central Institute of Land Planning	Adaptation of land planning sector to climate change.
	Institute of Forest Management	Estimation of GHG emissions, mitigation assessment and measures in forest sector.
Ministry of Higher Education	Global Environment Science College, KIM Il Sung University	Water resources management, sea-level rise and integrated management of coastal zone.
	Faculty of Agriculture and Faculty of Land and Environment Protection, Wonsan University of Agriculture	Protection of agricultural land, water use technology, agricultural climate change and culture of economic plants.
	Faculty of Irrigation, Hamhung University of Hydraulics and Power Science	Harbor, irrigation and hydraulic structures.

AAS	Institute of Crop Culture	Culture and distribution of crops.
	Institute of Pedology	Protective farming.
	Agricultural Technique Information Centre	Estimation of GHG emissions in agricultural sector and impact of climate change on agriculture.
Ministry of Public Health	Institute of Sanitary Science	Impact of climate change on human health.

6.3 Research and Systematic Observation

6.3.1 Climate change research

DPR Korea concentrates efforts and turns much state investment on the climate change related research, considering environment protection as a vital problem relating to future destiny of the nation (Table 6-4).

The SAOS organized the IGEI in 2011 and the Department for Energy and Climate Change Issues in the ITE in 2008 by reforming institutioal arrangement, and executed several research projects such as the preparation of national GHG inventory, the GHG mitigation assessment, the assessment of impacts of and adaptation to climate change in water resources, coastal zone and ecosystem, the development of climate change adaptation strategy by mobilization of several research forces.

The SHMA newly organized the Institute of Climate in 2012, while estimated seasonal climate change up to 2030, variation trends in annual mean temperature and annual precipitation up to 2100 by statistical transformation of GCM output, and introduced flood forecast program into the rainy season forecast.

Meanwhile, assessing the recent environment status of the country under the support of the Regional Office for Asia and Pacific of UNEP, the MLEP projected maximum summer temperature for the whole country, change in monthly temperature for Pyongyang and annual precipitation for the whole country and Pyongyang by 2030, 2050, 2070 and 2100 under the cooperation with the SHMA and CLIMSystems Ltd, New Zealand (MLEP, 2012).

In future, DPR Korea is planing to execute several research projects such as the estimation of GHG emissions, climate change mitigation and adaptation, TNA and improvement of climate scenarios, etc., during the 4th 5-Year Plan for Development of Science and Technology (2013-2017).

6.3.2 Systematic observation

The SHMA is responsible for systematic observation, hydrometeorological and marine meteorological forecast in DPR Korea.

Also, with the special services for agriculture, hydropower generation, public health and salt production areas, and the sandy dust forecast, the SHMA keeps in close contact with the Bureau for Disaster Prevention of SPC responsible for disaster measures and responses.

Observation network, data management and communication system

Observation network

In DPR Korea, regular observation of temperature and precipitation was begun since the early 1900's and the stations with regular observation before 1910 were only 3 (KIM Gum Suk *et al.*, 1994).

At present, observation network of the SHMA with meteorological observatory, hydrological observatory and marine observatory includes 186 of meteorological observatories, about 100 of hydrological observatories and 8 of coastal observatories (SONG Yong Chol, 2011a).

Meteorological observatories include 12 of provincial observatories, 2 of aerological observatories, 2 of meteorological radar observatories, 7 of climate observatories and 20 of agricultural meteorological observatories. Some agricultural universities have their own agrometeorological observatories, too. There are 27 of international synoptic meteorological observatories in DPR Korea.

Surface meteorological observation regularly is taken at 12 of provincial observatories and 186 of county observatories.

But, most of meteorological observatories are concentratively distributed in the East Sea and West Sea coastal regions and flat areas, and sparsely in highland areas (CHOE Kwang Su, 2011).

Data management and communication system

Hydrometeorological and marine data observed according to the observation regulations of the SHMA are collected in provincial observatories and then informed to the communication centre. After inspection of quality, observed data are stored into the national data centre, whose database keeps data from 1971 to the present (SONG Yong Chol, 2011a).

Communication system of the SHMA, national meteorological centre in the global communication system of the World Meteorological Organization, consists of domestic communication system using modem and telephone nettwork, international communication system and satellite data reception system. Theoretical transmission speed of communications being used in international synoptic observatories are 56kbps. The SHMA has two GTS lines for international communication; one is 64kbps of Chinese Beijing line and the other 9.6kbps of Russian Habaropsk line. Now, data reception system via satellite, that is, PC VSAT, FYCast and CMACast systems are being used in the SHMA. By using the GTS system and the satellite data receivers, the SHMA receives daily data (synoptic, aerological, airplane and ship, etc.), satellite photos, warnings, forecast bulletins and numerical weather forecast outputs.

Meteorological information service

Weather forecast

At present, the SHMA provides short-term (3 times per day), mid-term (once per week) and long-term (once per month or season) forecast, using various observed data, numerical weather forecast outputs and satellite data provided from the observatories and the regional meteorological centre, and the numerical weather forecast outputs from the European Weather Forecast Centre and German Meteorological Bureau (SONG Yong Chol, 2011a). Numerical weather forecast system in the SHMA consists of short-term Middle Scale Model (MSM), mid-term Northern Hemisphere Model (NHM) and Asian Sandy Dust Model (ADM).

Meanwhile, various media including TV, radio and newspaper forecasts weather to broad masses every day.

Agrometeorological forecast

Agrometeorological indeces and agometeorological outputs for actual service which various organizations including the Central Institute of Meteorology of the SHMA, the AAS, the Ministry of Agriculture, the MLEP jointly obtained using observed data, mid-term forecast, long-term forecast and satellite photo data (AVHRR) spread among users via TV and agricultural weather bulletin once per 10 days (SONG Yong Chol, 2011a).

Marine meteorological forecast

Marine observation and service are conducted by the Central Institute of Meteorology, the Institute of East Sea Marine and the Institute of West Sea Marine under the SHMA.

Sea-level which is observed in Wonsan since 1918 is the base sea-level in DPR Korea. Marine data is stored into MySQL database since the 1960's.

At present, short-term (3 times per day) and mid-term (once per week) marine meteorological forecast are conducted (SONG Yong Chol, 2011a).

Marine environment (surface water temperature, red tide, coast water depth and relief, chlorophyll content in the East Sea, ice distribution in the West Sea, etc.) is serviced actually by the SHMA and the IGEI of SAOS, using the data from meteorological satellite NOAA/AVHRR, global resources satellite Landsat, and environment monitoring satellite Terra/Aqua MODIS (CHOE Kwang Su, 2011).

Climate information service

Climate is monitored by 7 climate observatories under the SHMA, that is, Pyongyang, Chunggang, Sinuiju, Wonsan, Haeju, Kimchaek and Hyesan, with sustainable data records since 1918.

Climate database developed based on

NetCDF and MySQL serves climate information necessary for land developopment including assessment of double cropping region and construction of power stations.

Disaster management and warning

Flood

The State Commission for Flood Prevention is responsible for flood control and management, and local commissions for flood prevention in every province and county take part in prevention of flood (SONG Yong Chol, 2011a).

Flood forecast is done for main river such as Amnok River, Chongchon River, Taedong River, Tuman River, Rimjin River and Ryesong River, main lakes and dangerous flooding regions like Pyongyang.

NASH model, artificial nerve net model and DHI Mike11 are used for flood forecast. Models for flood forecast receive the data monitored from floodgate observatories once per 3 hour. At present, system for flood forecast for the branches with moment flood causing avalanche of earth and rocks and small rivers with steep gradient is under establishment.

Flood warning bulletin is provided to the Cabinet, State Commission for Flood Prevention, local commissions for flood prevention and ministries via computers, handphones, telephones and radios. Early warning signal for danger is provided via direct telephones and TVs.

Typhoon and tidal wave

Warnings for storm, tidal wave, strong wind and typhoon are done. The State HydroMeteorological Administration provides relevant organs with the information related to seismic sea wave received by global communication system (SONG Yong Chol, 2011a).

Forest fire

Monitoring and warning for forest fire have been done by the institute of global environment information, SAOS since 2003. System to assess the present condition of danger from forest fire and decision support system to put forest fire up based on the 3S technology of the institute inform the condition of forest fire to the Ministry of Land and Environment Protection and affiliated provincial organs via the national network every day (CHOE Kwang Su, 2011).

6.4 Education, Training and Public Awareness

Article 6 of the Convention has mentioned as follows; (i) the development and implementation of educational and public awareness-raising programs on climate change and its effects; (ii) public access to information on climate change and its effects; (iii) public participation in addressing climate change and its effects and developing adequate responses; and (iv) training of scientific, technical and managerial staff.

6.4.1 Education and training

Education on climate change

To suit the requirements of the "Law on Education" (Table 2-9), the Ministry of Basic Education has improved the teaching materials and methods on climate so as to consider pupils' characters in "Nature" subject in elementary school and "Geography" subject in middle school through the national reeducation training course for teachers since the year 2002 (PAE In Yong, 2002; KIM Kyong Su, 2007).

Kim Il Sung university newly has organized the department of global environment science in 2003 and trains capable experts in the field of global environment protection and management (KIM Kwang Phil, 2012c).

Main universities related to climate change including Kimchaek University of Industry and Wonsan University of Agriculturee educated the students being able to cope with climate change through development of the specialized education related to mitigation and adaptation to climate change.

Training

The Government of DPR Korea, in view of importance of the topics related to climate

change, has drawn many officials, scientists and technicians from several related units such as the State Commission of Science and Technology, Ministry of Land and Environment Protection, Ministry of Electricity, SAOS, State Hydro Meteorological Administration and Academy of Agriculture, etc., into domestic or international training workshops, meetings and courses and strengthened their capacities through taking advantage of several opportunities as well as implementation of the SNC project in recent years (Table 6-2, 6-5).

In particular, short-term training by the UNEP (Bonn, Germany, June 2005) and CGE hands-on training (Jakarta, Indonesia, February 2006) were greatly conductive to the commencement and successful implementation of the SNC project, and the international training (Beijing, China, November 2011) also has greatly contributed to training of the SNC experts and preparation for the third national communication.

Training program (Pyongyang-Norchoping, 2011-2012) implemented by the bilateral cooperation of the Ministry of Land and Environment Protection and Swedish General Bureau for International Development has contributed a large share to the capacity building of officials and experts for research on climate change, adaptation and mitigation assessment to climate change.

Besides, several scientists in the hydrometeorological and marine field have strengthened their research capacities on climate change through taking part in the symposiums and training courses on climate change in Asian-Pacific regions.

6.4.2 Public awareness

Mass media

In DPR Korea, mass media including TVs, newspapers and popular magazines, etc., hold very important place in public awareness raising on climate change and its impact.

"Rodong Sinmun" which is most influential and popular among readers publishes several tens of articles related to climate change every year, and has carried several tens of articles such as "To improve the effectiveness of cyclic production system" (January 26), "Energy problem concentrating international concerns" (February 18), "Let's plant lot of trees with patriotic passion" (March 2), "Let's take the proper steps to prevent damages from the rainy season " (June 29) and "Typical production structure of cyclic production system" (November 13), etc., simply in 2012.

"Minju Choson", "Pyongyang Sinmun" and "Chongyon Joni", the main newspapers in the country, and "Popular sciences", "World of sciences" and "Youth's life" which are the main magazines in the country carry lots of public awareness raising articles.

Korean Central Television Broadcast and Mansudae Television Broadcast also telecast news, documentaries, scientific and educational films, scientific and technological news and special editions on climate change and its effects.

Typical programs telecasted in 2012 are Korean documentary film "Nature reserve in Mt. Oka", scientific and educational film "Let's plant lot of good trees", "Heat radiation type thermal insulation kitchenrange", "History of climate", scientific and technological news "Household solar cell", special editorial "Ecocity in future" and "Future and challenges of the earth", etc.

In particular, television broadcasts, newspapers and popular magazines telecast and present various topics of introductory programs on the main occasion of the general mobilization period for land administration and global commemoration days such as "World Wetland Day" (February 2), "World Forest Day" (March 21), "World Water Day" (March 22), "World Meteorology Day" (March 23), "World Environment Day" (June 5), "World Desertification and Drought Prevention Day" (June 17), "International Ozone Day" (September 16), "World Biodiversity Day" (December 29).

Table 6-5 Major workshops, trainings and meetings (2005-2012)

№	Title of workshop/training/meeting	Organizer/supporting organization, venue, date, number of persons
1	Short-Term Training on the Project for Preparation of the SNC	UNEP, Bonn, Germany, June 2005, 2 persons
2	CGE Hands-on Training on Vulnerability and Adaptation Assessment in Asia and Pacific Regions	CGE, Jakarta, Indonesia, February 2006, 2 persons
3	National Training Workshop on the 2006 IPCC Guidelines and Uncertainty Management	UNEP/SNC, GPSH, Pyongyang, November 2006, 30 persons
4	National Training Workshop on the Integrated Climate Change Impact Assessment Models	UNEP/SNC, MLEP, Pyongyang, December 2006, 30 persons
5	National training workshop on CDM	Hanns Seidel Foundation, Taedong River House of Diplomatic Corps, Pyongyang, July 2008, 25 persons
6	Training Course on CDM	EEDP, Shenzhen, China, June 2009, 6 persons
7	The 2nd International Conference on the Energy Efficiency and Management Improvement	Vietnamese Peace Commission, Hanoi, Vietnam, March 2010, 5 persons
8	Northeastern Asia Ecology Forum on Low Carbon Society	Institute of Applied Ecology Academy of Sciences, Shenyang, China, September 2010, 4 persons
9	The 2nd International Conference on the Global Change and Environment in Asia and Pacific	The Zhongwen University of Hong Kong, Hong Kong, China, October 2010, 2 persons
10	Training on Integrated Waste management	UNEP, Nanyang, Singapore, March 2011, 7 persons
11	National Training Workshop on Using LEAP and COMAP	UNEP/SNC, SAOS, Pyongyang, April 2011, 35 persons
12	National Training Workshop on Using LEAP	UNEP/SNC, SAOS, Pyongyang, April 2011, 32 persons
13	National Workshop on Use of Methods and Tools for GHG Mitigation Assessment	UNEP/SNC, GPSH, Pyongyang, April 2011, 38 persons
14	National Training Workshop on CDM Project Development	UNEP/SNC, SAOS, Pyongyang, May 2011, 26 persons
15	National Training Workshop on Using WEAP and DIVA	UNEP/SNC, MLEP, Pyongyang, May 2011, 34 persons
16	National Training Workshop on Using WEAP	UNEP/SNC, GPSH, Pyongyang, May 2011, 30 persons
17	National Workshop on Methods and Tools to Evaluate Impacts of, and V&A to, Climate Change	UNEP/SNC, GPSH, Pyongyang, May 2011, 35 persons
18	Training Workshop on Climate Change and CDM	UNDP, Taedong River House of Diplomatic Corps, Pyongyang, June 2011, 6, 23 persons
19	The 7th JCOOM Training Workshop	WMO, Macao, China, October 2011, 2 persons
20	International Training on GHG Inventory and Climate change Mitigation and Adaptation	China Development and Reformation Commission, Beijing, China, November 2011, 9 persons

№	Title of workshop/training/meeting	Organizer/supporting organization, venue, date, number of persons
21	International Training Programme for DPR Korea: Climate Change - Mitigation and Adaptation	Swedish International Development Cooperation Agency, Pyongyang (November 2011, 38 persons; October 2012, 39 persons), Norrkŏng, Sweden (December 2011, 15 persons; February 2012, 23 persons)
22	FEB RAS - AASSA Regional Workshop on Impacts and Mitigation of Climate Change in Asia and Oceania	Global Network of Science Academies, Vladivostok, Russia, July 2012, 4 persons)

Source: Kim Hun, 2011

Environment day

In DPR Korea, various works for public awareness raising on the topic of climate change and environment protection are conducted with the national and public interest on the occasion of "World Environment Day" every year.

On June 5, 2008, the national workshop on the topic of "Climate Change and Energy" has been conducted at the People's Cultural Palace. In the Workshop, recent climate change, activities to reduce GHG emissions and prospects in the country have been screened. Besides, papers on environment protection were presented and video editorial presentation was telecasted at the Moranbong middle school No.1.

Various works for public awareness raising such as national symposiums on the topic of "The planet needs you. Let's unify for prevention of climate change" in 2009, "Many species of living things, One planet, One future." in 2010 and "Forest, nature for mankind" in 2011 have been made.

Role of NGOs and international organizations

In DPR Korea, the KNCU, KGFST and GPSH play an important role in public awareness raising related to climate change and its effects.

National scientific and technological paper readings and training courses where students and general public having interest in climate change, as well as scientists, technicians and officials in related fields of the country as a whole, take part in (e.x. Scientific symposium of agricultural sector on cyclic production system in December 2011, National scientific and technological paper readings for environment protection sector in August 2012, etc) are made under the auspices of the KNCU and KGFST every year.

The UNEP and EEDP whose office is in China contribute much to public awareness raising related to climate change in the country. The UNEP supports the function of "World Environment Day" every year, and the EEDP, in collaboration with the Pyongyang International New Technology and Economic information Center (PINTEC), sponsors several symposiums and training courses such as international environment training course (13-18 May 2012) and international symposiums on recovery of forest and scene (7-9 March 2012).

6.5 Capacity Building

Capacity building covers all activities under the Convention. Decision 2/CP.7 says that "Capacity building is the continuous, forward-oriented and sustainable process to be implemented based on the priority in developing countries."

In DPR Korea, various kinds of activities for capacity building including collaborative projects, symposiums and training courses, etc., are conducted, and structural, systematic, and human capacity for implementation of the Convention have been built to a certain degree (Table 6-5, 6-6). The project activities for the SNC including establishment of the National Climate Change Office (2006), training symposium on uncertainty management in GHG inventory (2006), training symposium for capacity building on integrated assessment model on climate change (2006) and training symposium on the use of LEAP and COMAP (2011), etc., have provided the project participants and stakeholders with good opportunities to strengthen their capacities.

Main collaborative projects and CDM projects related to climate change such as ALGAS, INC, NCSA and SWEDPRA impelented already or under implementing in the country have also contributed or under contribution to the capacity building directly or indirectly by characteristics in various aspects (Table 6-6, 5-2).

Table 6-6 Major cooperation projects related to climate change (1997-2012)

№	Project title	GEF fund, US$	Duration	Supporting organization
1	Enabling DPR Korea to Prepare its First National Communication in Response to its Commitments to UNFCCC	154,200	1997-2001	UNDP
2	National Biodiversity Strategy & Action Plan and Report to the COP	299,250	1998-2000	UNDP
3	Conservation of Biodiversity at Mount Myohyang in the DPR Korea	750,000	2000-2004	UNDP
4	Strengthening Environmental Assessment and Reporting in DPR of Korea	16,890	2001-2003	UNDP/UNEP
5	Coastal Biodiversity Management of DPR Korea's West Sea	774,523	2003-2006	UNDP
6	Enhanced National Capacity for Disaster Mitigation and Preparedness through GIS/RIS	504,822	2003-2006	UNDP
7	Strengthening Information Technology & Environment Monitoring Capability in DPR Korea Towards Sustainable Decision Making	344,830	2003-2006	UNDP/ UNEP
8	National Capacity Needs Self-Assessment for the Global Environment Management (NCSA)	200,000	2004-2005	UNEP
9	Enabling Activity for the Preparation of the Second National Communication of Democratic People's Republic of Korea to the UNFCCC (SNC)	405,000	2006-2012	UNEP
10	Capacity Building in Statistics Related to MDGs (MDG project)	734,770	2010-2011	UNDP
11	Sustainable Rural Energy Development (SRED)	5,076,205	2010-2012	UNDP
12	Small Wind Energy Development and Promotion in Rural Areas (SWEDPRA)	725,000	2010-2013	UNDP
13	Improved Seed Production for Sustainable Agriculture (ISPSA)	1,822,455	2011-2014	UNDP/FAO
14	Reduction of Post Harvest Losses for Food Security	1,798,686	2011-2014	UNDP/FAO

	(RPHLFS)			
15	Strengthening of Food and Agriculture Information System (SFAIS)	1,575,062	2011-2014	UNDP/FAO

In particular, the basis of strategy for national capacity building to implement the UNFCCC, UN Convention on Biodiversity and UN Convention on Combating Desertification has been made through implementation of the NCSA project (SAOS, 2005).

The national capacity building strategy to implement the Rio Convention is composed of the following 6 goals:

- To establish rational structural mechanism for implementation of the Rio Convention,
- To develop information systems for environment management,
- To develop management methods and means for implementation of the Rio Convention,
- To strengthen technology transfer and development for environment management,
- To strengthen environment education and development of human resources,
- To strengthen social public awareness raising related to environmental problems.

The activity plans for priority capacity building to implement the UNFCCC identified in the SNC project are as follows;

- Establishing the National Climate Change Center and building its capacity,
- Building structural capacity and material and technical basis to estimate GHG emissions and absorptions,
- Establishing the CDM Center and building its capacity,
- Capacity building for modernization of the existing thermal power plants,
- Establishing the Biogas Technology Center and building its capacity,
- Building the capacity to develop hydrogen/fuel cell,
- Supplementing and completing the national strategy and activity plan to implement the UNFCCC,
- Establishing the information exchange office on climate change and building its capacity,
- Building the capacity for specialized education on climate change.

6.6 Information Sharing

Information sharing takes very important place in the activity for implementation of the Convention and preparation of the NC.

In recent years, several institutions such as the SAOS and Industrial Publishing House have published many literatures, translated literatures, references related to climate change, and disseminated among the SNC participants and broad stakeholders (Table 6-7).

And the periodicals introducing many research papers related to climate change such as “Report on thermal engineering research”, “Meteorology and hydrology”, “Land management”, “Forest science”, “Agricultural science and technology”, “Nature preservation” and “Environment report”, etc., are published and disseminated among broad readers by the Grand People’s Study House and Scientific Library.

Meanwhile, the national computer network connected main organs such as the Central Science and Tehnology Information Bureau, Grand People’s Study House and General Bureau of Invention, etc., plays an important role in sharing information.

In 2011, the homepage on topic of “Climate Change and Carbon Trade” disseminating information related to the CDM project development has been established in the Naenara website and the Chomsong homepage was established in the homepage of the State Hydro Meteorological Administration.

Table 6-7 List of the major domestic books published in Korean (2005-2012)

№	Year	Author/translator and Title	Publishing House
1	2005	KNCU. United Nations Framework Convention on Climate Change.	Foreign language publishing house
2	2005	Centre for Development and Use of Natural Energy. 100 Ways for Fuel Saving in Households.	Industrial Publishing House
3	2006	KWAK Man Su, et al. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1: Greenhouse Gas Inventory Reporting Instructions.	ITE, SAOS
4	2006	CHOE Song Chol, et al. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Greenhouse Gas Inventory Workbook.	ITE, SAOS
5	2007	CHA Nae Un, et al. Today and Future of Energy (1).	Science and Technology Publishing House
6	2007	KIM Kwang Ju, et al. Rural Environment and Several Practical Technologies.	Industrial Publishing House
7	2008	KIM Kwang Ju, et al. Agroforestry System Technology.	Industrial Publishing House
8	2008	SONG Hak Chol, et al. Handbook on Vulnerability and Adaptation Assessment.	IGEI
9	2008	RYU Kwang Min. Application Method of Clean Development Mechanism (CDM).	ITE, SAOS
10	2008	KIM Hun, et al. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1: General Guidance and Reporting.	ITE, SAOS
11	2008	KIM Hun, et al. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy.	ITE, SAOS
12	2008	KIM Hun, et al. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3: Industrial Processes and Product Use.	ITE, SAOS
13	2008	CHONG Kum San, et al. Questions and Answers on Technologies for Biogas Production.	Industrial Publishing House
14	2009	RIM Dong Hyon, et al. Questions and Answers on Environment Protection knowledge.	Industrial Publishing House
15	2009	CHONG Kum San, et al. Energy and Environment, a Series of Energy.	Industrial Publishing House
16	2009	CHONG Kum San, et al. Solar Energy, a Series of Energy.	Industrial Publishing House
17	2009	KWAK Man Su, et al. Economics of Greenhouse Gas Limitations, Main Report, Methodological Guidelines.	ITE, SAOS
18	2010	HAM Chol Ho. Assessment and Conducting Method of Technology Needs related to Climate Change.	ITE, SAOS
19	2010	CHOE Song Chol. Development and Introduction of Renewable Energy Technology.	ITE, SAOS
20	2010	KIM Hun. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste.	ITE, SAOS
21	2010	CHOE Tae Jin, et al. Hydraulic Energy, a Series of Energy.	Industrial Publishing House
22	2010	CHOE Won Gyong, et al. Energy Saving, a Series of Energy.	Industrial Publishing House
23	2011	KIM Won Guk, et al. Climate Change and Agriculture.	Agricultural Publishing

			House
24	2011	PAK Chang Hong, et al. Compendium on Organic Agriculture.	Encyclopedia Publishing House
25	2011	CHOE Song Chol. User Manual of the IPCC Inventory Software.	ITE, SAOS
26	2011	SIN Hyok Chol, et al. CDM Baseline and Monitoring Methodology (Methane Recovery and Use).	ITE, SAOS
27	2011	CHONG Kum San, et al. Geothermal Energy, a Series of Energy.	Industrial Publishing House
28	2011	CHONG Kum San, et al. Biomass Energy, a Series of Energy.	Industrial Publishing House
29	2012	CHONG Jin Chang. New Technologies for Energy Use and Global Warming Prevention.	Central Scientific and Technological Information Bureau
30	2012	KWAK Man Su, et al. Technologies, Policies and Measures for Mitigating Climate Change.	ITE, SAOS
31	2012	KIM Hun. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use.	ITE, SAOS
32	2012	KIM Kang Il, et al. Wind Energy, a Series of Energy.	Industrial Publishing House
33	2012	KIM Chol Min. NAMAs and the Carbon Market.	ITE, SAOS
34	2012	KIM Hun. Resource Guide for Preparing the National Communications of non-Annex I Parties.	ITE, SAOS
35	2012	KWAK Man Su, et al. Guidelines for Mitigation Assessment.	ITE, SAOS
36	2012	HAM Chol Ho. A Primer on CDM Programme of Activities.	ITE, SAOS
37	2012	CHONG Kum San, et al. Use of Renewable Energy in Agriculture.	Agricultural Publishing House

CHAPTER 7 CONSTRAINTS, GAPS AND NEEDS

Chapter 7 Constraints, Gaps and Needs

7.1 Constraints and Gaps

Several constraints and gaps still have been raised in main activities for implementation of the Convention and preparation of the national communication. The constraints and gaps identified in implementation process of the SNC project, in brief, are as follows

Implementation of the Convention including preparation of the national communication

- Permanent institution coordinating successful implementation of the Convention has not been organized.
- The national center able to concentrate all potentials on solution of the topics on climate change has not been established.
- There was a lack of capacity of the National Climate Change Office.
- National climate change policy and plan have not been developed yet.
- There was a lack of reflection of climate change to the national plan, policy, regulations and laws.
- There was a lack of understanding of climate change in policy makers, decision makers and broad stakeholders.

GHG Inventory

- There is a lack of institutional framework to prepare GHG inventory.
- The strategy for GHG inventory has not been developed.
- There is a lack of capacity of organs involved in preparation of GHG inventory and data management.
- Data are insufficient and of high uncertainty, and there is a lack of subdivided activity data.
- The default emission factors provided in IPCC guidelines were used.
- There are some errors in IPCC 2006 software for national GHG inventory.
- Integrated QA/QC procedure has not been developed.
- Frequent shifting of technical experts for inventory preparation.
- Lack of technical experts' capacity, expertise and activity for international training&exchange.

Adaptation to climate change

- Lack of capacity of research institutions related to adaptation to climate change.
- The national adaptation action plan to climate change has not been developed yet.
- Adaptation strategy to climate change has not been completed yet.
- Insufficient collarboration with stakeholders involved in V&A assessment.
- Recent adaptation assessment model and sufficient basic data have not been used.
- Lack of capacity managing disasters.

Mitigation to climate change

- Unclear institutional framework for mitigation assessment, and lack of relationship with related sections.
- Insufficiency of data for projection of emission trends and their high uncertainty.
- The strategy and action plan for NAMA plan and CDM activities have not been developed yet.
- Complexity in management procedure of CDM and lack of connection with CERs buyers.
- Lack of legal and institutional framework to accelerate introduction of energy efficiency improvement and renewable energy, and inexistence of energy efficiency standards.
- Lack of financial resources for implementation of mitigation options.
- Lack of competent technical experts, insufficient training and lack of application capacity of mitigation assessment models.

Technology transfer

- Insufficient technology needs assessment on climate change and inexistence of technology action plans.
- Lack of funds for technology development and transfer.
- Lack of capacity for development and implementation of technology transfer projects.

Research and systematic observation

- Lack of capacity for systematic observation and climate change research, insufficient and old observation equipment.
- Accuracy of climate change scenario and sea-level rise scenario by 2100 is not high.
- Development of re-analysis climate data and assessment of climate resources by numerical assimilation model have not been done.
- Monthly and seasonal climate have not been estimated by regional climate model.
- Lack of experts' system to forecast disastrous climatic events.
- Insufficiency of danger assessment and forecast alarm system for flood, landslide and avalanche of earth and rocks.

Education, training and public awareness-raising

- Implementation framework of the Article 6 of the Convention has not been developed yet.
- Lack of education process specializing in climate change, and its low quality.
- Activities to raise public awareness are not diverse, content of data to raise public awareness is insufficient and level of public awareness is still low.

Capacity-building

- Strategy for capacity building and integrated capacity building implementation programme have not yet been developed.

Table 7-1 Priority capacity building needs for implementation of the UNFCCC

Index	Priority capacity building needs
Institutional	• Strengthening the authority and role of the NCCE.
	• Establishing the National Climate Change Centre and building its capacity.
	• Strengthening the Climate Change Office.
	• Strengthening the institutions that are involved in preparation of the GHG inventory and data management.
	• Strengthening the institutions relating to climate change mitigation and adaptation.
Systematic	• Developing the national climate change policy and plan, and mainstreaming climate change into the national plans, policies, laws and regulations.
	• Developing and implementing the GHG inventory strategy.
	• Developing the national adaptation action plan.
	• Developing the NAMAs plan.
	• Developing the CDM strategy and action plan.
	• Developing the integrated implementation programme for capacity building.
	• Conducting the climate change technology needs assessment and developing technology action plan.
	• Improving the climate information service and the observation network.
	• Developing the specific climate change degree courses and raising public awareness.
Individual	• Training the specialists and experts in all areas of the preparation of the national communication and the capacity building framework.
	• Enhancing the capacity to design adaptation measures, CDM projects and climate change projects.

- Building the capacity of policy makers, decision makers and a wide range of stakeholders.

Source: KIM Hun, 2011

7.2 Capacity Building Needs

Priority capacity building needs to promote implementation of the UNFCCC were identified based on the above constraints and gaps, the NCSA output (SAOS, 2006), and decision 2/CP.10, 10/CP.16 and 11/CMP.6. Identified priority needs for institutional, systematic and individual capacity building are summarized in Table 7-1.

7.3 Financial Needs

7.3.1 Financial support conditions

For the past 21 years (1991 to 2012) the GEF, through the UN organizations such as the UNDP and UNEP, provided a total of US$ 6,155,405 of financial support for implementation of the UNFCCC in DPR Korea.

In recent years, developing countries continuously implemented several projects with one year or 2 to 3 years or above of periods and enhanced technology transfer and put greater vitality into the activities related to climate change adaptation and mitigation. But, financial support through the UN organizations to the projects related to implementation of the UNFCCC in DPR Korea lapses into a very sluggish state and technology transfer gets much of external influences in the connection with international organizations.

Over 21 years from 1991 to 2012, the financial support by GEF to the projects relating to climate change and multi focal area already implemented or under implementation in DPR Korea, non-Annex I Party of the UNFCCC was only a total of US$ 6,155,405, that is, US$ 154,200 for the FNC, US$ 405,000 for the SNC, US$ 5,076,204.5 for the SRED, US$ 725,000 for the SWEDPRA and US$ 200,000 for the NCSA (Table 6-6).

In recent years, the implementation of projects under the financial support by GEF in DPR Korea met with serious barriers such as cooperation interruption (from March 2007 to October 2009), delay of cash advance.

The SNC project, enabling activity started in April 2006 had two breaks from April 2007 to March 2008 and from October 2008 to March 2011 due to the cooperation interruption. Moreover, it was not until May 2011 that the second cash advance (US$ 100,000) was provided since the first (US$ 64,550) in May 2006 for the project implementation.

In the result, serious issues including advance of the Government fund, delay of the project timeline, inevitable turnover of the project participants, barrier to consultant invitation, delay of overseas training of project participants and others raised in implementation of the SNC project.

Financial support from Annex II Party contributed to capacity building for successful implementation of the UNFCCC including preparation of the national communication in DPR Korea.

The Sweden, Annex II Party of the UNFCCC significantly contributed to build capacity of the experts and stakeholders relating to the national communication through the implementation of the international training programme on climate change (Table 6-5).

7.3.2 Projects for financing

The UN organizations and UNFCCC secretariat should pay attention to the following issues in order to implement the UNFCCC and prepare the national communications on continuous basis, raise up further the concern to climate change and actively carry out the activities for prevention of global warming:

- To be prior the projects for financing proposed in the national communication

to all others, reflect to the GEF focal area strategies and thus implement with top priority,

- To pay the supporting fund for successful implementation of the national communication project in time without any interruption and delay of cash advance owing to any causes in accordance with the project timeline,
- To pay attention to priority capacity building needs including technical assistance and take relevant measures.

The projects for financing to be implemented with top priority according to the Article 12, paragraph 4 of the UNFCCC in DPR Korea were identified based on the priority adaptation options (Table 4-15), the mitigation options (Table 5-8) and the priority capacity building needs (Table 7-1).

The identified priority projects for financing are shown in Table 7-2. The proposals of the priority projects for financing are presented in the Annex 1.

Table 7-2 List of priority projects for financing

Classification	Project title	Budget (million US$)	Duration (years)
Cross-cutting	1. Establishment of National Climate Change Centre and its capacity building.	1.0	3
Inventory	2. Development of GHG Inventory Strategy and Capacity Building.	0.25	2
	3. Preparation of biennial GHG inventory in DPR Korea.	0.35	2
Mitigation	4. Promotion of CDM Project Activities in DPR Korea.	0.6	2
	5. Capacity Building of the CRUE.	1.0	4
	6. Clean Production and Energy Efficiency.	1.0	3
	7. Energy Efficiency Standards and Labeling in DPR Korea.	1.0	4
	8. Climate Change Technology Needs Assessment in DPR Korea.	0.25	2
	9. Chongchon River Cascade Hydropower Generation Project.	80.0	7
	10. Replacement of Incandescent Lamps by CFLs/LEDs.	40.0	5
	11. Capacity Building for Sustainable Forest Management.	1.0	3
	12. Production of Energy, Fuel and Fertilizer from Municipal Solid Waste.	1.0	2
	13. Capacity Building for Integrated Management of Solid Waste.	0.7	2
Adaptation	14. Improvement of Climate Information Service in DPR Korea.	0.5	3
	15. Improvement of Observation Network in DPR Korea.	2.0	3
	16. Capacity Building for Integrated Water Resources Management in the Teadong River Basin.	1.5	3
	17. Recovery of Degraded Forest and Firewood Forest Management in Community Areas.	1.0	3
	18. Capacity Building for Integrated Management of Coastal Zones.	0.9	4
	19. Promotion of Development and Dissemination of Advanced Agricultural Technologies for coping with Climate Change.	0.7	3
	20. Control of forest pests outbreaks by climate change and integrated forest pest management.	3.0	3
	21. Improvement of Ecosystem Conservation System in Coastal Zone of the Korean West Sea.	0.2	3
	22. Capacity Building for Improving the Community-based Disaster Management System.	1.5	3

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ANNEX 1 PRIORITY PROJECTS FOR FINANCING

A.1 Cross-cutting Project

Project 1 Establishment of National Climate Change Centre and its Capacity Building

Background	To meet its obligations under the UNFCCC, DPR Korea has prepared its SNC and established the National Climate Change Office during the implementation of the SNC Project. But, there is no national centre which can facilitate concentration of efforts, financial and human resources, i.e. the whole potential relevant to solving climate change issues including periodical preparation of the national GHG inventory and national communication in DPR Korea.
Objectives	• To establish National Climate Change Centre and build its capacity to prepare and implement effectively the climate change related activities for implementing the UNFCCC in DPR Korea.
Activities	• Establishment of National Climate Change Centre with computers, printers, communication facilities and office supplies, etc. • Development of 5 year action plan and priority projects related to climate change. • Capacity building for preparation of the national communications periodically.
Outputs	• National Climate Change Centre. • 5 year action plan and priority projects proposals. • Strengthened human, technical and institutional capacity.
Executing Agency	NCCE and relevant agencies.
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	3 years

A.2 GHG Inventory Projects

Project 2 Development of GHG Inventory Strategy and Capacity Building

Background	According to Article 4.1 (a) of the UNFCCC, all Parties should develop, periodically update, publish and make available to the COP, national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol. In DPR Korea, The national GHG inventory for 1990 was prepared during the implementation of the FNC project. On the base of previous inventory, the national GHG inventory has been updated and improved up to 2002 under the SNC project.
Objectives	• To develop national strategy and strengthen human and institutional capacity for GHG inventory.
Activities	• Development of GHG inventory strategy. • Capacity building, including hands-on training, on all aspects relating to GHG inventory.
Outputs	• GHG inventory strategy. • Strengthened human, technical and institutional capacity
Executing Agency	SAOS and relevant agencies.
Budget	US$ 0.25 million, including Government US$ 0.1 million
Duration	2 years

Project 3 Preparation of Biennial GHG Inventory in DPR Korea

Background	The GHG inventory in DPR Korea has been prepared twice up to now, but the activity for the GHG inventory has not been undertaken in sustainable manner on continuous basis. Financial support problem for ensuring the quality and continuity of estimation for GHG inventory, as well as institutional framework, is raised. With financial support to ensure the consistency and still good quality of GHG inventory, the project to update and report national GHG inventory comes to be proposed biennially according to decision 17/CP.8 and decision of COP 16.
Objectives	• To strengthen the institutional framework for the national GHG inventory, and periodically submit the report for biennial GHG inventory to COP on continuous basis.
Activities	• To develop country-specific emission factors for key categories. • To collect activity data and update database for GHG inventory for 2004 and 2006. • Capacity building including hands-on training related to GHG inventory.
Outputs	• Database and report for biennial GHG inventory. • Proposal of the project for the next biennial GHG inventory. • Proposal of country-specific emission factors.
Executing Agency	SAOS and related institutions.
Budget	US$ 0.35 million including Government US$ 0.2 million
Duration	2 years

A.3 Mitigation Projects

Project 4 Promotion of CDM Project Activities in DPR Korea

Background	DPR Korea signed the UNFCCC in December 1994 and the Kyoto Protocol in April 2005. Recognizing the important role of CDM in contributing to sustainable development and reducing GHG emissions, the Government has taken active measures to participate in CDM, including establishing a DNA for CDM and establishing the national framework for implementation of the CDM projects. But, DPR Korea is yet one of the countries with fewer than 10 registered CDM project activities.
Objectives	• To establish the political and institutional frameworks for sustainable and successful CDM activities. • To build capacity for facilitating CDM project activities in accordance with sustainable development objectives.
Activities	• Establishment of political and institutional framework to support CDM activities. • Training of experts and stakeholders relating to CDM. • Capacity building of CDM-related institutions. • Development of strategy and action plan for CDM activities.
Outputs	• Strengthened human, technical and institutional capacity. • Strategy and action plan for CDM activities.
Executing Agency	MFT and relevant agencies.
Budget	US$ 0.6 million, including Government US$ 0.2 million
Duration	2years

Project 5 Capacity Building of the Centre for Rational Use of Energy

Background	Most of GHGs in DPR Korea is emitted from the combustion process of fossil fuels used in energy sector and their potentials of emission reductions are very great. However, equipments for energy audit in the CRUE established under the support of UNDP in 1990's were old, so work for energy saving and GHG mitigation in the factories/enterprises is not being done based on advanced technology and method.
Objectives	• To build the capacity for energy audit of the CRUE. • To reduce GHG emissions in the major factories/enterprises using fossil fuels through energy audit and technology needs assessment.
Activities	• Replacement of the existing equipments for energy audit in the CRUE by the up-to-date equipments. • Training of the experts and technicians in the CRUE. • Energy audit and technology needs assessment for the selected factories/enterprises.
Outputs	• CRUE equipped with the up-to-date equipments for energy audit. • Strengthened human and institutional capacity. • Energy audit report for the selected factories/enterprises.
Executing Agency	SCST and SAOS
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	4years

Project 6 Clean Production and Energy Efficiency

Background	DPR Korea is a unique country which uses domestic coal in all industrial sectors as a predominating energy source. Potential of energy saving and associated GHG emissions reduction in DPR Korea would be impressive, because rough estimation shows that specific energy consumption exceeds the developed country's figure more than twice. Only an adoption of appropriate measures easily available in current circumstances will allow reducing the total energy consumption by 30%.
Objectives	• To build the DPR Korea's capacity for the effective implementation of the clean production and energy efficiency issues in major industrial sectors to reduce GHG emissions.
Activities	• Development of clean production and energy efficiency action plan for major industrial sectors. • Implementation of training program for energy service providers. • Capacity building for program management and monitoring.
Outputs	• Clean production and energy efficiency action plan. • Energy service providers trained. • Staff trained and expertise.
Executing Agency	SCST and relevant agencies.
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	3years

Project 7 Energy Efficiency Standards and Labeling in DPR Korea

Background	DPR Korea has a population of over 24 million using different kind of household appliances. In recent years, the people's livelihood has been stabilized and the living standard is increasing at high speed. This implies that several millions of appliances will be added in future, such as refrigerator and freezer, air conditioner, washing machine and TV, etc.
Objectives	• To reduce GHG emissions from household appliances in DPR Korea through the implementation of energy efficiency standards and labeling program.
Activities	• Development of legal and regulatory framework. • Capacity development of key agencies involved in this program. • Awareness raising campaign for energy efficiency standards and labeling. • Development and implementation of monitoring and evaluation methodology.
Outputs	• Legal and regulatory framework developed. • Capacity and awareness increased • Monitoring and evaluation methodology.
Executing Agency	SCST and relevant agencies.
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	4 years

Project 8 Climate Change Technology Needs Assessment in DPR Korea

Background	The GEF, at the GEF-5 Focal Area Strategies, announced "the GEF will continue to fund the preparation and updating of TNAs, especially for countries that did not receive support for TNAs during GEF-4, in accordance with UNFCCC guidance". But, DPR Korea as a non-Annex I Party to the UNFCCC has not yet carried out the TNA on climate change.
Objectives	• To carry out the DPR Korea's TNA on climate change according to the Article 4.5 of the UNFCCC and develop national technology action plan for prioritized technologies.
Activities	• Preparation of the DPR Korea's TNA report. • Development of national technology action plan for prioritized technologies which reduce GHG emissions and support adaptation to climate change. • Capacity building for TNA and technology transfer.
Outputs	• The DPR Korea's TNA report. • National technology action plan. • Strengthened human and technical capacity.
Executing Agency	SAOS and relevant agencies.
Budget	US$ 0.25 million, including Government US$ 0.05 million
Duration	2 years

Project 9 Chongchon River Cascade Hydropower Generation Project (CDM Project)

Background	DPR Korea is developing and using water resources systematically according to one's own strategy for economic development. Chongchon River, which is located in western area of DPR Korea, has rich water resources and great potential for generating electricity. If Chongchon River cascade hydropower stations are constructed in the western area with more thermal power stations than other areas, GHG emissions will be reduced compared with baseline scenario in this area.
Objectives	• To supply electricity generated by renewable energy to a grid in the local area. • To reduce GHG emissions from a grid in the local area. • To contribute to the sustainable development of the local area.
Activities	• To construct 10 units of 10MW hydropower stations by cascade along the Chongchon River. • To supply the generated electricity to the local grid.
Outputs	• Less dependence on the fossil fuel in electricity production. • GHG emissions reduction of 280,000 tCO_2/yr.
Executing Agency	MEI and relevant agencies.
Budget	US$ 80 million, including Government US$ 78 million
Duration	7 years

Project 10 Replacement of Incandescent Lamps by CFLs/LEDs (CDM Project)

Background	Most of households in DPR Korea are using the ICLs of 100W and 60W. The energy efficient CFL is 8 times longer in lifetime, 5 times brighter and 80% less power consumption than ICL. If the CFLs are distributed to grid-connected households in exchange of ICLs, then the electricity consumption for lighting will be reduced and thus CO_2 emission reduced.
Objectives	• To reduce the GHG emissions from the grid. • To raise the public awareness for the energy saving.
Activities	• Collection and destruction of ICLs in all households. • Distribution of the efficient CFLs up to 4 per household. • Development and implementation of monitoring and supervision methodology.
Outputs	• Saving of electricity consumption for lighting. • GHG emissions reduction of 1,000,000 tCO_2/yr.
Executing Agency	Ministry of Electronic Industry and relevant agencies.
Budget	US$ 40 million, including Government US$ 10 million
Duration	5 years

Project 11 Capacity Building for Sustainable Forest Management

Background	In DPR Korea, most of total land area is mountainous, which is covered with temperate forest. The forests accounted for 74.7% of the total land area and play a key role in socio-economic development and people's life. In 2005, the area of non-tree forest was about 9.8% of forest land area (about 0.88 million ha).
Objectives	• To assess forest resources and its management properly and to raise public awareness on sustainable forest management. • To build the institutional capacity, to establish goals and aims for sustainable forest management and to implement the national forest strategy framework.
Activities	• Rasing public awareness on sustainable forest management. • Development of criterion and indicator for sustainable forest management in line with country's realities, and assessment of forest management activities. • Development of national strategy framework and building of the institutional capacity for sustainable forest management. • Training for sustainable forest management and capacity building of the forest training centre.
Outputs	• Strengthened human, technical and institutional capacity. • Development and publication of sustainable forest management report. • Development of national strategy for integrated sustainable forest management system.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	3 years

Project 12 Production of Energy, Fuel and Fertilizer from Municipal Solid Waste

Background	In most major cities in DPR Korea, municipal solid waste is dumped and land-filled without safe treatment. Organic waste that could be used to produce energy or increase soil fertility are not being effectively diverted to those purposes and instead become a source of methane emissions in landfill sites. As such, current solid waste management practices are GHG emissions intensive.
Objectives	• To reduce GHG emissions associated with current solid waste disposal practices. • To increase the utilization of the municipal waste in the production of energy and production of fuels and fertilizers that can contribute to agricultural production.
Activities	• Construction of integrated waste treatment plants. • Capacity building of the waste treatment unit for environment monitoring, measurement and analysis. • Raising public awareness on integrated treatment and reuse of waste.
Outputs	• An integrated waste treatment factory. • Strengthened human, technical and institutional capacity.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	2years

Project 13 Capacity Building for Integrated Management of Solid Waste

Background	As a result of socio-economic development and the rapid growth of the industrial production in DPR Korea the prevention of the environmental pollution caused by solid waste and the protection and rational utilization of natural resources have emerged as an important issue. Most solid waste is dumped and land-filled without adequate treatment and has become the source of GHG emissions. Therefore, capacity building for integrated management of solid waste is a priority for sustainable development.
Objectives	• To improve the legal, institutional, and practical aspects of solid waste management thereby contributing to sustainable development and efficient resource use.
Activities	• Improvement of the legal framework for solid waste management. • Institutional and technical capacity building on data collection, analysis, assessment and management of solid waste. • Preparation of an integrated solid waste management strategy. • Capacity building on monitoring and supervision of waste disposal.
Outputs	• Strengthened legal, human, technical and institutional capacity building. • Integrated solid waste management strategy. • Reduction of GHG emissions.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 0.7 million, including Government US$ 0.2 million
Duration	2 years

A.4 Adaptation Projects

Project 14 Improvement of Climate Information Service in DPR Korea

Background	Trends in temperature and precipitation observations recorded over the last century suggest that the DPR Korea's climate is changing. Also, the fact that recently national economy and people's livelihood have been negatively affected by climate change shows that DPR Korea is vulnerable to climate change. But, the DPR Korea's existing capacity to obtain the information on climate change and variability in regional and local scale suitable to disaster management and adaptation is very weak.
Objectives	• To strengthen national capacity to develop and utilize the information on climate change and variability needed for prevention of climate related disasters and adaptation to climate change.
Activities	• Improvement of computation and communication equipments. • Development of database and software for analysis, validation, regional climate model and climate change scenarios. • Organization of training workshops on climate information service.
Outputs	• Improved climate related information and database. • Strengthened public awareness.
Executing Agency	SHMA
Budget	US$ 0.5 million, including Government US$ 0.1 million
Duration	3 years

Project 15 Improvement of Observation Network in DPR Korea

Background	Systematic observation is very important for climate change research. Due to the lack of computers and observation equipments, the SHMA has many difficulties in climate research.
Objectives	• To improve climatic observation network by using automatic meteorological observation instruments in DPR Korea.
Activities	• Improvement of observation quality through setting up of automatic observation instruments in 12 meteorological observatories. • Installation of modern observation equipment in 15 hydrological observatories. • Introduction of modern network server in SHMA. • Development of software related to the observation and service.
Outputs	• Improved technical capacity in observatories. • Observation database established in SHMA. • Software related to the observation and service.
Executing Agency	SHMA
Budget	US$ 2 million, including Government US$ 0.5 million
Duration	3 years

Project 16 Capacity Building for Integrated Water Resources Management in the Teadong River Basin

Background	The area of Taedong River basin is nearly 20,247km^2 and the annual precipitation is about 1,027mm. In the Teadong River basin, the density of population is higher than other river basins and there are many industrial parks around it. Also there are a lot of granaries with a great share in agricultural production of the country. This project aims to address water resources and related issues in the Taedong River basin through establishment of advanced and integrated water resources management system in consonance with the specific conditions of the country.
Objectives	• To overcome shortage of water resources due to impacts of climate change. • To improve the people's living conditions and promote the sustainable development of basin with better water quality.
Activities	• Strengthening of the legal framework on water use and establishment of information system for water resources. • Creation of sustainable water use system, including assessment of water value and establishment of water distribution system. • Improvement of water quality in Taedong River.
Outputs	• Legal framework strengthened and information system improved. • Water resources protected and the risks of flood disasters minimized • Local economies and people's living conditions improved.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 1.5 million, including Government US$ 0.4 million
Duration	3years

Project 17 Recovery of Degraded Forest and Firewood Forest Management in Community Areas

Background	In DPR Korea, deforestation is a primary factor of land degradation and a main constraint in solving food security and energy issues in rural areas. Most of the rural population depends on firewood for energy. By 2005, the area of non-timber forests had increased by 5,000 km^2 compared to 1996. This project will contribute to afforestation by all-people participation and to building management capacity with the county as a unit.
Objectives	• To supply firewood and food security through efficient forest establishment by improved management method in pilot forests and the advanced technologies for forest management.
Activities	• Development of assessment methodology and assessment of forest resources. • Establishment of firewood forest and rehabilitation of forest resources by improved growing method. • Building of institutional capacity for sustainable forest management with the county as a unit.
Outputs	• Assessment methodology for forest resources developed. • Firewood forest established and forest resources rehabilitated. • Institutional capacity strengthened.
Executing Agency	MLEP and relevant agencies
Budget	US$ 1 million, including Government US$ 0.3 million
Duration	3 years

Project 18 Capacity Building for Integrated Management of Coastal Zones

Background	DPR Korea is bounded by two large bodies of water: the Korean East Sea on the east and the Korean West Sea on the west, with long coastlines on its two sides. Coastal zones are very likely to be exposed to increasing risks in future due to climate change such as rise of sea-level and sea surface temperature and storm surge. This requires building the capacity for integrated management of coastal zones to adapt to climate change.
Objectives	• To increase adaptation capacity of coastal zone to climate change through integrated management of coastal zones to mitigate the negative effects of climate change.
Activities	• Capacity building for integrated coast management including hands-on training and supply of necessary equipments. • Development of space database of coastal zones and assessment of impacts of climate change on the coastal zones. • Establishment of methodology for integrated coast management and an early warning system.
Outputs	• Integrated coast management capacity strengthened. • Report on assessment of impacts of climate change on the coastal zones. • Methodology for integrated coast management and an early warning system.
Executing Agency	MLEP and relevant agencies
Budget	US$ 0.9 million, including Government US$ 0.3 million
Duration	4 years

Project 19 Promotion of Development and Dissemination of Advanced Agricultural Technologies for coping with Climate Change

Background	Over the period 1918 to 2000, annual mean temperature increased by 1.9°C in DPR Korea. Also, the accumulated temperature of over 10°C rised by several hundreds of degrees in the eastern and western coastal zones due to the impacts of climate change. Every year many paddy fields are inundated with water due to flood and the agricultural production is affected by serious erosion of soil. This requires developing and disseminating advanced agricultural technologies for coping with climate change.
Objectives	• To promote development and dissemination of advanced agricultural technologies for sustainable food production for coping with climate change.
Activities	• Strengthening of legal and institutional frameworks for development and dissemination of advanced agricultural technologies. • Training on adaptation and mitigation technologies to climate change in agricultural sector. • Capacity building of related agencies.
Outputs	• Legal and institutional frameworks strengthened. • Strengthened human, technical and institutional capacity.
Executing Agency	AAS and relevant agencies.
Budget	US$ 0.7 million, including Government US$ 0.2 million
Duration	3 years

Project 20 Control of Forest Pests Outbreaks by Climate Change and Integrated Forest Pest Management

Background	In 2011, forests covered approximately 74.7% of the country. Forest pests cause considerable damage to forest ecosystem. For the 2000-2002, approximately 300 km^2 of forest were damaged by forest pests including pine moth. It is expected that, by the impact of climate change, forest pests will appear explosively and frequently in future. Healthy and abundant forests are essential to the provision of building materials, energy and ecosystem services. It is a necessary condition for food security and sustainable socio-economic development.
Objectives	• To control the propagation and extension of forest pests and plant pathogens breaking out by impacts of climate change to reduce the forest damage and promote the sustainable development of forest ecosystem.
Activities	• Control of propagation and extension of forest pests including pine moth. • Establishment of monitoring system on subtropical pests and tree diseases. • Implementation of measures for integrated forest pest management and improvement of institutional and management system.
Outputs	• Controlled propagation and extension of forest pests. • Monitoring system on subtropical pests and tree diseases. • Institutional and management system improved.
Executing Agency	MLEP and relevant agencies
Budget	US$ 3 million, including Government US$ 0.9 million
Duration	3 years

Project 21 Improvement of Ecosystem Conservation System in Coastal Zone of the Korean West Sea

Background	DPR Korea has rich biodiversity relative to its size and many species are unique to the country. The coastal zone of the Korean West Sea has many protected areas that are important for biodiversity conservation in habitats and is largely affected by climate change, particularly by sea-level rise. It requires improving ecosystem conservation system in coastal zone of the Korean West Sea.
Objectives	• To conserve ecosystem and biodiversity in coastal zone of the Korean West Sea and to promote their sustainable development.
Activities	• Raising public awareness for ecosystem conservation in coastal zone of the Korean West Sea and strengthening of legal control. • Assessing impacts of climate change on ecosystem in coastal zone of the Korean West Sea and building study capacity on adaptation measures. • Building qualification and capacity of relevant experts and managers.
Outputs	• Raised public awareness. • Report on assessment of impacts of climate change on ecosystem in coastal zone of the Korean West Sea. • Strengthened human and study capacity.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 0.2 million, including Government US$ 0.07 million
Duration	3 years

Project 22 Capacity Building for Improving the Community-based Disaster Management System

Background	Nowadays, it is obvious that the MDGs cannot be achieved without consideration of disaster risk and the sustainable development cannot be brought about without reflecting the disaster risk management to development activities, planning and implementation. Due to the impacts of climate change, extreme weather events are occurring occasionally and the natural disasters such as floods and heavy rain are more frequent phenomena in DPR Korea, too. This needs to improve disaster management through building institutional and human capacity.
Objectives	• To improve the community-based disaster management system, thus contributing to improvement of their livelihood and promotion of safe agricultural production.
Activities	• Development and implementation of disaster management plan for disaster prevention and prompt response measures. • Training for reduction of disaster risk and effective disaster management. • Replication of lessons learnt from disaster management in other areas.
Outputs	• Disaster management plan developed and implemented. • Disaster risk reduced and effective disaster management. • Success and lessons learnt from disaster management.
Executing Agency	MLEP and relevant agencies.
Budget	US$ 1.5 million, including Government US$ 0.5 million
Duration	3 years

ANNEX 2 SUMMARY TABLES FOR DPR KOREA GHG INVENTORY FOR 1990-2002

B.1 Summary Table for the Year 1990

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	164,989	-13,726	1,181	12	3,058	458	234	3,122
1. Energy	156,964	-	987	3	1,960	421	230	3,117
A. Fuel combustion (Sectoral approach)	156,964		168	3	1,960	421	230	3,117
1. Energy industries	53,452		1	1	12	161	3	1,125
2. Manufacturing industries and construction	49,714		5	1	67	142	9	868
3. Transport	7,159		1	0	100	37	19	119
4. Other sectors	40,997		161	1	1,775	64	199	895
5. Other (please specify)	5,642		1	0	7	17	1	110
B. Fugitive emissions from fuels	-		819		-	-	-	-
1. Solid fuels			819		-	-	-	-
2. Oil and natural gas			-		-	-	-	-
2. Industrial processes	21,717	-	0	7	6	7	4	5
A. Mineral products	9,785				-	-	0	4
B. Chemical industry	3,696		0	7	6	7	4	0
C. Metal production	8,235		0	0	0	0	0	0
D. Other production	0				-	-	-	-
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	-	-	-	-	-	-	-	-
3. Solvent and other product use	-			-			-	
4. Agriculture			155	1	1,092	31	-	-
A. Enteric fermentation			62					
B. Manure management			13	1			-	
C. Rice cultivation			80				-	
D. Agricultural soils			-	1			-	
E. Prescribed burning of savannahs			-	-	-	-	-	
F. Field burning of agricultural residues			-	-	1,092	31	-	
G. Other (please specify)			-	-	-	-	-	
5. Land-use change and forestry	-	-13,726	-	-	-	-	-	-
A. Changes in forest and other woody biomass stocks	-	-16,300						
B. Forest and grassland conversion	-	-22	-	-	-	-		
C. Abandonment of managed lands		-						
D. CO_2 emissions and removals from soil	2,717	-						
E. Other (please specify)	-	-122			-	-		
6. Waste	33		38	1	-	-	-	-
A. Solid waste disposal on land			6		-		-	
B. Waste-water handling			31	1	-	-	-	
C. Waste incineration	33		1	0	-	-	-	-

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
D. Other (please specify)			-	-	-	-	-	-
7. Other (please specify)	-	-	-	-	-	-	-	-
Memo items								
International bunkers	-		-	-	-	-	-	-
Aviation	-		-	-	-	-	-	-
Marine	-		-	-	-	-	-	-
CO_2 emissions from biomass	20,126							

B.2 Summary Table for the Year 1994

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	119,978	-13,370	929	15	2,801	318	202	2,369
1. Energy	118,968	-	745	3	1,649	269	196	2,367
A. Fuel combustion (Sectoral approach)	118,968		133	3	1,649	269	196	2,367
1. Energy industries	30,912		0	0	7	30	2	646
2. Manufacturing industries and construction	51,398		5	1	72	148	10	960
3. Transport	4,555		1	0	69	22	13	72
4. Other sectors	24,674		126	1	1,494	47	171	564
5. Other (please specify)	7,430		1	0	7	22	1	124
B. Fugitive emissions from fuels	-		613		-	-	-	-
1. Solid fuels			613		-	-	-	-
2. Oil and natural gas			-		-	-	-	-
2. Industrial processes	14,345	-	1	10	9	17	6	2
A. Mineral products	4,960				-	-	0	2
B. Chemical industry	4,610		0	10	9	17	5	0
C. Metal production	4,776		0	0	0	0	0	0
D. Other production	0				-	-	-	-
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	-		-	-	-	-	-	-
3. Solvent and other product use	-			-			-	
4. Agriculture			143	1	1,143	32	-	-
A. Enteric fermentation			57					
B. Manure management			7	1			-	
C. Rice cultivation			80				-	
D. Agricultural soils			-	1			-	
E. Prescribed burning of savannahs			-	-	-	-	-	
F. Field burning of agricultural residues			-	-	1,143	32	-	
G. Other (please specify)			-	-	-	-	-	
5. Land-use change and forestry	-	-13,370	-	-	-	-	-	-
A. Changes in forest and other woody biomass stocks	-	-16,067						
B. Forest and grassland conversion	-	-22	-	-	-	-		
C. Abandonment of managed lands		-						
D. CO_2 emissions and removals from soil	2,755	-						

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
E. Other (please specify)	-	-36	-	-	-	-		
6. Waste	34		40	1	-	-	-	-
A. Solid waste disposal on land			7		-		-	
B. Waste-water handling			32	1	-	-	-	
C. Waste incineration	34		1	0	-	-	-	-
D. Other (please specify)			-	-	-	-	-	-
7. Other (please specify)	-	-	-	-	-	-	-	-
Memo items								
International bunkers	-		-	-	-	-	-	-
Aviation	-		-	-	-	-	-	-
Marine	-		-	-	-	-	-	-
CO_2 emissions from biomass	21,291							

B.3 Summary Table for the Year 2000

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	52,108	-16,633	582	4	2,448	169	161	1,297
1. Energy	64,226	-	410	2	1,332	136	161	1,297
A. Fuel combustion (Sectoral approach)	64,226		99	2	1,332	136	161	1,297
1. Energy industries	26,127		0	0	6	25	1	553
2. Manufacturing industries and construction	18,617		2	0	26	52	3	327
3. Transport	1,414		0	0	58	11	11	5
4. Other sectors	14,224		96	1	1,239	37	144	348
5. Other (please specify)	3,844		1	0	3	11	1	64
B. Fugitive emissions from fuels	-		311		-	-	-	-
1. Solid fuels			311		-	-	-	-
2. Oil and natural gas			-		-	-	-	-
2. Industrial processes	4,477	-	0	1	1	2	1	1
A. Mineral products	1,658				-	-	0	1
B. Chemical industry	853		0	1	1	2	1	0
C. Metal production	1,965		0	0	0	0	0	0
D. Other production	0				-	-	-	-
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	-		-	-	-	-	-	-
3. Solvent and other product use	-			-			-	
4. Agriculture			130	1	1,115	31	-	-
A. Enteric fermentation			44					
B. Manure management			8	0			-	
C. Rice cultivation			78				-	
D. Agricultural soils			-	0			-	
E. Prescribed burning of savannahs			-	-	-	-	-	
F. Field burning of agricultural residues			-	-	1,115	31	-	
G. Other (please specify)			-	-	-	-	-	
5. Land-use change and forestry	-	-16,633	-	-	-	-	-	-
A. Changes in forest and other woody	-	-19,084						

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
biomass stocks								
B. Forest and grassland conversion	-	0	-	-	-	-		
C. Abandonment of managed lands								
D. CO_2 emissions and removals from soil	2,455							
E. Other (please specify)	-	-3	-	-	-	-		
6. Waste	38		42	1	-	-	-	-
A. Solid waste disposal on land			7		-		-	
B. Waste-water handling			34	1	-	-	-	
C. Waste incineration	38		1	0	-	-	-	-
D. Other (please specify)			-	-	-	-	-	-
7. Other (please specify)	-	-	-	-	-	-	-	-
Memo items								
International bunkers	-		-	-	-	-	-	-
Aviation	-		-	-	-	-	-	-
Marine	-		-	-	-	-	-	-
CO_2 emissions from biomass	20,544							

B.4 Summary Table for the Year 2002

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total national emissions and removals	56,897	-16,880	601	5	2,495	159	170	1,384
1. Energy	68,391	-	424	2	1,395	125	169	1,383
A. Fuel combustion (Sectoral approach)	68,391		103	2	1,395	125	169	1,383
1. Energy industries	26,041		0	0	6	1	1	559
2. Manufacturing industries and construction	22,072		2	0	30	62	4	400
3. Transport	1,488		0	0	65	13	12	5
4. Other sectors	13,959		99	1	1,290	36	150	338
5. Other (please specify)	4,831		1	0	4	14	1	81
B. Fugitive emissions from fuels	-		322		-	-	-	-
1. Solid fuels			322		-	-	-	-
2. Oil and natural gas			-		-	-	-	-
2. Industrial processes	5,347	-	0	1	1	3	1	1
A. Mineral products	2,522				-	-	0	1
B. Chemical industry	910		0	1	1	2	1	0
C. Metal production	1,916		0	0	0	0	0	0
D. Other production	0				-	-	-	-
E. Production of halocarbons and sulphur hexafluoride								
F. Consumption of halocarbons and sulphur hexafluoride								
G. Other (please specify)	-		-	-	-	-	-	-
3. Solvent and other product use	-			-			-	
4. Agriculture			134	1	1,098	31	-	-
A. Enteric fermentation			46					
B. Manure management			9	0			-	
C. Rice cultivation			79				-	
D. Agricultural soils			-	0			-	

Greenhouse gas source and sink categories	CO_2 emissions (Gg)	CO_2 removals (Gg)	CH_4 (Gg)	N_2O (Gg)	CO (Gg)	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
E. Prescribed burning of savannahs			-	-	-	-	-	
F. Field burning of agricultural residues			-	-	1,098	31	-	
G. Other (please specify)			-	-	-	-	-	
5. Land-use change and forestry	-	-16,880	-	-	-	-	-	-
A. Changes in forest and other woody biomass stocks	-	-19,289						
B. Forest and grassland conversion	-	0	-	-	-	-		
C. Abandonment of managed lands		-						
D. CO_2 emissions and removals from soil	2,429	-						
E. Other (please specify)	-	-20	-	-	-	-		
6. Waste	40		42	1	-	-	-	-
A. Solid waste disposal on land			7		-		-	
B. Waste-water handling			35	1	-	-	-	
C. Waste incineration	40		1	0	-	-	-	-
D. Other (please specify)			-	-	-	-	-	-
7. Other (please specify)	-	-	-	-	-	-	-	-
Memo items								
International bunkers	-		-	-	-	-	-	-
Aviation	-		-	-	-	-	-	-
Marine	-		-	-	-	-	-	-
CO_2 emissions from biomass	21,621							