State of the Environment

DPR KOREA

2003

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DPR KOREA : State of the Environment 2003

Published by the United Nations Environment Programme

ISBN: 92-807-2144-5

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Distributed by

United Nations Environment Programme
Regional Resource Centre for Asia and the Pacific
(UNEP RRC.AP)
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FOREWORD

DPR Korea has been endowed with vast environmental resources in the form of water, forest, long coastline with important maritime resources and rich heritage of biodiversity. Environment and natural resource management has been one of the major development priorities. A series of natural disasters during the mid 1990s has emphasized the pressing need of the environmental consideration for the sustainable livelihood in the country. DPR Korea has engaged with the global community as being a partner in managing environmental resources towards promoting the sustainable development.

Since the establishment of the UNDP country office in Pyongyang in 1980, a strong partnership has been forged between Government and UNDP towards the environmental conservation. Environment has been considered as one of major priority areas in the first (1997-2000) and second (2001-2003) Country Cooperation Framework (CCF), which is basis for UNDP's Cooperation with DPRK. The first Common Country Assessment (CCA) carried out by the UN system for DPRK has also identified Environment and Energy as one of seven thematic groups.

UNEP Executive Director Klaus Töpfer visited Pyongyang in November 2000 to strengthen programmes of UNEP in DPR Korea. A partnership was forged with UNDP to assist DPR Korea in strengthening capabilities on environment assessment and monitoring, including the preparation of the State of the Environment (SoE) report 2003.

UNEP is mandated to assess regularly the major environmental developments and trends at global level. The publication of the Global Environmental Outlook (GEO) series involved participatory assessment process to review the state of the world's environment and to chart a new process for global environmental policy. GEO process entails vertical integration of information from national, regional to global. Data and indicators at the national, subregional and regional level are a quantitative base for GEO reports.

The present report is the first SoE report of DPR Korea. The report covers the five priority issues pertaining to environment: forests, water, air, land, and biodiversity. The issues were identified in consultation with Ministry of Land and Environment (MLEP) and analysed following the Pressure-State-Impact-Response Framework.

The National Coordinating Council for Environment (NCCE) was the National Focal Point responsible for overall implementation of the project, where as MLEP was the Implementing agency. MLEP has played a pivotal role in facilitating the participatory process as well as soliciting input from various line ministries of the government and other agencies. Around 20 agencies and 60 individuals were involved in the process of preparing the SoE report.

We hope that this report will be a valuable document for all concerned with environment and development. The report will also be helpful in formulating environmental action plan, policy setting, resource allocation and decision making.

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ACKNOWLEDGEMENTS

UNEP would like to thank the many individuals and institutions who have contributed to the preparation of ***DPR Korea : State of the Environment 2003.*** They included individuals in Government Ministries, departments, academic institutions, and other organizations. A full list of contributors, reviewers and participants of the national State of the Environment training and consultation, are included in Part V. Special thanks are extended to:

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National Coordinating Committee for Environment (NCCE), DPR Korea

National Implementing Agency
Ministry of Land and Environment Protection (MLEP), DPR Korea

Collaborating Centre
Environment and Development Centre (EDC), DPR Korea

Funding
The United Nations Development Programme (UNDP), DPR Korea and United Nations Environment Programme (UNEP) have provided the neccessary financial support for the preparation of the ***DPR Korea: State of the Environment 2003.***

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PART III KEY ENVIRONMENTAL ISSUES

Part I EXECUTIVE SUMMARY

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The National State of the Environment (SoE) Report of DPRK was produced in a partnership between the Ministry of Land and Environment Protection (MLEP), United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP). MLEP prepared this report in collaboration with other Ministries and Commissions such as the Ministry of Agriculture, the State Planning Commission and the Central Statistics Bureau, and scientific institutions including the Academy of Sciences, the Academy of Forest Science and the Environment & Development Center. This report is based on the UNEP guidelines and composed of four part.

- Chapter 1. Executive summary of the state of the environment
- Chapter 2. Overview of the major trends and developments affecting environmental resources
- Chapter 3. Analysis of five key issues in a state- pressure-impact-response framework.
- Chapter 4. Conclusions and recommendations

The objectives of the DPR Korea State of the Environment (SoE) report are: identify the key environmental issues that act as barriers to attain sustainable development, and provide policy settings and options that can be undertaken to offset any negative environmental trends. Five priority key environmental issues have been identified by the Government of DPR Korea through the consultative process following the UNEP guidelines. The five priority issues are (1) forest depletion, (2) water quality degradation, (3) air pollution, (4) land degradation, and (5) biodiversity. The Pressure-State-Impact-Response (P-S-I-R) framework analysis has been used to evaluate the five environmental issues. The National State of the Environment Report of Democratic People's Republic of Korea (DPR Korea) aims to provide guidelines for environmental action planning, based on analysis of the state of, and trends in the nation's environment. These will enhance and modify environmental conditions in a positive manner, as well as the quality of life in DPR Korea.

The Democratic People's Republic of Korea is located in the Asian continent's Far East. It is bounded east and west by two large bodies of water. The land area of DPR Korea is 122,762 square kilometers. The average annual temperature is 9.0 ~10.0 ^{0}C, with averages of 24 ^{0}C in summer (June~August) and -5.5 ^{0}C in winter (November~February).

The population of DPR Korea was 22 million during 1996 and growth trend shows that by 2020 the population will be around 29 million. Increasing population growth and the existing mountain terrain along with the occurrence of natural disaster have exerted pressure on the existing natural resources and environment of the country. The country's environment resources offer great potential for expanding economic opportunities and sustainable development of the country. The effort has given in this report to analyse the key environmental issues to identify the areas of intervention for timely measure to negative the environmental degradation trend. The summary of the five key priority environmental issues in DPR Korea is discussed below.

Forest Depletion

The forest, in its functional characteristics, plays two important roles since it is used both for national economic development and human well-being. In terms of geography, the forests are distributed all over the country, with high cover in the northern area. The majority of the forests represent a mountain forest cover, of which more than 70 percent stands on slopes above 20 degree. In 1978, the forest stock per hectare amounted to 53.6 cu. m. while in 1990 it was 55.9 cu. m. , demonstrating that forest stock per hectare increased by around 2.3 cu.m during the 12 year period. In 1996, the forest area was estimated at 8.906 million hectare, with 499.29 million cu. m. of biomass stock.

Because of substantial growth of firewood consumption to meet energy demand, forest fires, landslides and noxious insect damage have rapidly decreased forest area and stocks. This trend has been accentuated by conversion of forest into farmland. Forest degradation in DPR Korea leads to decrease of timber resources and habitats, weakness in control function of the biosphere on atmosphere and hydrology, loss of biological species, flooding and soil erosion

The government has under taken initiative to restore forests damaged by recent flooding, drought, forest fire and illegal deforestation, with the aim of achieving sustainable forest development. DPR Korea adopted:

- Cabinet Decision No 57. "Protection and Control Regulations of the Forest" on 15 May 1972;
- Cabinet Decision No 86. "Regulation on Forest Management" on 19 August 1972. On 11 December 1992; and
- "Law on the Forest of DPR Korea" was adopted, with two subsequent revisions in 1999.

The measure undertaken in DPR Korea included:

- proclamation on enactment of Tree Planting Day and which has been celebrated on 2 March of every year; and
- developed "Ten-Year Plan for Afforestation/ Reforestation" to restore and rehabilitate 2 million hectare of degraded forests with good tree species and directed considerable efforts to its implementation.

The proposed measures for forest degradation includes: establishment of the forest resource information base for science base policy formulation, implementation and monitoring; promotion of energy efficient technology for burning firewood for the livelihood; preparation and implementation of the strategy for the sustainable management of the forest resources.

Water quality degradation

DPR Korea is rich in water resources. The water resources in DPR Korea are characterized by large fluctuation in precipitation across the country and the short outflow time of rainfall due to the narrow width and steep slope of catchments. These characteristics create obstacles to effective management of the water resource.

The major sources of water are defined as rainfall, river and underground water. Among them, river water is considered an important source of water with regard to its potential for development. There are, however water shortages and pollution due to improper protection and management of water resources and extreme climatic events, such as drought and floods. In recent years, abnormally high temperature and continued drought led to low water level in rivers, resulting in imbalance in demand and supply of water for hydropower generation and agriculture.

With expansion of industry and population growth, some problems related to water conservation and management is emerging. The demand for drinking water, public water supply and water for industrial and other needs is becoming higher with economic development and the

Photo 1.1 *Pine forest on the mountain slope*

Photo 1.2 *Fresh Water resource*

improvement in standards of living. The discharges from some urban settlements and industries now mean that certain water bodies are subject to severe eutrophication and some water quality indices do not meet environmental standards. In particular, large quantities of untreated wastewater and sewage are discharged into the rivers, resulting in critical pollution of water bodies in recent years. Industrial wastewater has also increased, leading to degradation of river and lake ecosystems. With water contamination and lack of investment in disinfections in storage reservoirs, some diseases related to water use are surging.

The government had been putting up efforts for water resources management with the following policy measures.

- adopted Cabinet Decision No.15 on "Control Regulations on Rivers and Streams" in 1965 in order to conduct activities for river and stream management;
- designated a "middle and small-sized river and stream arrangement week" in spring and autumn;
- adopted the "Law on Water Resource, DPR Korea" on 18 June 1997, and subsequently amended on 14 January 1999, thus laying down a firm legal basis for water resource protection and sustainable development;
- in accordance with the "Law on Environment Protection, DPR Korea" and the "Enforcement Regulation for Environmental Protection", the government is currently strengthening legal control on effluent and sewage from factories, enterprises and purification plants. The "Polluter Pays Principle" is now applied to factories, plants and enterprises polluting rivers and streams, while the mass media, including TV, radio, newspapers and newsletters, inform the public about the need for water conservation;
- programmes for sustainable water development are also being initiated. In line with a policy to supplement construction of large-size hydro, medium or small-size hydropower plants have been constructed throughout the country, with 1,517 small-size hydropower plants newly built in 1998 alone; and
- to address irrigation water shortages, a large-scale national project started in 2000 to construct a canal between Gaechon and Taesong Lake.

Photo 1.3 *Water resources from the forested mountains*

Photo 1.4 *Bathing beach*

Water resource protection and management is a critical issue to be addressed immediately in DPR Korea. An appropriate share of national funding is required to be allocated to both protection and sustainable development of water resources. It is critical to improve purification efficiency through the introduction of modern technologies in water treatment and to establish pollution monitoring systems to provide a solid foundation for developing water resources in a sustainable manner.

Air Pollution

Together with industrial development and population growth, air quality is deteriorating, particularly in urban and industrial areas. The major causes of air pollutions have been associated with industrial boilers, kilns, motor vehicles and residential areas in and around the city and industrial areas. In 1990, existing boilers and industrial kilns in Pyongyang consumed 3,398,372 tonnes of coal. In the same year, household consumption for heating and cooking amounted to 357,665 tonnes.

DPR Korea meets its primary energy demand by using domestic coal resources, releasing SO_2, suspended particulate matter and NOx the main air pollutants associated with coal combustion. Primary energy consumption is expected to double, increasing from 47.974 Mtoe in 1990 to 95.948 Mtoe in 2020.

In DPR Korea, data available for air pollution assessment are very limited, while most studies relating to air pollution have been confined to Pyongyang City, the capital. Currently, the concentration of air pollutants in Pyongyang City does not exceed national environmental standards.

The energy policy of DPR Korea aims to satisfy increasing energy demand and ensure stability of supply in order to raise economic productivity and improve public welfare.

The government has given priority for the prevention of air pollution in Pyongyang City and major industrial towns, with positive measures being drawn up for policy implementation included:

- active steps are being undertaken, both to enhance combustion efficiency and exhaust gas purification in boilers and industrial kilns, and also to achieve maximum reduction of coal consumption in the household sector;
- emission sources like factories/plants and enterprises using boilers and industrial kilns are laid down by government to ensure strict compliance with the law and reinforce social controls;
- encourage the installation of fuel-efficient technologies, such as thermal insulation of furnaces, high efficiency of combustion, more effective heat use, and active elimination of exhaust gas emissions;
- relocation of certain factories and polluting enterprises away from Pyongyang and other industrial towns.

The government has prepared an energy strategy and its implementation is now underway. The key long-term priorities for policy implementation include the following:

- To secure stability of supply and increase the uptake of energy efficiency in end-use sectors by satisfying the need for energy through exploitation of local resources, particularly coal.
- To improve energy efficiency by means of effective energy use.
- To minimize the environmental impact of energy generation and use, increase efficiency of conversion and end-use and secure environmental sustainability by promoting a switch to the use of renewable energy use.
- The improvements of energy efficiency and energy savings are the highest priorities in the energy strategy.

For sustainable management of the air quality, it is necessary to establish comprehensive monitoring systems across the country and strengthen the study on impacts of air quality public health and ecosystems. It is also important to introduce advanced technologies such as clean coal technology (CCT), high efficiency purification of exhaust gas and renewable energy options for environmentally sound energy development.

Land Degradation:

In DPR Korea more than 80 percent of the land area consists of mountainous terrain where suitable land for the cultivation is limited. Severe degradation of land resources has been closely associated with natural disaster like landslide, flooding and the incidence of drought in recent years had substantial impacts on sustainable management of land resources, in particular agricultural production. The inundation of arable land by flooding in 1995 inflicted damage estimated at US$ 925 million. Along with these factors, forest degradation has adverse effects, which encourage land erosion. Conversion of forest land in hilly areas to agricultural land has been accelerated by population growth and by the decrease in agricultural production, leading to further land degradation

The acidification of arable land by fertilizer application brings about a decline both in soil humus content and in crop output. In order to protect land resources from acidification and to enhance fertility, treated sewage and coal ash from urban centers are being applied on the land. The volume of municipal solid waste generated from Pyongyang is estimated to be 420 thousand tonnes per annum. Of this, a proportion is being processed at a solid waste disposal site to be used as fertilizer

Photo 1.5 *Mountain*

in farming areas around Pyongyang City. Most of the remaining untreated solid waste is being trucked to certain areas in the vicinity of the city. There has been pressing need for the research on the urban solid waste management and its impact on the land quality.

The measures undertaken for the land management by the government are as follows:

- carried out afforestation and water conservancy work since liberation;
- focused on the restructuring of the land for the effective use of land and creating favourable condition for irrigation and mechanization. In recent years, restructuring of hundreds of thousand of hectares land was carried out in Kangwon, North Pyongan and South Hwanghae Proviences;
- adopted "Law of Land , DPR Korea" on 29 April 1977. After entered into force, it was amended to meet a growing set of requirements thus laying down a legal frame work to help protect and develop land resources in a useful and sustainable manner.
- rehabilitation of land for improvement of crop production through agricultural industrialization/modernization. It envisages: carrying out realignment of rivers and streams and afforestation/reforestation for land protection; and organizing and making headway with land management under a far-reaching program; and
- initiated the follow-up activities for the land resources protection, which are given as follows: preventive action on soil erosion by rehabilitation of degraded forest and planting trees in associated forests and suitable areas; realignment of rivers and streams as well as the construction of embankments to protect the land resources from flooding and drought; build the terraced fields for preventing possible fertile soil loss from the sloping land.

Photo 1.6 *Rice grain with rising sun*

Photo 1.7 *Agriculture land*

Government consider land as the basis for the livelihood and prosperity of the people of the country. So there has been contineous efforts from the government to maintain the productivity and fertility of land. There has been measures required for increasing the awareness of the people about the importance of land quality ; reasearch studies on the activites affecting the quality and loss of productive lands.

Biodiversity

Given the importance of biodiversity for present and future generations, as well as the benefits it offers at the national, regional and global levels, DPR Korea has made special efforts on biodiversity conservation. Though its territory is not large, the country is endowed with abundant biological species

and genetic resources. Ecosystems in DPR Korea can be classified as forest and alpine ecosystems; river and lagoon ecosystems; wetland ecosystems; coast and marine ecosystems; and agricultural land ecosystems, according to natural geographical conditions.

Under IUCN criteria, fauna and flora in DPR Korea can be divided into critically endangered species, endangered species, rare species and regionally-based populations. For higher vegetation, there are 10 critically endangered species, 42 endangered species, 76 rare species and 26 species of region-based populations, giving a total of 158 species, representing 4 percent of threatened higher vegetation species worldwide.

In the case of vertebrates, 9 critically endangered species, 29 endangered species and 119 rare species, account for around 11 percent of global vertebrate species under threat. Ecosystem degradation is followed rapidly by forest degradation, soil erosion, water deterioration, depletion of economically valuable natural resources, and natural disasters including flooding. Over- exploitation beyond the reproductive capacity of biological resources becomes a main cause of biodiversity loss.

Government has initiated numbers of initiatives and legal basis for the protection and conservation of the national biodiversity resources included:

- prepared the " National biodiversity Strategy and Action Plan of the DPR Korea" in 1998 involving the concerned line agencies to conserve the biodiversity of the nation for the welfare of its people;
- prepared a framework for the conservation of various ecosystems and species diversity , particularly genetic resources;
- designated environmental protection as a priority over all productive practices and defined it as a prerequisite for sustainable development in article 57, chapter 3 of "DPR Korea Socialist Constitution" revised in 6 th September 1998;
- Adopted a "Forest Law" in 1992, "Fishery Law" (1995), "Law on Marine Product" (June1995), "Law on Water Resources" (1997), and "Law on Protection against Marine Pollution" (1997) in order to strengthen the conservation and management of national biodiversity resources;
- In addition the government adopted regulations for enforcement of all laws concerned with environmental protection, in order to implement these laws it has since 1996 organized widespread public campaigns, such as the "Land Development Campaign in Spring and Autumn";
- Strengthened and improved the national administrative mechanism for biodiversity conservation; and
- Introduction of public awareness program on biodiversity resources through mass media and awareness campaign.

Along with the government efforts, few measures are proposed to conserve the biodiversity resources. These includes: inventory and evaluation of national biodiversity resources; establishment of the biodiversity resource center to conserve and protect the biodiversity wealth of the country; rehabilititation and management of the degraded ecosystem; and improvement of the marine reserves.

Photo 1.8 *Wild ducks on the Taedong River*

Photo 1.9 *Herons perching*

Part II

OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

2.1 General Context

Geography/Meteorology

The Democratic People's Republic of Korea is located in the Asian continent in the Far East. It is bounded east and west by two large bodies of water.

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

DPR Korea, located in the northern zone of Temperate Asia, has a mild climate with four pronounced seasons; spring, summer, autumn and winter.

Climate is influenced by the continental mass of Asia and by the surrounding oceans, and is typically humid in summer and cold and dry in winter. Annual average temperatures are 9 ^{0}~10 ^{0}C, with averages of 24 ^{0}C in summer (June~August) and -5.5 ^{0}C in winter (November~February) respectively.

The annual precipitation, at approximately 1,000 mm ~ 1,200 mm, varies somewhat by region throughout the country.

The underground resources of DPR Korea are coal, iron, magnesite, and limestone, but neither crude oil nor natural gas is available.

2.2 Environmental Resources

Major environmental resources in DPR Korea are forest, soil, water, atmosphere, and biodiversity. This section describes the condition of these resources, together with the trends and driving forces.

Photo 2.1 *Colours of autumn*

2.2.1 Forest

Forest is a principal resource of DPR Korea and constitutes about 73.2 percent of total land area. In terms of the country's geographic attributes, the forest is distributed through out most of the country, but forest canopy is much more dense in the north. Most cover consists of montane forest of which more than 70 percent is on slopes above 20^0.

In 1996, total forest area was estimated at 8.906 million ha, while forest accumulation was assessed to be 499.29 million cu.m. The forest resource has certain characteristics which depend on geographical /and topographical with climatic conditions.

Vegetation Resource

The forest resource is diverse in species composition and resource types. The vegetation species amount to 8,785, including 3,943 higher plant species, 209 endemic plant species, and 604 cultivated species.

Having experienced successive impacts over the millennium of the Ice Age and a tropical interglacial period, DPR Korea has now a range of vegetation, from the sub-tropical to the temperate and frigid zones. These species still thrive because of the compound effects of oceanic and continental climates on the Korean peninsula.

Mammal Resource

The mammals of DPR Korea are a part of the fauna of the eastern region of Asia and the Continent of Eurasia. It encompasses a range of animals dependant upon a biota system in which mixed forests of needle and broadleaf trees are dominant. It is mainly composed of Asian type animals, with animals from a northern origin substantially represented.

Of these animals, 87.5 percent of artiodactyls, 76.4 percent of carnivore and 77.7 percent of insectivore are represented in DPR Korea.

The typical animal species of northern origin involve *Cervus Nippon, Cervus elaphus, Nemorhaedus goral raddeanus, Capreolus capreolus bedifordi, Moschus moschiferus, Sus scrofa, Mustela sibiricus, Martes zibellina, Martes flavigula, Meles meles, Ursus thibetanus, Ursus arctos, Felis pardus, Sorex caecutiens, Erinaceus europaens, and so on, and southern origin one are Hydropotes inermis, Felis tigris, Vulpes vulpes, Lepus mand schuricus, Pteromys volans etc.*

In terms of bird species, the distinct dominators are of boreal origin, consisting of Eastern Asia types including Siberian, Mongolian and European types.

The typical bird species are *Phasianus colchicus, Dendrocopos kizuki, Dendronanthus indicus, Anthus hodgsoni, Tetrastes bonasia, Lyrurus tetrix, Picoides tridactylus, Nucifraga caryocatactes, Tarsiger cyanurus, Loxia curuirostra, Corvus frugilegus, Cuculus micropterus, Caprimulgus indicus, Eurystomus orientalis, Otus bakkamoena, Ninox scutulata and so on.*

The forest mammals, reptiles and amphibians are all from boreal origin.

The endemic forest mammal species are some birds such as *Dryocopus richardsi* and some insects, and the endemic subspecies are *Pantheratigris coreensis, Hydropotes intermis,* some birds and insects.

Photo 2.2 *Four Seasons in DPR Korea - spring, summer, autumn,winter*

Photo 2.3 *Taedong Riverside*

2.2.2 Water

Water conservation and management is one of the critical environmental issues in DPR Korea. Economic development and population growth create some problems in water conservation and management, resulting in water pollution by discharge of untreated wastewater and sewage into the rivers. The water resource of DPR Korea is characterized by great regional variation of rainfall and short runoff duration due to narrow and steep water basins. These factors create difficulties for effective water management. The average precipitation is between 1,000~1,200mm per annum, which is high in relation to the figure of 840mm of mean annual precipitation at the global level.

The monsoon pattern in DPR Korea creates wet weather in summer, whereas spring is dry. In winter, a dry, cold wind from north or northwest persists, while summer brings the return of heavy rain from a warm humid south or southeast wind. Under these climatic conditions, precipitation in summer ranges from 50 percent to 60 percent of total annual precipitation, but rainfall in winter is limited. These meteorological and hydrological conditions exert significant impacts on the national economy, particularly in the agricultural sector.

Photo 2.4 *Still Water resource*

2.2.3 Land

Most of the territory of DPR Korea consists of mountainous areas, in which forest area in 1996 was estimated to be 8,960,000 hectares, while agricultural land accounted for 2,013,000 hectares However, socio-economic development is leading to loss and degradation of agricultural land and forestland, and it is expected that this trend will continue in the future. Similarly, it is expected that the area for residential and public land such as housing, road, factory, park, etc, will be further expanded.

2.2.4 Biodiversity

The ecosystems of DPR Korea, in accordance with its natural and geographical features, are divided into alpine ecosystems, lake and lagoon ecosystems, wetland ecosystems, coastal and marine ecosystems, and farmland ecosystems.

Table 2.1 Land use status (million hectares)

Land Use	1990	1993	1996
Agricultural Land	2.038	2.087	2.103
Forest Land	9.020	8.211	8.183
Industrial Land	0.189	0.196	0.199
Water Land	0.710	0.720	0.727
Residential Land	0.137	0.152	0.157

Source: *CSB (1997)*

The forest ecosystem can be broken down into three types of forests: latifoliate leaf forest, coniferous forest and mixed forest.

The latifoliate forest encompasses temperate deciduous forest, mainly with sub-arctic deciduous trees and *Quercus acutissima* Carr.

The typical coniferous forest is a sub-arctic forest with *Abies nephrolepis* Maxim and *Picea jezoensis* Carr and includes temperate coniferous forest types.

According to climatic zones, the mixed forest can be divided into three types : sub arctic evergreen mixed forest, the north temperate mixed forest, and the south temperate mixed forest. The unique alpine ecosystem is distributed in the area above 2000 m, with a distinct plant community. A total 3 percent of land is occupied by rivers ecosystems. These include differentiated wetland ecosystems in the tidal zone, estuary, lake vicinity, alpine swamp and peat area, and also the unique coastal and marine ecosystem, while the agricultural land ecosystem occupies 17 percent of total land area of country.

Surveyed and registered plants account for 8,785 species, of which 3,900 are higher plants. The vascular plants are 3,176 species, 790 genus, 204 family, so it is clear that vegetation species in DPR Korea are relatively abundant in relation to land area.

Of 1,431 species of vertebrates investigated so far, fish species are 865, amphibians 17, reptile 26, birds 416, and mammals 107 (of which terrestrial animals are 79 species). This means approximately

Photo 2.6 *A flock of sheep*

3.2 percent of global level vertebrate species are represented in DPR Korea.

The country has a long history of agricultural practice, and there is evidence of rice, bean, millet *(Panicum miliaceum)*, Indian millet, etc, having been used for 6,000 years. Cultivated crops include about 600 species, so ample genetic resources are available in DPR Korea. The high proportion of medicinal plants is a characteristic of the cultivated plant inventory.

The livestock resources of DPR Korea includes 50 breeds of seven species, such as cattle, pig, goat, sheep, etc, while domestic fowls include 30 breeds of eight species, such as hen, duck, goose, and quail.

In terms of the preservation of genetic pool diversity, it is important to investigate the gene resources linked to livestock and cultivated vegetation and at the present time in-depth research is being conducted in this field.

Photo 2.5 *Forest in the mountain*

Photo 2.7 *A grove of metasequoia in Ongjin County*

2.2.5 Marine Resources

The conservation of marine resources and the development of aquaculture are greatly significant for constantly enhancing these resources, while also providing high yields from sound production methods in fisheries to meet human demand for seafood. DPR Korea, with long coastlines on its two sides enjoys favorable conditions for the development of marine farming.

In addition, there are also good conditions for fresh water fish breeding in the broad tidal zones, inland lakes, reservoirs, rivers and paddy fields. Some fish stock are however now in a critical state due to excessive pressure on resources in coastal areas over the past 10 years.

Economic difficulties have forced a reduction in financial support to the fishery sector and this has weakened the deep-sea fishery capacity. Since demand for marine products could not be met from this source, pressure has increased in inshore and coastal areas, resulting in a substantial decline of marine species such as shells, sea-cucumber, sea-urchin and flat fish

This is a key political issue and the government attaches great importance to the facilitation of freshwater fish culture on a large scale throughout the country. During the last two years, a number of freshwater fish farms, such as a catfish farm, have therefore been constructed to establish freshwater fish production capacity

Photo 2.8 *A fishing area*

2.3 Socio-economic Profile

2.3.1 Population

The population of DPR Korea was 20,960,000 in 1990, and 22,114,000 in 1996. Table 2.2 refers to population growth between 1976-1996.

The urban population accounted for 60.9 percent of total population in 1990 and 60.2 percent in 1996 and the average life is 66.8 years. The estimated population will be 29,164,000 in 2020.

2.3.2 Economy

DPR Korea is a socialist industrial state with an independent national economy relying mainly on its own technologies and resources. Table 2-4 shows the national economic profile.

Table 2.2. Population State (in thousands)

Year	Total population (1,000)
1979	17,000
1986	19,060
1990	20,960
1993	21,213
1996	22,114

Source: *DPR Korea (2000)*

Table 2.3 Expected population growth

Year	Totalpopulation (1,000)	Population growth (percent)
2000	22,996	0.950
2005	24,404	1.196
2010	25,879	1.195
2020	29,164	1.196

Source: *DPR Korea (2000)*

Table 2.4 Economic profile

	1992	1994	1996
GDP(million US$)	20,875	15,421	10,588
Industry (percent)	37.6	41.7	45.1
Agriculture (percent)	21.8	20.9	14.7
Construction (percent)	6.3	5.9	4.8
Others (percent)	34.3	31.5	35.4
GDP($) per capita	990	722	482
Total exports (million US$)	962	896	756
Total exports (million US$)	962	896	756
Total crop yield (thousand tones)	8,800	7,083	2,502
Of which Rice	4,500	3,177	1,426
Of which Corn	3,718	3,547	825

Source: *DPR Korea (2000)*

Total industrial output increased by 196 times in 1977, 431 times in 1984 (as compared with 1946), respectively, and 1.5 times in 1993 as against 1986. High economic growth was accompanied by increased energy demand.

In 1992, GDP was US$ 20.875 billion, but in 1996, it decreased to US$ 10.588 billion. Of GDP, the share contributed by industrial sectors such as iron, chemistry, cement, magnesite, machine manufacturing, electricity, electronics, construction and the like amounted to 37.6 percent in 1992 and 45.1 percent in 1996.

The share of the agricultural sector decreased from 21.8 percent to 14.7 percent due to continued natural disasters such as flooding, drought and tidal waves. The main cultivated crops are rice and corn. In 1992, the total crop yield was 9.1 million tonnes, of which rice and corn outputs amounted to 4.5 million tones and 3.8 million tones, respectively.

The other shares, contributed by transport, communication, commercial, trade, financial and public sectors, accounted for 34.3 percent in 1992 and 35.4 percent in 1996. The national economy, although experiencing constraints over recent years, will be further expanded on a stables, sustainable basis.

2.4 Environmental and Economic Development Issues

DPR Korea identified environment as an important sector and pursued environmental protection policies.

In line with economic development, the government directed great concern to securing sustainably of development, endorsing the principle of giving priority to environmental protection. As a result, significant progress has been made in protection and sustainable development of environmental resources - forest, water, fisheries, air quality, soils etc.

However, continued natural disasters and some economic difficulties brought about a decline in investment for the environment sector, giving rise to some issues in conservation of resources and in the pursuit of sustainable development.

Forest Degradation

The forest in DPR Korea constitutes about 73.2 percent of its territory and it plays a significant role in national economic development. However, over the past 10 years, continuous drought, heavy rain and vermin caused considerable forest damage. Timber production and firewood consumption are considered to be the main reasons for the decrease in forest stocks. In particular, some economic difficulties brought about a shortage of the coal necessary for residential use and agriculture, resulting in over-exploitation to meet thermal energy demand. In 1990, total firewood output per year was 3 million cu.m, but it increased to 7.2 million cu.m in 1996.

Another factor has been the degradation of some tree species such as Pinus densiflora Sieb. The decrease in forest stocks and area exerts negative impacts on national economic development, people's livelihood and sustainable development of forest resources.

Land Degradation

DPR Korea has satisfied the demand for food with domestic production. Land is therefore an important environment resource for agriculture and people's livelihood. The government gives priority to sustainable land conservation.

Over past decades, positive practices have been carried out to protect and expand the land resource in the form of build-up of terraced fields, reclamation of tidal areas, enlargement of irrigated areas, and acquisition of new land. Now, great progress has been made in reforming several hundred thousand hectares through the adjustment of fields in Kangwon, North Pyongan, and South Hwanghae provinces. As noted above, forest degradation, flood, drought and tidal wave had significant negative impact on the land resources of the country.

Soil erosion in arable land was assessed at 15 ton/ hectares in 1996. Thus soil erosion prevention is considered a key priority for sustainable agricultural production in DPR Korea.

Water Degradation

DPR Korea is rich in water resources, which play a great role in national economic development. The government puts great significance on rational and sustainable use and conservation of water resources.

The government completed the irrigation project to streghen of the rural economy while making efforts to not only prevent flooding by constructing many gates including the sea barrage, large and small-sized dams like the Taechon hydropower plant dam and facilities for water management, but also to meet rapidly growing water demand.

However, lack of investment in treatment of wastewater and sewage, together with insufficient management and repair of treatment facilities, results in contamination of water resources, particularly Taedong River.

Photo 2.9 *Wild blossoms*

Photo 2.10 *Landscape*

Photo 2.11 *Pristine water*

Photo 2.12 *Terraced fields*

Although the demand for water in the agricultural sector has risen sharply as a result of severe and sustained drought episodes, it cannot be adequately met on account of the scarcity of water resources in some areas.

Environmental Management Profile in Industrial Sector

DPR Korea is a socialist industrial state with an independent national economy relying on its own resources. Its major industrial structure encompasses electric power, iron and steel, metal, mining, processing, manufacturing and chemical industries that are mainly dependent on domestic resources.

In DPR Korea, the primary energy resource is coal, which meets more than 80 percent of the energy demand. Coal is a major fuel and crude material, widely used in all fields of the national economy. In 1990, coal output amounted to 60 million tonnes, but it decreased to 22.07 million tonnes in 1998. Air pollution by coal combustion became a serious issue. In particular, outdated thermal generation, of electricity and old-fashioned scrubber/purification of exhaust gases are the main sources air pollution. At present, it is most important to raise energy efficiency and introduce updated exhaust gas/waste water treatment technologies in the industrial sector.

Agricultural Development in DPR Korea

DPR Korea, attaching great importance to self-sufficiency in food as a national policy, has constantly focused on its implementation. However, agricultural output is decreasing rapidly due to natural disasters such as continued drought, flooding, and tidal waves in recent years. In addition, shortage of fertilizer, herbicide, farm machine, fuel etc. are also key factors in the decline of agricultural production. In 1990, the crop yield accounted for 9.1 million tonnes, but only 3.02 million tonnes in 1998.

The decline of agricultural output gives rise to substantial adverse impact on overall socio-economic development and resource management.

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Part III KEY ENVIRONMENTAL ISSUES

PART III KEY ENVIRONMENTAL ISSUES

3.1 FOREST DEPLETION

Forest plays an important role in the livelihood of the people of DPR Korea. Presence of forest in the mountainous terrain has significant positive impact in reducing landslide and flood disaster. It has also major role in contributing agriculture production and recharging of the ground water aquifer and perennial fresh water resources in the river system of DPR Korea. The forest ecosystem can be said to be the habitats for various animals, plants and microorganisms including trees as a major component.

Increase of population and the demand for food and firewood has exerted pressure on the forest ecosystem of the country resulting loss of habitats and frequent occurrence of natural disaster.

3.1.1 State

The area under forest in DPR Korea was estimated at around 9.7 million hectares. in 1945, with 1,308 million cu.m of total forest stocks and 14.2 cu.m of biomass stocks per hectares. Since the great leader Comrade Kim Il Sung planted trees on the Moonsu Hill in Pyongyang City on 6 April 1947 in order to publicize the need for reforestation throughout the country, many efforts have been undertaken for afforestation/reforestation each year in DPR Korea.

Even during the war, from 1950 to 1953, mobilization of the entire people continued for reforestation and was executed under an order of the Military Commission. The government set out the policy for establishing the economic value of forests in December 1959 and has since been energetically carrying out afforestation throughout the country.

Photo 3.1 *Degraded forest on the mountain slope*

Table 3.1 Forest land composition and stocks

Classification	Area (000 hectares)	Biomass stock (tonnes/hectares)
Forested land	8,201	62.3
Forest of timber industry	5,440	74.55
Economic forest	1,436	48.3
Firewood forest	196	40.95
Protected forest	1,129	66.15
Non-timber forest land	436	3.15
Unforested area	383	-
Grass field	170	18

Source: *CSB (1997)*

Table 3.2 Typical compositions of forest species

Classification	Ratio (percent)
Compositions by species of forest land	100
Coniferous forest	41.9
Latifoliate forest	35.6
Mixed forest	22.5
Coniferous forest	
Pinus	37.8
Larch	33.8
Pinus koraiensis	11.9
Kind of Deodar	14.8
3 needle-leaf Pinus	1.7
Latifoliate forest	
Oak	52.4
Lime	6.4
White birch	6.3
Acacia	3.2

Source: *DPR Korea (1998b)*

As a result of the dramatic increase in forest, total stocks increased to 539.46 million cu.m, representing more than a fourfold increase over 1945 levels. In 1978, forest stocks per hectares. were 53.6 cu.m but increased to 55.9 cu.m in 1990. Over the same 12-year period, the afforested/reforested area expanded from 970,000 hectares. to 1.13 million hectares., a rise of 160,000 hectares.

However, socio-economic and industrial development led to a drop in the area under forest, with a loss of 144,012 hectares. in total forest between 1986-1996. At present, therefore, the government has a strong policy of reforestation and the area under forest is again being systematically expanded.

Table 3.1 shows forest land area and stocks by forest type.

The forest in DPR Korea can be divided into three main types; latifoliate forest, coniferous forest and mixed forest. The latifoliate forest occupies 38.1 percent of total forest area and consists of *Larix* forest, *Pinus koraiensis* forest and *Pinus densiflora* forest. *Abies nephrolepis-Picea jezoensis forest*, a typical sub-boreal latifoliate forest, is characterized by the major species of Abies nephrolepis, *Abies holophylla*, *Picea jezoensis*, *Picea koraiensis*, etc.

Table 3.3 Incidence of forest fires (1996 - 1997)

Province	Damaged area (hectares.)	Cases of forest fire
Pyongyang city	452	28
South Pyongan Province	327	60
North Pyongan Province	595	70
Zagang Province	281	25
South Hwanghae Province	5,705	197
North Hwanghae Province	4,652	136
Kangwon Province	583	75
South Hamgyong Province	10,435	77
North Hamgyong Province	21,619	130
Ryanggang Province	942	71
Kaesong city	178	9
Nampho city	248	34
Total	46,017	911

Source: *CSB (1998)*

The original location of *Pinus koraiensis* is in fact DPR Korea itself, so its distribution through out the country is extensive. It is now the main species for afforestation/reforestation. Table 3.2 indicates the typical composition of forest species in DPR Korea.

3.1.2 Pressure

Because of the substantial growth of firewood consumption to meet energy demand, forest fires and noxious insect damage (caused by sustained drought), forest area and stocks have decreased rapidly in recent years. This trend has been accentuated by conversion of forest into farm land.

Photo 3.2 *Degraded pine forest*

Photo 3.3 *Timber rafting*

Temporary economic difficulties created barriers to investment in the forest sector. Continuing pressures are reflected in the growth of firewood consumption between 1990-1996, which more than doubled from 3 million cu.m to 7.2 million cu.m.

Forest fire damage caused by high temperature/ severe drought during the period 1996-1997 is shown in Table 3.3.

3.1.3 Impact

Forest resources play an important role in national socio-economic development. Combating further possible degradation and achieving sustainable development of forests are therefore crucial issues to be addressed in DPR Korea as a matter of urgency.

Rapid decline of forested area and stocks exerts negative impact on overall socio-economic progress and sustainable management of environmental resources.

Exploitation and consumption of forest resources currently exceeds the replacement capacity and hundred of thousands of hectares have been lost because of irregular forest clearing and grazing.

Table 3.4 Damage by flooding in 1995 and 1996 in US $

Indices	1995	1996
Total damaged cost (000)	15,000,000	2,270,862
Affected counties (number)	145	117
Inhabitants affected (000)	5,200	3,270
Inhabitants outdoor (000)	-	147
Victims (no. of individuals)	-	116
- Damage cost across sectors (US$ in million)	-	2,271
Agricultural sector	-	782
Land managerial sector	-	203
Municipal managerial sector	-	391
Industrial sector	-	110
Railway sector	-	126
Communication sector	-	214
Educational sector	-	196
Public health sector	-	-
Loss of farming land	925	-
Loss of husbandry	111	-

Source: *CSB (1998)*

In addition, natural disasters such as the explosion of insect populations, fire and landslides bring about degradation of the remaining forests.

The decline in overall productivity and the weakening of the forest's environmental protection function lead to negative impacts on national socio-economic development, resulting in a failure to implement both the "Forest Principles" and environmental protection policy. Forest degradation in DPR Korea leads to decrease of timber resources and habitats, weakness in the control function of the biosphere on atmosphere and hydrology, loss of biological species, flooding and land erosion.

As shown in Table 3.4, unprecedented heavy rain in 1995 and 1996 created extensive damage and economic losses.

3.1.4 Response

The main policy for sustainable forest development in DPR Korea is to plant mixed forests, including fibre-bearing forest, oil-bearing forest and timber forest, with fast-growing and useful tree species. Public support and involvement can consolidate the successes attained in establishing a sound raw material basis and a forest of economic value.

The government has taken positive measures to restore forests damaged by recent flooding, drought, forest fire and illegal deforestation, with the aim of achieving sustainable forest development. DPR Korea adopted Cabinet Decision No 57. "Protection and Control Regulations of the Forest" on 15 May 1972 and Cabinet Decision No 86. "Regulation on Forest Management" on 19 August 1972. On 11 December 1992, "Law on the Forest of DPR Korea" was adopted, with two subsequent revisions in 1999. Simultaneously, the government proclaimed "On Enactment of Tree Planting Day, DPR Korea" and now celebrates 2 March each year as Tree Planting Day.

The forestry policy of DPR Korea aims to enhance forest productivity and its function for environmental protection, together with land and water protection, through both the establishment and conservation of forests. The Ministry of Land and Environment Protection is responsible for afforestation/reforestation, forest protection and land management. A structured forest management system has been put in place covering provinces, counties and urban areas.

Civil society groups include the Forest Conservation Association (under Korean Nature Conservation Union), and a Forest Association (under the General Union of Science and Technology). Together with youth and children's organizations they take an interest in afforestation, forest protection and nurseries, aiming in particular at the fast recovery of degraded forest ecosystems. They also take part in activities for forest conservation and reforestation, building public awareness and disseminating information on science and technology relevant to forests.

Table 3.5 Change in forested area and biomass stocks by 2020

Classification	Forest area (000 hectares)		Forest biomass stock (t/ hectares)	
	1990	2020	1990	2020
Timber forest land	8,201	7,9028	-	-
Protected forest	1,129	1,000	66.15	142.33
None-timber forest land	436	200	3.15	9.6
None forest land	383	750	-	-
Grass field	170	513	18	18

Source: *State Planning Commission (2000)*

The agencies concerned with land and environmental protection, and the enterprises and communities in charge of forests, have set up nurseries with well-organized systems for breeding and seed selection in order to increase seedling production. MLEP has established central nurseries covering 100 hectares, and arranged seedling bases to produce fast- growing saplings with economic value. These are installed in every province and in counties to supply the billion saplings necessary for afforestation/reforestation. The government developed "Ten-Year Plan for Afforestation/ Reforestation" to restore and rehabilitate 2 million hectares. of degraded forests with good tree species and directed considerable efforts to its implementation.Projected changes in forest area and stocks under this Plan are shown in Table 3.5.

3.1.5 Conclusion

In order to rapidly increase the forest resource and ensure its effective use in socio-economic development, it is important to develop a rational long-term afforestation/reforestation plan and implement it in integrated and sustainable manner. "Forest Law, DPR Korea" should be strictly adhered to in the management of this process.

The law highlights specific principles and methods for afforestation/reforestation, forest protection, use of forest resources, and forest management. For sustainable increase, protection and management of forest resources, it is critical to increase investment in the forest sector.

In line with the demands of the 21st Century and a new millennium, the government of DPR Korea will contribute to the implementation of "Forest Principles" and "Agenda 21" adopted by the "1992 Earth Summit in Rio" by preparing and implementing strategies to prevent forest degradation and ensure sustainable forest development.

Photo 3.4 *Hills with forest cover*

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3.2 Water Quality Degradation

DPR Korea is relatively rich in water resources. The main sources of water are rainfall, river and underground water. Among these, river water is considered a crucially important source of water in terms of its potential for development. The demand for drinking water, public water supply (including needs for sewage disposal), agriculture, industry, hydropower and water transportation, timber industry, etc. is growing with economic development and improvements in the population's standard of living.

There are however imbalances in water demand and supply for agriculture and hydropower, due to low water level in rivers and reservoirs caused by abnormally high temperatures and drought, while illegal discharge of untreated wastewater and sewage into rivers create periodic breaches in some water quality standards.

Photo 3.5 *A harbinger of spring*

3.2.1 State

Water Pollution Profile

The total average ion content in rivers and streams in DPR Korea is about 112.1 mg/ℓ with levels of 16.3 mg/ℓ of calcium ion and 4.1 mg/ℓ of magnesium ion. Full details of mean water quality in major river basins is given in Table 3.6.

In recent years, pollution of rivers and streams became severe because of a decrease in investment in environmental protection and abnormal operation of wastewater/sewage treatment plants.

Table 3.7 shows levels of pollution in the Taedong River, which flows through the centre of Pyongyang City.

As shown in Table 3.7, the quality of Taedong River exceeds the environmental standards and is deteriorating further as years go by. In particular, since the construction of the sea barrage, natural purification capacity has been weakened by low flows in the river, accumulation of contaminants around discharge points for wastewater and severe pollution of tributaries feeding into the Taedong River.

Table 3.6 Water quality in main rivers and streams (mg/ℓ)

Rivers and streams	Basin area Km^2	Ca^{2+}	Mg^{2+}	$Na^{+}+K^{+}$	HCO_3^{-}	SO_4^{2-}	CL^{-}	Gross ion	Hardness
Taedong River	16,580.5	26.0	7.2	6.0	106.4	11.0	8.9	165.5	5.7
Chongchon River	5,933.1	11.9	2.6	7.7	44.0	6.7	9.6	8.25	2.0
Jangza River	5,155.9	9.7	1.8	8.9	43.1	5.0	4.4	72.9	1.8
Jangzin River	6,920.0	8.8	3.4	4.2	28.1	8.6	8.6	61.7	1.9
Hochon River	5,140.0	12.0	4.8	4.4	50.5	7.9	6.1	85.7	3.7
Sod Stream	2,392.0	8.0	3.4	3.3	38.9	4.0	5.0	61.6	2.5
Orang Stream	2,014.0	9.5	3.0	10.2	42.9	14.5	8.0	88.1	2.1
Songchon River	2,417.7	8.6	2.5	5.5	25.0	9.0	11.0	61.6	1.5
Kumya River	2,200.5	19.8	5.9	6.7	84.0	6.5	8.5	131.4	4.1
Namdae Stream	857.0	20.0	4.0	9.5	65.0	9.0	11.0	118.5	3.5
Rimjin River	8,129.5	23.9	4.0	9.5	78.3	9.0	12.9	137.6	3.8
Ryesong River	3,916.3	27.5	6.0	9.5	110.0	8.4	9.0	170.4	4.5

Source: *DPR Korea (1991)*

Table 3.7 Pollution state of the taedong river by season (1999-2000)

Indices	Winter (Dec.)	Spring (Apr.)	Summer (Jul.)	Autumn (Sep.)	Annual average
COD(mg/ℓ)	0.73	2.14	1.33	0.78	1.25
NH4-N(mg/ℓ)	0.20	0.27	0.87	0.08	0.35
Cl (mg/ℓ)	10.0	7.2	8.4	8.4	8.7
Coliform (no./ℓ)	68,500	311,666	4,847	2,300	96,828

Source: *Hong Chun Gyong (2000)*

Photo 3.6 *Taedong River*

Pollution levels in the Amnok River during 1995-1996 are given in Table 3.8.

Table 3.8 Status of the water pollution in the Amnok River (1995-1996)

Indices	Unit	1995	1996
pH	-	7.3	6.65
SS	mg/ℓ	14	18.5
COD	mg/ℓ	4.53	6.32
CN^-	mg/ℓ	-	0.0002
As	mg/ℓ	0.0004	0.0005
Pb	mg/ℓ	0.0048	0.018
Zn	mg/ℓ	0.0055	0.067

Source: *Rim Dong Hyon (1998)*

Most pollution indices in this river meet environmental standards, apart from COD. This indicates that the Amnok River is polluted by organic pollutants. Table 3.9 sets out water quality standards in DPR Korea.

Photo 3.7 *Twin rainbow over lake Chon on the summit of Mt. Paekdu*

Aquatic Ecosystems

Change in the hydrological features of rivers and lakes and increase in water pollution bring about some changes in aquatic ecosystems. In recent years, the ecosystem in the Pyongyang basin of the Taedong River has been greatly changed. With the construction of the sea barrage, the downstream basin of Taedong River turned into a big lake and the growth of aquatic plants increased markedly. *Potamogeto Crispus L*, a kind of aquatic grass, increased in biomass by as much as 45 times in 1995, as compared with 1987 and by 5.9 times in distributed area in June 2000 (as against 1995).

Aquatic plants, when growing, play a positive role in removing contaminants such as nitrogen and phosphorous, but cause secondary contamination when decomposing after reaching maturity. The rapid increase of biomass such as algae and zooplankton in the lower reaches of the Taedong River has in recent years been accompanied by a red tidal phenomenon in spring and a blue tidal phenomenon in Autumn. In this stretch of the river, concentration of coliform bacteria and some heavy metals exceeds environmental standards.

Utilization of Water Resources

In DPR Korea, total annual precipitation is estimated at about 127.41 billion cu.m, of which 83.15 billion cu.m becomes the surface water resource and 44.26 billion cu.m is removed by evaporation. The groundwater resource is about 53.18 billion cu.m. The largest share of surface water is used for hydropower. Water for electricity generation accounts

Table 3.9 Water quality standards in river, stream, lake and lagoon

No	Indices of Water quality	Unit	Special water area	Water area
1	Odor		None	None
2	Color	Shade	Below 2	Below 2
3	PH	mg/ℓ	7.0~8.5	6.5~8.5
4	Suspended Solid Matters	mg/ℓ	Below 20	Below 30
5	NH_4-N	mg/ℓ	Below 0.1	Below 0.2
6	NO_2-N	mg/ℓ	Below 0.01	Below 0.01
7	NO_3-N	mg/ℓ	Below 5	Below 10
8	CL^-	mg/ℓ	Below 20	Below 30
9	DO	mg/ℓ	Above 7.5	Above 5
10	COD_{Mn}	mg/ℓ	Below 1.5	Below 3
11	BOD_5	mg/ℓ	Below 2	Below 4
12	Ni	mg/ℓ	Below 0.1	Below 0.1
13	CN^-	mg/ℓ	Below 0.001	Below 0.001
14	As	mg/ℓ	Below 0.05	Below 0.05
15	Hg	mg/ℓ	Below 0.0005	Below 0.0005
16	Cr	mg/ℓ	Below 0.03	Below 0.03
17	Zn	mg/ℓ	Below 1.0	Below 1.0
18	Cu	mg/ℓ	Below 0.1	Below 0.1
19	Pb	mg/ℓ	Below 0.1	Below 0.1
20	Cd	mg/ℓ	Below 0.01	Below 0.01
21	Phenol	mg/ℓ	Below 0.001	Below 0.001
22	F	mg/ℓ	Below 0.7	Below 0.7
23	Organic chlorine	mg/ℓ	Below 0.02	Below 0.02
24	Coliform	no./ℓ	Below 500	Below10,000
25	PCB	mg/ℓ	Removal	Removal

Source: *Ministry of Land and Environment Protection (2000)*

Photo 3.8 *Pond for fish farming*

for around 80 percent of total surface water usage, corresponding to 77 percent of gross water resources. It is therefore the central component in water utilization.

Water consumption in agriculture accounts for 12.8 percent of total surface water (to which can be added a small amount taken from underground water). This demand is met by reservoirs (43 percent), pumping stations (39 percent), irrigation ponds (15.7 percent) sewage and other facilities (2.3 percent).

Photo 3.9 *Paddy field damaged by drought*

Photo 3.10 *Water resources in Yodok County*

In DPR Korea, about 47.5 billion cu.m of water is used by the industrial sector. Annual water consumption for human needs is about one billion cu.m, of which 63 percent comes from surface water and 37 percent from groundwater. Daily water use per capita is 137 litres, which is a relatively high level.

3.2.2 Pressure

The socio-economic impact on conservation and management of water resources in DPR Korea is increasing rapidly. Higher volumes of domestic sewage due to population growth, discharge of wastewater from industrial development activities, utilization of pesticides and fertilizers in the agricultural sector, extensive exploitation of water resources - are all factors with negative impacts on the conservation and management of water resources.

Population growth is a key factor affecting water quality. The country's population increased by around 1.56 percent per annum during the period from 1979 to 1996. With positive measures by government to conserve water resources, many sewage treatment plants were constructed, but due to their restricted capacity, large numbers of households in small towns and rural areas are not connected to the networks for sewage treatment and discharge untreated sewage into the rivers.

Another direct cause of water pollution is the increase in industrial wastewater resulting from economic development. Although most plants and enterprises have purification facilities to treat industrial wastewater, untreated effluents of great volume are

Table 3.10 Pollution loads in tributaries of the Taedong River

	COD (mg/ℓ)	NH_3-N(mg/ℓ)	Cl (mg/ℓ)	Coliform (no./ℓ)
Hyuam stream	4.40	15.0	31.8	3,195,000
Habjang River	2.10	0.22	42.6	11,000
Mujin stream	7.60	7.5	46.9	-
Potong River	5.90	4.75	24.1	270,000
Environmental standards	3.0	0.3	30	10,000

Source: *Hong Chun Gyong (2000)*

being directly discharged into rivers because the treatment technologies are outdated and the operation of the facilities is intermittent.

For example, 12 factories and plants in the vicinity of Pyongyang city are discharging 30,000 cu.m of wastewater directly into the Taedong River every day. Pollution of streams, caused by discharge of untreated sewage and industrial wastewater, also leads to severe pollution of the river. Table 3.10 shows pollution in the Hjuam stream, Hapjang River, Mujin stream, and Potong River, all tributaries of the Taedong River around Pyongyang City.

Serious pollution in these tributaries is mainly caused by ineffective implementation of measures for treatment of industrial effluent and domestic sewage. The pollution of the lower Amnok River, which is a boundary between DPR Korea and China, is mainly associated with industrial effluent and domestic sewage from Sinuiju City, DPR Korea, and Dandong City, China. Wastewater discharged into the Amnok River reaches daily levels of 100,000 cu.m and 210,000 cu.m from the two cities respectively.

Natural disasters triggered by human activities also have significant impacts on the conservation and management of water resources. Deforestation and conversion of hilly forest land to agricultural uses can aggravate soil erosion, landslide events and flooding, with direct adverse impacts on water quality.

3.2.3 Impact

In DPR Korea, where human beings are regarded as most precious and where the material and cultural well-being of the individual is a top level policy goal, the protection of water from pollution is a key priority for human health reasons. It is well-known that water pollution is closely related to human health and the government has initiated positive measures to prevent waterborne diseases.

Disinfected drinking/sanitary water supply systems at the country level were completed in the early 1970s to establish a concrete basis for eradicating water-related diseases. Drinking water and sanitary water are supplied through water pipes,

Table 3.11 Rates of contagious disease (per 10,000 head of population)

	1996	1998	1999
Typhoid , paratyphoid fever	1.7	0.4	0.3
Germ dysentery	0.02	-	-
Epidemic diarrhea and gastroenteritis	16.2	8.4	9.5

Source: *CSB (2000)*

while disinfection of the water supply is carried out according to health criteria. Critical levels of water contamination and the lack of funds for water treatment in reservoirs have however caused water-related diseases.

The rates of the contagious types of water - boene diseases are given in Table 3.11.

3.2.4 Response

Since the liberation of the country, the government of DPR Korea has devoted considerable efforts to the conservation and management of water resources, with priority directed to sustainable use of water resources in keeping with industrial development, population growth and improvement of living standards.

The government adopted Cabinet Decision No.15 "Control Regulations on Rivers and Streams" in 1965 in order to conduct activities for river and stream management. It also designated a "middle and small-sized river and stream arrangement week" in spring and autumn. The purpose is to mobilize the whole population to prevent degradation of aquatic ecosystems.

Likewise, the "Law on Water Resource, DPR Korea" was adopted on 18 June 1997, and subsequently amended on 14 January 1999, thus laying down a firm legal basis for water resource protection and sustainable development.

In accordance with the "Law on Environment Protection, DPR Korea" and the "Enforcement Regulation for Environmental Protection", the government is currently strengthening legal control on effluent and sewage from factories, enterprises and purification plants. The "Polluter Pays Principle" is now applied to factories, plants and enterprises polluting rivers and streams, while the mass media, including TV, radio, newspapers and newsletters, inform the public about the need for water conservation.

Programmes for sustainable water development are also being initiated. In line with a policy to supplement construction of large-size hydro, medium or small-size hydropower plants have been constructed throughout the country, with 1,517 small-size hydropower plants newly built in 1998 alone. To address irrigation water shortages, a large-scale national project started in 2000 to construct a canal between Gaechon and Taesong Lake. With the completion of this project, sufficient irrigation water will be supplied for the grain-growing areas on the country's West Coast.

3.2.5 Conclusion

DPR Korea is abundantly endowed with water resources but the demand fuelled by population growth and socio-economic development is not fully satisfied as yet. In some areas of the country there are shortages of irrigation water due to drought in spring, while outbreaks of water-related diseases are a consequence of poor use of disinfectant in supply reservoirs. The effluent and sewage from industry, animal husbandry and households is the main source of pollution of rivers and groundwater in DPR Korea.

It is necessary for conservation and sustainable development of water resources to proceed in accordance with statutes such as "Law on Environment Protection", "Law on Water Resources" and "Law on Land". In particular, an increase of investment in conservation and sustainable development of water resource is most important. These funds should target the completion of domestic sewage networks in all cities and towns of the country, ensure normal operation of existing purification plants and renovate old water and sewage networks in order to raise the effectiveness of water use.

It is important to strengthen international cooperation in the field of water resource management. The government will therefore act in consultation with international efforts to foster water conservation. DPR Korea will introduce state-of-the-art science and technology in wastewater and sewage treatment plants to improve purification processes. It will also establish a nationwide monitoring system in order to create a robust foundation for sustainable water development.

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3.3 Air Pollution

Air is essential for human existence. Together with water and soil, it is one of the three environmental elements used by man and other living organisms to survive. The maintenance of clean air is therefore a key component of environmental policy. It is moreover an area, which raises a number of crucial issues in public health, so that addressing air pollution becomes a priority for protection of both people's health and the global environment.

The government has accordingly given priority to the prevention of air pollution caused by development-related activities. It has taken positive initiatives, including logical planning for productive investment, adoption of "state of the art" technologies for prevention of air pollution, rational adjustment of urban scale and location, and control of emissions from vehicles in and around cities.

3.3.1 State

Air Quality

The concentration of pollutants in the air is closely linked to point source emissions and meteorological conditions. In general terms, the pollutant density level in the air around urban and industrial areas is relatively higher than that found in rural areas. Together with industrial development and population growth, air pollution has thus tended to go from bad to worse, particularly in urban and industrial areas.

In DPR Korea, data available on levels of air pollution are limited. Most studies on the topic have been confined to the central area of Pyongyang City and its surroundings. Here, the major causes of atmospheric pollutions have been associated with industrial boilers, kilns, motor vehicles and residential areas in and around the city.

Figure 3.1 traces recent variations in precipitated particulates in central districts of Pyongyang.

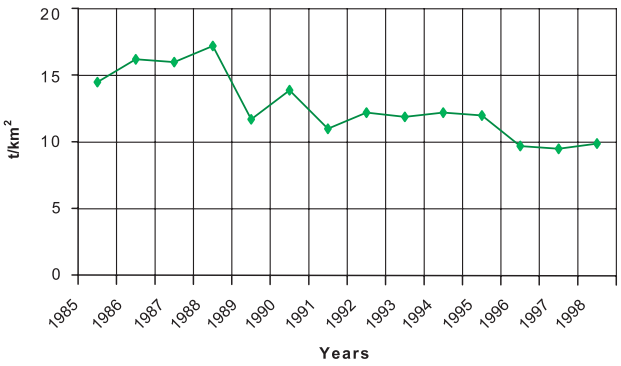

Figure 3.1 *Variation of precipitated dust*
Source: *Li Ju Hyop (2000).*

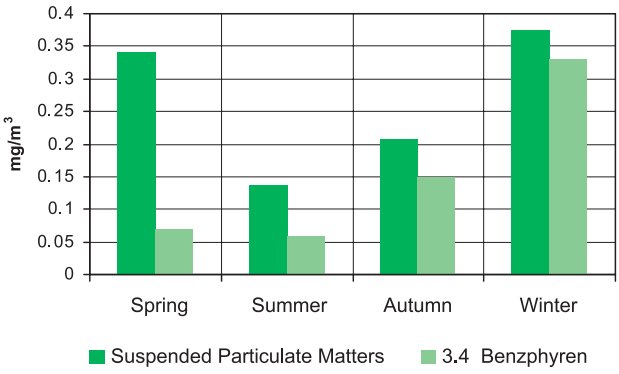

Figure 3.3 *Seasonal variation of suspanded particulate matters and 3.4 Benzphyren concentration.*
Source: *Li Ju Hyop (2000).*

As shown in the Figure, the level of particulates has fallen progressively in central districts between 1985-1998. The seasonal variation of precipitated dust is quite substantial. Month-to-month conditions in Pyongchon are closely related to dust pollution in Pyongyang City (shown in Figure 3.2). By 1998, the density of suspended particulates revealed a falling trend, being lower by an average of 62.6 percent compared with 1993 levels. Average seasonal variation of suspended particulates and 3.4 Benzphyren (carcinogenic substance) is shown in Figure 3.3.

The next two figures show annual average density of sulphur dioxide and nitrogen dioxide decreasing in the air around Pyongyang City during the 1990s.

The density of environmental pollutants in the air around Pyongyang City now exceeds environmental protection standards of the DPR Korea. A substantial contributing factor to air pollution is the number of coal combustion boilers in Pyongyang City. This is because certain factories/plants and enterprises consuming fossil fuel are not operating on a regular basis. However, proper control and response options to address air pollution are being fully developed and consolidated at a national level. The standards established for major air pollutants are given in Table 3.12.

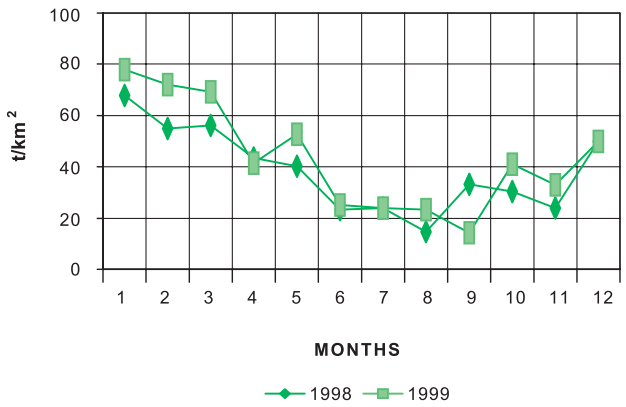

Figure 3.2 *Monthly variation of precipitatied dust*
Source: *Li Ju Hyop (2000).*

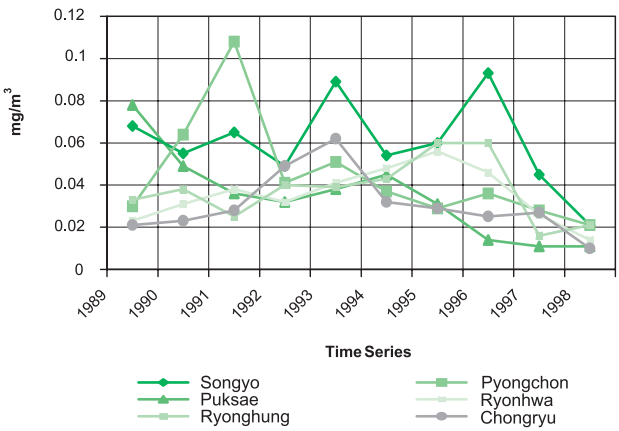

Figure 3.4 *SO_2 yearly variation*
Source: *Li Ju Hyop (2000).*

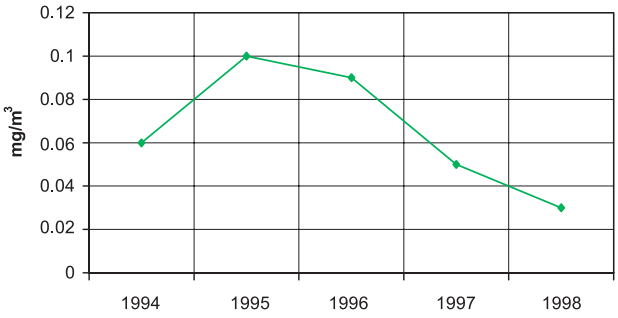

Figure 3.5 *NO_2 yearly variation*
Source: *Li Ju Hyop (2000).*

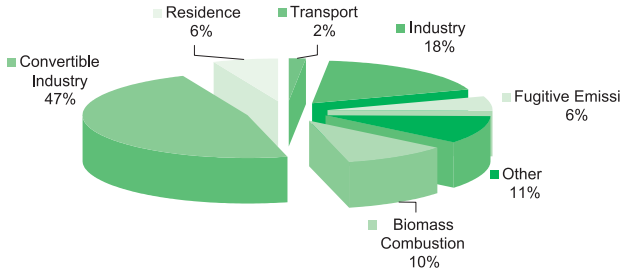

Figure 3.6 *Emissions across economic sectors*
Source: *DPR Korea (1999)*

Air Pollutants and Greenhouse Gas Emissions (GHG)

Using the guidelines for GHG inventory (1996) distributed by the Inter-governmental Panel on Climate Change, emissions in 1990 of GHGs and other pollutants were estimated for industrial, commercial, residential, agricultural, transportation, forest and land-use sectors.

The constitution of GHG emissions by national economic sectors is given into Figure 3.6.

Energy conversion and industry are both considered as key sources of SO_2 emissions from coal combustion.

Table 3.12 Air Environment standards by areas (mg/cu.m)

No	Substances	Special class		First grade		Second grade		Third grade	
		Daily maximum	A day average	1	2	1	2	1	2
1	Suspended matters	0.05	0.03	0.10	0.50	0.30	0.10	0.50	0.20
2	SO_2	0.05	0.03	0.10	0.05	0.30	0.10	0.50	0.15
3	NO_2	0.04	0.01	0.06	0.03	0.10	0.04	0.15	0.05
4	CO	3.0	1.0	4.0	2.0	6.0	3.0	15.0	10.0
5	Oxidant	0.05	0.02	0.10	0.03	0.12	0.04	0.14	0.06

- Special grade: natural reserves/areas under particular concern by the country
- First grade: resort, health cure site, recreation site, tourist site
- Second grade: residential area
- Third grade: industrial area

Source: *Ministry of Land and Environment Protection (2000)*

Table 3.13 DPRK's National Greenhouse Gas inventory in 1990

Sources and Sinks	CO_2 Emission	CO_2 Removals	Net CO_2	CH_4	N_2O	NO_x	CO	CO_2 Equivalent
Total National Emissions	**169,445**	**-14,631**	**154,814**	**975**	**39**	**432**	**478**	**187,379**
1. All Energy (Fuel Combustion +Fugitive)	159,942	-	159,942	649	17	425	475	178,341
A . Fuel Combustion 159,942	-	159,942	44	17	425	475	165,636	
Energy and Transformation Industry	90,775	-	90,775	1	13	279	19	94,826
Industry34,273	-	34,273	3	5	105	50	35,88	
Transport	3,473	-	3,473	-	-	24	94	3,473
Commercial-institutional	2,824	-	2,824	-	-	3	55	2,824
Residential	10,610	-	10,610	32	-	11	11	11,282
Traditional Biomass Burned for Energy	(20,257)	-	(20,257)	-	-	-	-	20,257
Others 15,735	-	15,735	-	-	-	-	15,735	
B.Fugitive Fuel Emissions	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oil and Natural Gas Systems	-	-	-	-	-	-	-	-
Coal Mining	-	-	-	606	-	-	-	12,726
2. Industrial processes	9,503	-	9,503	-	1	7	-	9,813
A. Cement Production	6,929	-	6,929	-	-	-	-	6,929
B. Others								
Lime production	1,146	-	1,146		-	-	-	-
Chemical production	595	-	595		1	7		905
Metal production	833	-	833		-	-	-	833
3. Agriculture	-	-	-	255	20	-	-	11,555
A. Enteric Fermentation	-	-	-	52	-	-	-	1092
B. Manure Management	-	-	-	39	-	-	-	819
C. Rice Cultivation	-	-	-	164	-	-	-	3444
D. Agricultural Soils	-	-	-	-	20	-	-	620
4. Land use Change and Forestry	-	-14,631	-	-	-	-	4	-
A. Changes in Forest & Other Woody Biomass Stocks	-	-15,021	-	-	-	-	-	-
B. Forest and Grassland Conversion	298	-	298	-	-	-	4	298
D. Others(please specify)	-	-	-	-	-	-	-	-
5. Waste -	-	71	-	-	-	1,491	-	
A. Solid Waste Disposal on Land	-	-	-	67	-	-	-	1,407
B. Wastewater Treatment	-	-	-	4	-	-	-	84

Source: *DPR Korea (1999)*

3.3.2 Pressure

Energy Consumption

As in most countries, the energy sector in DPR Korea plays an important role in developing the national economy. Over the past decades, energy consumption has been coupled to economic growth rates, and thus has been steadily increasing. DPR Korea is now among countries consuming energy at the greatest level.

National energy consumption per capita is therefore very high in relation to GDP. In DPR Korea, imbalance between supply and demand is generated by the growth in energy demand and has led to economic hardship in some end-use sectors in recent years.

Since coal is the vital source of primary energy in DPR Korea, SO_2 emissions, particulate precipitation and NO_2 are mainly linked to coal combustion. Energy consumption by sectors and fuel types in 1990 is set out in Table 3.14 below. Estimates of primary energy consumption show a doubling from 47.974 Mtoe in 1990 to 95.948 Mtoe by 2020.

The more industry is developed and energy consumption increases, the higher the level of atmospheric emissions, suggesting that air pollution will continue to be a crucial problem.

Growth in Population & Urban Development

Over the period 1990-1998, average population growth was 0.8 percent per annum. For the period 2000 - 2020, an average annual growth rate of 1.2 percent is projected. This suggests that the total population of DPR Korea will be 29.164 million by 2020, if present trends continue.

Apart from the growth in population, demand for energy (particularly from fossil fuel) will inevitably rise, creating heavier pollution load in the atmosphere. In 1990, existing boilers and industrial kilns in Pyongyang consumed 3,398,372 tonnes of coal. In the same year, household consumption for heating and cooking amounted to 357,665 tonnes.

Use of Ozone-depleting Substances

Household appliances such as refrigerators and air-conditioners are more broadly used in urban settlements than in the rural areas of DPR Korea. In 1996, the volume of CFC-12 used as a refrigerant (in refrigerators as well as cooling facilities) was 165 tonnes.

3.3.3 Response

The commitment to control air quality is an important link to the health of the individual as well as to the sustainable development of society at large, and this issue is therefore of direct concern to the government of DPR Korea. In particular, priority has been given by government to the prevention of air pollution in Pyongyang City and major industrial

Photo 3.11 *Pyongyang thermal power plant*

Photo 3.12 *A Station of Pyongyang Metro*

Table 3.14 Primary energy consumption in 1990 ('000 tonnes)

	Industry	Residence	Transport	Agriculture	Other
Anthracite	34,614	2,178	1,820	1,886	4,911
Bituminous coal	7,995	1,918	740	-	1,281
Gasoline	-	-	215.6	7	90
Diesel	-	-	420	-	263
Heavy oil	1,015	-	-	-	885
LPG	45	6	-	-	24
Naphtha	220	-	-	-	-
Kerosene	-	150	-	-	40
Coke	4,020	-	-	-	-

Source: *CSB (1997)*

towns, with positive measures being drawn up for policy implementation.

Prevention of Pollution by Coal Combustion.

The government focuses a great deal of attention on atmospheric pollution caused by coal combustion, taking into account the fact that coal is still the major source of primary energy. Active steps are being undertaken, both to enhance combustion efficiency and exhaust gas purification in boilers and industrial kilns, and also to achieve maximum reduction of coal consumption in the household sector.

Table 3.15 Energy growth, DPR Korea

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

Source: *DPR Korea (2000)*

Table 3.16 Timetable relating to the production and phase-out of ozone-depleting substances

Substances	Particulars	Timetable
CFC-11	Closure down of production facility Phase out of consumption	December 2003 December 2010
CFC-12	Closure down of production facility Phase out of consumption	December 2003 December 2010
CFC-113	Closure down of production facility Phase out of consumption	December 2003 December 2010
Halon	Phase-out of Halon consumption	Already done
CTC	Closure down of production facility Phase out of consumption	December 2003 December 2010
Methyl chloroform	Closure down of production facility Phase out of consumption	December 2003 December 2010

Source: *Minisry of Land and Environment Protection (1996)*

The appropriate rules relating to emission sources like factories/plants and enterprises using boilers and industrial kilns are laid down by government to ensure strict compliance with the law and reinforce social controls. In addition, encouragement is given to the installation of fuel-efficient technologies, such as thermal insulation of furnaces, high efficiency of combustion, more effective heat use, and active elimination of exhaust gas emissions. In recent years, steps have been taken to remove certain factories and polluting enterprises in Pyongyang and other industrial towns and relocate them to the perimeter of towns or other areas.

Finally, an energy strategy was compiled by the government and its implementation is now underway. The strategy aims at building capacity for the national economy and improving people's well-being by securing energy stability while meeting the increasing energy demand. Key long-term priorities for policy implementation include the following:-

- To secure stability of supply and increase the uptake of energy efficiency in end-use sectors by satisfying the need for energy through exploitation of local resources, particularly coal.
- To improve energy efficiency by means of effective energy use.
- To minimize the environmental impact of energy generation and use, increase efficiency of conversion and end-use and secure environmental sustainability by promoting a switch to the use of renewable energy use.

The improvement of energy efficiency and energy savings are the highest priorities in the energy strategy. The energy mix of DPR Korea for 1990 - 2020 is given in the Table 3.15.

Measures in Traffic and Transportation Sectors

The government has taken positive measures both to ease the pressures on public transport and control exhaust gas emissions from vehicles in urban areas. In particular, government puts the limit on wide use of private cars, whereas zero-emission public transport modes (trolley bus, tram car and trains) are encouraged in urban areas. In order to decrease the load on public transport, and taking into account the health benefits, there is a campaign for people to walk 10,000 steps each day, as well as promotion of bicycle use.

Initiatives for Protection of the Ozone Layer

The DPR Korea signed the Montreal Protocol in January 1995 and ratified it in April that year. The timetable for the phase-out of ozone-depleting substances is included in the national action plan to implement the Montreal Protocol and is reproduced in the Table 3.16.

3.3.4 Conclusion

The key sources of air pollution are listed as coal-fired boilers, industrial kilns and households. Population growth and industrial development is likely to lead to increased levels of pollution with more serious implications for human health. With recent economic hardships, coal production and consumption have been considerably restricted, but as a result of continued economic development, demand and consumption of coal are both expected to grow steadily.

Assessment of atmospheric pollution is limited to certain urban areas - Pyongyang and Hamhung cities - and pollutant indices are only available for particulate precipitation, suspended solids, SO_2 and NO_2. Statistical analysis on the number of patients suffering from respiratory diseases is still not carried out, while no studies concerning air quality impacts on ecosystems and socio-economic development have been undertaken.

A comprehensive monitoring system of atmospheric conditions needs to be set up and in-depth study of the impact of air pollution on human health and ecosystems is also called for. In addition, state-of-the-art technologies for clean coal combustion, exhaust-gas purification and renewable energy alternatives need to be widely adopted.

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3.4 Land Degradation

Soil is a valuable resource with a key productive role in agriculture and forestry, since it is needed to produce crop harvests, vegetables, fruit, timber, and other items. Prevention of soil erosion, together with sustainable management of the soil resource, are therefore central issues, not only for the present generation but also for the welfare of future generations. These areas are the focus of close attention by the government of DPR Korea, which attaches great significance to soil conservation as the foundation for sustainable development in the agricultural and forestry sectors.

In DPR Korea, where land suitable for cultivation is limited, it is very important to protect land appropriately. Mountainous terrain with steep contours is predominant, and there is a pattern of periodic high rainfall, whereas seasonal distribution is uneven. Unless strong measures to preserve soil are taken, this resource (and the wealth it brings to the country) could be under pressure.

Since liberation in DPR Korea, afforestation/ reforestation and water conservancy work - including land protection - have been carried out in line with national policy.

Photo 3.13 *Peach orchard sloping on land used for horticulture*

3.4. 1 State

In DPR Korea more than 80 percent of the land area consists of mountains, associated land of a degradable nature and areas with similar characteristics. It is therefore of importance for national economic development that both forest and agricultural lands should be developed and used in a sustainable way.

The need for food is being basically satisfied with crops produced at a national level, so rational land use and protection, plus proper management, can be seen as catalysts for the sustainable development of agriculture. Table 3.17 describes the current status of land use in the agricultural sector.

Table 3.17 Profile of agricultural land use, DPR Korea (in '000 hectares.)

	1996	1998	2000
Agricultural Area	1854	1850	-
Of which Rice	580	579	-
Maize	589	593	-
Wheat,Barley		80	123
Orchard	160	160	158
Mulberry		93	93

Source: *CSB (1997)*

Severe degradation of land resources has been closely associated with persistent flooding and the incidence of drought in recent years. Along with these factors, forest degradation has adverse effects which encourage land erosion. Land degradation level by slope of agricultural land in non-forested land is given in Table 3.18.

Table 3.18 Soil erosion by gradient

Gradient in degree (°)	Erosion (cu.m/hectares/year)
Below 10 °	1
10 ° ~20 °	5
20 ° ~25 °	20
Above 25 °	Above 30

Source: *Li Bong Rak (2000)*

The inundation of arable land by flooding in 1995 inflicted damage estimated at US$925 million. The convenience of using chemical fertilizers, together with the increase in crop yields, is also giving rise to land acidification, with adverse impacts on sustainable development of land resources. Table 3.19 indicates acidulation level by agricultural land in ambient of Pyongyang.

Photo 3.14 *Paddy field on Onchon Plain*

Photo 3.15 *Fertile plain in Mundok County*

Table 3.19 Acidification level of farming land around pyongyang (percent)

Class/pH	Below 4	4~5.5	5.5~6.5	6.5~7.5	Above 7.5
Wet land	0.5	4.8	13.17	77.1	3.9
Dry land	1.6	6.6	14.7	66.4	0.5
Orchard	25.4	22.6	18.1	29.7	4.2
Mulberry land	13.6	20.4	15.4	45.4	5.2
Average	3.7	7.6	14.8	66.9	7.0

Source: *Paek Ok In (2000).*

In order to protect land resources from acidification and to enhance fertility, treated solid sewage and coal ash from urban centers are being applied on the land. Precipitated sludge from purification sites treating urban sewage is now also being used in lieu of fertilizer in rural areas close to towns. But since urban garbage and sewage disposal needs are not fully met, there is a chain of secondary pollution from this practice. The loss of fertile topsoil as a result of soil erosion also accelerates land degradation. The humus content of agricultural land around Pyongyang is shown in Table 3.20.

The positive measures taken by the government are intended to protect land resources - through afforestation/reforestation, tree planting for erosion control, realignment of rivers and streams, land amelioration, restructuring and so on.

3.4.2 Pressure

Chemical fertilizer remains the principal means of increasing crop yields in the agricultural sector. Table 3.21 shows chemical fertilizer output and consumption over the period 1996-2000.

The acidification of arable land by fertilizer application brings about a decline both in soil humus content and in crop output. In addition, municipal solid waste is an acute source of land degradation. The volume of municipal solid waste generated from Pyongyang is estimated to be 420,000 tonnes per annum. Of this, a proportion is being processed at a solid waste disposal site to be used as fertilizer in farming areas around Pyongyang City. Most of the remaining untreated solid waste is being trucked to certain areas in the vicinity of the city.

Table 3.20 Organic composition of agricultural land around Pyongyang (percent)

Classification of organic contents	1.5 mg/100 g soil	1.5~2 mg/100 g soil	Over 2 mg/100 g soil
Wet field	46.3	36.6	17.1
Dry field	58.1	28.2	13.8
Average	54.3	30.8	14.8

Source: *Paek Ok In (2000).*

Table 3.21 Output and consumption of chemical fertilizers ('000 tonnes)

	1996	1998	2000
Nitrogen fertilizer output	416	176	158
Phosphate fertilizer output	132	22	5
Potassium fertilizer output	36	4	7
Nitrogen fertilizer consumed	517	442	528
Phosphate fertilizer consumed	119	121	133
Potassium fertilizer consumed	32	12	54
Nitrogen fertilizer imported	248	304	417
Phosphate fertilizer imported	-	98	126
Potassium fertilizer imported	-	-	45
Nitrogen fertilizer exported	90	24	13

Source: *CSB (2001)*

Table 3.22 Variation of agricultural output from 1990 to 2000 (in '000 tonnes)

Item	1990	1996	1998	2000
Crop output	9100	2502	3022	3262
Rice	4500	1426	1568	1533
Wheat	-	-	-	218
Maize	3900	825	1175	2046

Source: *CSB 2001*

3.4.3 Impact

Land degradation has a large impact on agricultural production. Following the decline of humus content of soil and land acidification, the fertility of cultivated land is weakened, while landslide and flooding also reduce agricultural output. Table 3.22 highlights variation of agricultural output over the period 1990-2000.

Photo 3.16 *A herd of sheep*

3.4.4 Response

Legal Basis for Land Resource Protection

The government adopted "Law on Land, DPR Korea" on 29 April 1977. After it entered into force, it was amended to meet a growing set of requirements, thus laying down a legal framework to help protect and develop land resources in a useful and sustainable manner. The Law on Land covers all sorts of principles and tools addressing rights to land ownership and the overall planning of land management and protection on a legal basis.

The law covers the rehabilitation of land for improvement of crop production through agricultural industrialization/modernization. It envisages i) carrying out realignment of rivers and streams and afforestation/reforestation for land protection, and ii) organizing and making headway with land management under a far-reaching program.

The law also stipulates conditions for conservation and use of agriculture/forest lands including areas of particular significance - revolutionary battlefields, historic places, cultural sites and monuments, relics, etc. The laws addressing land, forest, water resources, and environmental protection alike are thus assigned a principal legal basis in DPR Korea.

Photo 3.17 *Land realignment*

Photo 3.18 *Valley land used for paddy cultivation*

Photo 3.19 *Snow covered agricultural land during winter*

Follow-up Activities for Land Resources Protection

Activities will be directed to land resource protection as follows:

- Undertaking preventive action on soil erosion by rehabilitating degraded forest and planting many more trees than ever before in associated forests and suitable areas. Flexible measures are being considered to enable government to rehabilitate degraded forests, protect land from flooding and drought, and also from forest fire and illegal deforestation, thus using forest resources in a sustainable way.

  Afforestation/reforestation is intended to further expand the area under forest by 2 million hectares. by 2005, and by 3.306 million hectares. by 2020 with a view to protecting and securing the use of forest resources on an integrated and sustainable basis. In addition, forest stock is forecast to reach 87m^2 of stock per hectare through more extension, giving a total of up to 110 million m^2 by 2020. In the forest sector, targeted undertakings are envisaged by 2020, extending the forest of oil-bearing trees by 250,000 hectares., carrying out afforestation/reforestation for fuelwood forest of 800,000 hectares, with 50,000 hectares. of *Evodia Danillii Ben forest* on one hand, and replanting in particular areas, including the Amnok River and the Chongchon River, which are extremely affected by flooding.

- Realignment of rivers and streams as well as the construction of embankments, as an important method of protecting land resources from flooding and drought. The government will pursue its effort by giving emphasis to restructuring and rehabilitation of rivers and streams. Afforestation for erosion control will be promoted under mass campaigns mobilizing people for land management once in spring and once in autumn.

- Land protection through build-up of terraced fields is also a key method for preventing possible land loss in DPR Korea in steep areas. Since 1976, under a long-term program of building up terraces over areas ranging from 150,000 hectares. to 200,000 hectares., a firm basis has been established to prevent land loss.

3.4.5 Conclusion

In-depth studies on land resources were commissioned at an early stage in DPR Korea, but these reports did not contain profound analysis of various trends or of reasons for land degradation. This was due to the shortage of fund and equipment necessary for research and data collection at the time. An essential cause of land degradation is the close linkage with forest degradation and unsustainable farm production in DPR Korea. In order to prevent land loss there must therefore be a stronger effort to restructure and improve land use, combined with forestry and water conservancy projects.

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3.5 Biodiversity

Human existence and activity are both closely linked to biodiversity. In general terms, the web of animal life and vegetation, plus the micro-organisms, which constitute biodiversity and the core of the natural ecosystem as well as key elements for the sustainable development of economy.

"Biodiversity" is a term which covers the whole range of biological classification, from gene to species, populations, communities, and ecosystems, and the entire global life support system, including the interaction all forms of life have with each other.

The life-support role played by biodiversity is the unique product of an evolutionary process on Earth which has continued over a vast period of time. The loss of biodiversity occurring nowadays on a global scale brings the threat of destruction, both for natural ecosystems and for economic development. It therefore threatens human survival.

Conserving biodiversity is a principal responsibility resting with the government of DPR Korea. It is the government's policy to use land in sustainable manner to integrate land development into sustainable economic development a cross the country. Through sustainable land development practice, it can prevent loss of biodiversity - a critical undertaking for the present generation, which must combine economic development with the stewardship of a beautiful land and its plentiful resources, so that these can be handed down to future generations.

DPR Korea signed the Convention on Biodiversity which was adopted by the UN Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, in June 1992 and ratified it in October 1994. The government is well aware of its responsibility to protect biodiversity, not only for future generations in Korea, but also to create environmental benefits at the regional and global levels.

3.5.1 State

Diversity of Ecosystem

The ecosystems of the peninsula can be divided into five categories according to natural geographical features:- forest and alpine ecosystems; river and lagoon ecosystems; wetland ecosystems; coast and marine ecosystems and agricultural land ecosystems.

Photo 3.20 *Sea birds*

The forest ecosystem covers three patterns of forest; one with needle-leaf trees, another with broadleaf trees, and the other with mixed trees. A typical pattern of forest of needle-leaf trees is a sub-boreal forest zone with mixed *Abies nephrolepis-Picea jezoensis*, forest of *Larix olgensis*, and temperate varieties of needle-leaf trees.

Photo 3.21 *National Reserve for Egrets*

The forest of broadleaf trees consists of sub-boreal and temperate deciduous broadleaf trees with mainly sorts of *Quercus acutissima*. Mixed forest is classified into three patterns according to climatic zone, namely sub-boreal evergreen mixed forest, temperate northern deciduous mixed forest, and temperate southern evergreen and deciduous mixed forest.

The alpine ecosystem is host to an indigenous plant community, distributed through areas more than 2,000 m above sea level in DPR Korea.

Around 30 percent of the territorial area is occupied by river and stream ecosystems, largely because these are closely distributed. In addition, there are various sizes of wetland ecosystems in/around tidal flats, river estuaries, perimeters of large lakes, alpine wetlands, and peat areas. Since most of the territory is close to the sea, unique coast and marine ecosystems exist on both sides of the peninsula. Finally, a territorial area of around 17 percent is made up of agricultural land ecosystems.

Species Diversity

Surveyed plants recorded so far total 8,875 species, of which 3,900 are high plant species. Vascular vegetation covers 3,176 species, with 790

Photo 3.22 *Asiatic Sparrow hawk*

genus in 204 families, which are relatively abundant over the extent of the territory. Among 1,431 species of vertebrate investigated to date, there are 865 fish species, 17 species of amphibian, 26 species of reptile, 416 bird species, and 107 animal species (of which 79 are terrestrial). The total represents around 3.2 percent of global vertebrate species (45,417).

Genetic Diversity

DPR Korea has a long agricultural history, in particular, there is recorded evidence that rice, bean, millet and Indian millet have been cultivated since 4000 BC. Crops currently cultivated cover around 600 species, so there is a good supply of genetic resources in DPR Korea. A special feature of the cultivated range is the high proportion of medical plants.

The livestock industry uses 50 breeds of 7 species -cattle, pig, goat, sheep, etc. - as well as domestic birds (30 breeds of 8 species- hen, duck goose, quail, etc.). Some other sorts of animals and insects are used for fur and skin as well as medicine.

Attributes of Diversity

In proportion to the land area of the country, animal and vegetation species are profuse, while there is a good range of other biological species. This is because the DPR Korea is geographically a peninsula where dynamic migration and dispersal of both northern and southern species has been proceeding over both glacial and interglacial periods.

Among large plant species, the rate of endemism is at a high level in DPR Korea, where the endemic plants surveyed up to now cover 315 species of higher vegetation (542 species if varietals and hybrids are included), corresponding to around 10 percent of vascular plant species.

Photo 3.23 *Black-naped Oriole*

Endemic animals encompass one species plus varieties, corresponding to 2.9 percent of recorded vertebrates (within which group 33 species and varieties of fish are categorized as endemic).

There are endangered and rare species among animals and plant populations, which are under pressure because of their biological characteristics and loss of habitat.

The animal and plant species are classified in accordung World Conservation Union (IUCN) criteria for rare and endangered species. The list for higher vegetation shows 10 endangered species, 42 vulnerable species, 76 rare species, and 26 species populations reducing. This adds up to a total of 158 species, corresponding to 4 percent of the country's higher plant species

For vertebrates, there are nine critically endangered species, 29 endangered species and 119 rare species, accounting for around 11 percent of the country's vertebrate species.

3.5.2 Pressure

Pressure on Ecosystems

Ecosystem degradation follows rapidly upon the effects of natural disasters, e.g. loss of forest cover, soil erosion, deterioration of water quality and depletion of economically useful resources, and flood damage. With mountainous landform accounting for more than 80 percent of total land area, diversity in the forest ecosystem plays a key role in protecting diversity at a national level.

The area under forest has however been falling in recent years because of the growth in population and associated extension of farmland, increase of firewood consumption, forest fire and damage by noxious insects. Totel forest area amounted to 8,211,300 hectares. in 1993, but by 1996, it had dropped to 8,183,000 hectares. Unforested land increased over the same period from 361,000 hectares. in to 380,000 hectares.

It is obvious that forest destruction not only causes variation of water flow and soil erosion, but also brings changes in the river and stream ecosystem, leading to adverse downstream impacts on the diversity of the coastal ecosystem. Since the country is divided into

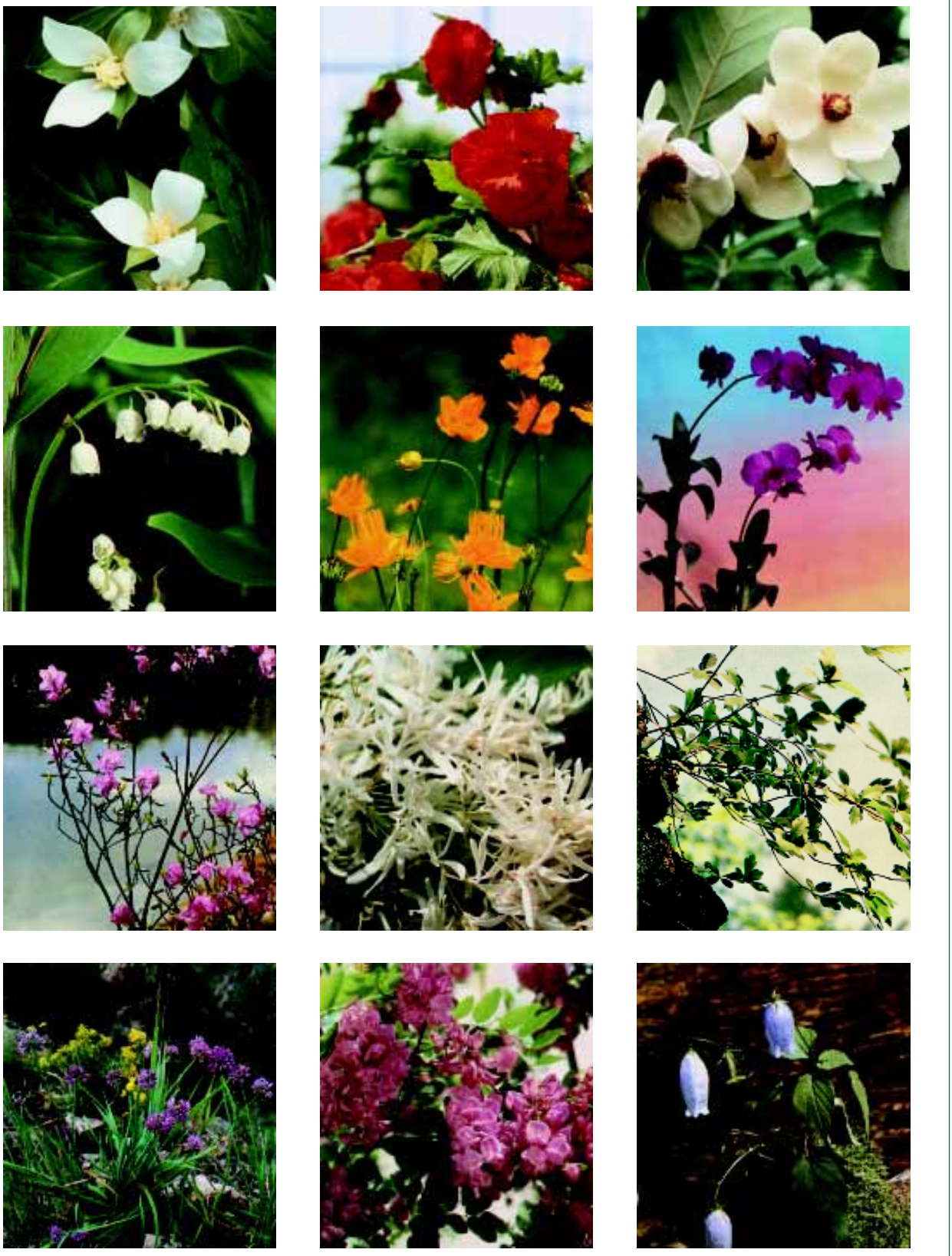

Photo 3.24 Flowers of DPR Korea

catchments, forest control and biodiversity conservation in each basin makes a direct contribution to the national effort.

The flow in rivers and stream varies considerably, with more than half of annual precipitation occurring in the brief rainy season (July-August), so the water ecosystem is under constant threat. Several flood events occurred in recent years and led to significant damage, mainly because abnormal climatic conditions coincided with unsatisfactory forest management. The heavy rains also had direct impacts on biodiversity in water ecosystems.

Unlike an organism living in sea or on land, a freshwater organism is limited in its ability to expand beyond its area of natural distribution. Thus, if a fish ladder is not properly incorporated into the design for hydro-electric dams, these structures become a barrier to the movement of fish populations. Similarly, if rivers and streams are impounded, freshwater organisms will be threatened by eutrophication caused by fertilizer run-off and domestic sewage load.

Pressure on Species

Numerous animal and plant species per unit of area can be found in DPR Korea, particularly around 10 percent of the bird species which are critically endangered in Asia and which have habitats within the territory of DPR Korea. Current assessments reveal that 52 species of higher plants and 38 species of vertebrates are critically endangered or endangered. out of 158 species of endangered and rare vegetation 48 species are endemic plants.

There are also 159 species of rare mammals, including 19 species of endemic mammals. Within the avian population, the crested ibis, which was once distributed in DPR Korea, has been seen nowhere since the end of the 1970s. Certain rare species, such as the Manchurian crane and the Blackfaced spoonbill, are at risk on account of habitat diminution.

In addition, similar trends are observed within species having an economic value. Substantial pressure is observed among medicinal plants and coastal species. Among herbs, those with roots used for medicinal purposes are vulnerable, while among coastal marine life, those varieties(such as sea urchin and sea cucumber) with high export value are clearly falling in number.

Pressure on Genetic Stock

Genetic resources, both for cultivated plants and livestock, are under substantial risk. If the emphasis is placed only on higher productivity for crops, livestock and domestic fowls, then those endemic species domesticated over time to natural conditions may come under pressure. For example, endemic species such as millet, German millet and Indian millet, with higher endurance and productivity even in barren soil, are very likely to extirpate.

Similarly, during the war of 1950-1953, traditionally cultivated plants and livestock species were reduced in number in DPR Korea. In these situations, conventional crops and livestock species are being cultivated and bred on a smaller scale and the key

Photo 3.25 *Deers on Mt. Daesong*

Photo 3.26 *Black faced Spoonbils*

priority is to establish a regular mechanism to gather stocks for storage in a gene bank at the national level.

3.5.3 Impact

Population Growth

Steady growth in population has been experienced as follows: 19.06 million in 1986, 20.96 million in 1991, 21.51 million in 1994, 21.21 million in 1995 and 22.11 million in 1996 (CSB,2001). Population density of 180 persons per square kilometer is relatively high compared to China (131 persons/sq.km). Population growth leads simultaneously to increased consumption of biological resources and more significant human impacts on ecosystem diversity.

Habitat Degradation and Overuse of Resources

The health of wild animals and plants are closely linked to habitat. Loss of habitat is thus a factor due to which diversity is likely to be reduced. Habitat destruction is mainly due to over-exploitation of specific resources.

In DPR Korea, habitat for flora and fauna is being affected by increased fuelwood consumption caused by the growth in rural population. In recent times, most of the fuel consumed in rural areas has come from the forest. The volume of fuelwood consumed in these areas in 1996 was 7.2 million cu.m (2.4 times over the level of consumption in 1993). In order to avoid this trend in habitat destruction, a shift needs to be made away from reliance on fuelwood from forests.

Reference has been made above to destruction of habitat as a result of uncontrolled soil erosion in DPR Korea. When quantities of soil are removed by heavy rain, the disturbance to the ecosystem requires a long recovery time. In addition, there is an emerging threat to forest habitat, from the increase in the area subject to fire during the drought season (in April) and from degradation by noxious insects, such as the black fly which invades Korean spruce.

Photo 3.27 *Wild pear flower*

There are 800 species of medicinal plants used in traditional Korean medicine, but fewer herbs are now being produced. The more root vegetation is used as a medicine, the more severe such a decline becomes. Consequently, a potential harvest of 40,000 tonnes of such plants in 1984 was down to 24,000 tonnes by 1996. As noted above, sea-urchin and sea cucumber harvest has similarly declined (with a one-third drop in the period 1985-1990).

Climate Change

Global warming has influence on biodiversity of DPR Korea.

According to analysis on the long-term climatic fluctuation over 1910-1980, it was cold climate being less 0.2 to 0.60 °C than average temperature over 1900s-1940s, while warming trend with above 0.2-0.30 °C was being experienced over 1950s-1980s.

At the beginning of the 1990s, annual average temperature rose in general, while higher abnormal high temperature recorded in summer season in 1994 exhibited a maximum value since climate observation in 1918.

Furthermore, at the beginning of 1990s, the years 1990, 1995 and 1996 were recorded as abnormal rainy years, but on contrary, there was a countrywide severe drought phenomenon in 1997.

Other Impacts

There is some evidence of biodiversity loss through transboundary impacts from nearby countries. For example, acid rain is carried from China by air circulation in the Sea and could result in damage to forests, as has happened elsewhere. Similarly, biodiversity in water areas adjacent to national borders, such as the Amnok and Tumen Rivers, is now being affected by transboundary impacts. Finally, both exotic noxious insects and infectious diseases could bring adverse impacts for the nation's biodiversity.

3.5.4 Response

Building the National Legal Basis for Biodiversity

DPR Korea specified some topics to protect environment prio to all productive practices according to the article 57, chapter 3 of "Socialist Constitution, DPR Korea, " as a national principal law (6th September 1998) and intensified to create, protect, and control forest resources together with forest ecosystem through adopting "Forest Law" in December 1992 by reinforcing sectoral legal basis associating with " Law on Environmental Protection. " the government adopted and issued "Law on Marine Product" in July 1995 and "Law on Water Resources" plus "Law on Marine Pollutant Control" in June and October 1997, so that protecting and proliferating ecosystems and resources in all water areas are being secured well.

The government has come to a decision for all specific administrative codes such as "Administrative Code for Environmental Protection Law" (adopted in September 1995).

Furthermore, for the purpose of its positive execution, the government saw to it that the entire country and the people participate in a campaign for land management every Spring and Autumn, as a joint decision adopted in August 1995.

Improvement of Administrative Structures for Biodiversity Conservation

Positive steps have been taken to carry out environmental protection in a uniform way, and to combine specialist administrative services with relevant scientific and research work. This has been achieved by setting up a separate Ministry of Land and Environmental Protection (MLEP).

In addition, partial responsibilities for forest protection and management were reallocated. For forest management, protection and control (including afforestation/reforestation by provinces), the Ministry of Timber Industry is responsible for three provinces in northern areas where the main timber forests stand, while the remainder of the forest estate comes under MLEP.

In order to achieve effective protection/ management of the natural environment and land, supervisory offices were established at city and county level. These supervisors take charge of, and manage the forest, rivers and streams in a comprehensive manner. Improving the institutional framework in this manner will secure further successful implementation of biodiversity conservation in several respects.

Policies and Programs for Biodiversity Conservation

This is due to be implemented by the year 2020. The major objective is to establish a national environmental protection and management system, preventing environmental pollution in large cities like Pyongyang and Hamhung, retrofitting facilities controlling environmental pollution, and implementing afforestation/reforestation in mountains by closely integrating natural environment with forest and water conservancy projects.

Natural Resources Development, Protection and Use

The central policy in development is the sustainable use of the country's own resources. The government of DPR Korea attaches great importance to programs relating to sustainable development of biological resources.

In view of the limited territory and relatively high density of population, a framework is being prepared for the conservation of various ecosystems and species diversity, particularly genetic resources, in order to apply sustainable practices when using natural resources of the country.

Education and Public Awareness for Biodiversity Conservation.

In 1992, a program was introduced to strengthen education on environmental protection, together with biodiversity conservation, and associated steps for its implementation have been taken. The program of environmental education involves biology, geography, agriculture, fishery, forestry, public health, construction, etc. Simultaneously, it includes acquiring full basic knowledge about biodiversity conservation and a review of textbooks for all phases of primary and senior education.

Public dissemination of environmental information is being facilitated by means of both the mass media - newspapers, radio and TV - and literature and artistic activities. A number of scientific films are being disseminated to show the beauties of nature, and the qualities of animals and plants. These include "Primitive Forest of Mt. Oga," " International Protected Bird," "Let's Protect White-bellied Black Woodpecker" and similar works.

Countrywide public awareness through "Land Protection Month," "Bird Protection Month," "Afforestation/reforestation Month" and "Wild Animals Protection Month" is encouraged and carried out in various forms.

Strategy for Environmental Protection Through Agricultural Development (1998).

This includes an Action Plan with a number of specific headings:-

- Capacity building for maintaining agro-biodiversity
- Establishment of a national gene bank and setting up a system for genetic preservation
- Adoption of state-of-the-art technologies to avoid soil erosion
- Introduction of co-management systems in areas of combined forestry and agriculture
- Introduction of organic farming methods
- Creation of a dedicated fuelwood forest and installation of a system for its sustainable use
- Focus on study of agro-biodiversity
- Set-up of information center available for agro-biodiversity
- Selection of conventional crop species and enlargement of area under cultivation
- Dual-crop farming and inter-cropping technology
- Integrated relief system for vermin avoidance
- Establishment of proper grass pasture in appropriate areas

3.5.5 Conclusion

There is a need to overcome shortcomings in national objectives and goals for biodiversity conservation and sustainable use. These are associated with a failure to integrate actions in several fields relating to biodiversity. Examples include legislation/ organization, construction of facilities to protect human resources, scientific and technical development, education and training, build-up of information management systems and international cooperation.

DPR Korea has already laid down a legal basis for biodiversity conservation and sustainable use. The relevant laws are - "Law on Environmental Protection," "Land Law," "Forest Law". As yet, however, no by-laws are available for effective protection of wild animals and plants plus natural ecosystems.

Regulations pursuant to existing laws do not reflect sufficiently the codes of protection needed over all biological resources, including ecosystems and wildlife. Moreover, laws and regulations relating to the preservation and use of genetic resources do not cover all relevant issues.

By and large, the contradiction between protection and development in DPR Korea is being overcome by incorporating the plan for biodiversity conservation into an overall scheme for land management. There is however a tendency to ignore protection issue and concentrate heavily on development alone.

This is illustrated by excessive deforestation to meet rising demand for both timber and fuel, by conversion of forest into farm land due to food scarcity and by over-extraction of fish resources; all these lead to destruction of wildlife habitat and ultimately lead to unprecedented pressure on biodiversity.

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Part IV CONCLUSION

PART IV CONCLUSIONS and RECOMMENDATIONS

The key environments priority issues in DPR Korea are forest, water, air, land, and biodiversity, which are closely linked with each other.

This chapter includes the conclusions and recommendations for priority issues and environment in general. Various policies and strategies identified to protect and conserve these resources for the benefit of the people of DPR Korea have been discussed. The concept paper developed on priority issues are included in Annex II.

Priority Issues:

Forest degradation

The degradation of forest resources in DPR Korea has emerged as the most urgent priority. Abnormal climatic patterns have created a series of natural disasters with flow-on impacts -landslides and land loss, as well as forest destruction and decreases in crop production. The forest covers 74.2 percent of the country's land area plays a key role in national economic development. Timber lumbering, fuelwood consumption and conversion of forest into farmland are vital causes of forest stock depletion.

Another cause of forest stock depletion is the degradation of certain species of trees, such as pine. Dynamic efforts are being put into the design and implementation of an afforestation/ reforestation program for rehabilitation and amelioration of 2 million ha. of degraded forest with healthy and sound tree species by 2005.

In this context, enormous endeavors are directed to rehabilitation of degraded forest and enhancement of the conservation function through reforestation with fast-growing and healthy tree species, including Acacia, in the form of an all-out campaign.

The government attaches great significance to bilateral/multilateral international cooperation for the Sustainable development of forest resources and is focusing on its implementation.

The measures for forest degradation includes: establishment of the forest resource information base for science base policy formulation, implementation and monitoring; promotion of energy efficient technology for burning firewood for the livelihood; preparation and implementation of the strategy for the sustainable management of the forest resources.

Water quality degradation

The country is rich in water resources, but poor conservation and management of water resources lead to water scarcity as well as heavy contamination. Adverse impacts on the conservation and management of water resources include: increases in domestic sewage as a result of growth in population; growing effluent from industrial development; wide use of pesticides and fertilizers in the agro-sector; and large- scale exploitation of water resources.

Water pollution threatens human health and has adverse effects on aquatic ecosystems. Having focused on water resources conservation and management, the country set a priority on maintaining sustainable use of water resources during the process of economic development, combined with population growth and the improved living standard of people.

The "Polluter pays principle" adopted by government is one of the legal tools to prevent the factories and plants from discharging contaminants into the rivers and streams, while public awareness of water resources conservation is fostered through mass media such as T.V, radio, newspapers and newsletters.

Some of the measures could be taken to improve and maintain the water quality includes: establishment of the national pollution monitoring system in the major river system; promotion of efficient technology in to the industry for the effluent treatment into the industry discharging effluent in to the river system; establishment of the municipal waste water treatment plant equipped with the latest energy efficient technology.

Government has given close attention to bilateral/ multilateral international cooperation in the area of water resources conservation and management.

Air pollution

To protect and keep the atmospheric environment clean is a key element of environmental protection. Furthermore, given that air quality remains a vital public issue, the prevention of air pollution becomes a priority for protecting both people's health and global ecosystems.

The major cause of air pollution is the release of gases from fossil fuel combustion in boilers, industrial kilns, vehicles and residential areas. In recent years, steps have been taken by the government to remove certain factories and plants emitting pollutants into the atmosphere around Pyongyang and other industrial towns to the perimeter of other towns and areas.

An energy strategy to mitigate air pollution and reduce GHG emissions was prepared and its implementation is proceeding at a good speed. The improvement of energy efficiency and energy conservation is the main priorities in the energy sector.

Air pollution caused by the growth in population and by industrial development is forecast to become a more critical issue. Therefore there is as need for the establishment of the integrated system to monitor the nationwide air quality and commission a study on impacts on human health and ecosystems. Government need to encourage the introduction of modern technologies for coal combustion and exhaust-gas purification in the industrial sector and thermal power plants. A program for educating people and the scientific community is required to raise the knowledge about the air pollution and likely adverse health impact and prevention measures.

Land Degradation

In DPR Korea, where the area under cultivation is limited, it is of importance to protect land well. The causes of land deterioration are mainly related to forest degradation. The government is taking positive measures for protection of land through reforestation, afforestation for erosion control, arrangement of the rivers and streams, land amelioration and readjustment.

The countrywide land readjustment of hundreds of thousands of hectares has been completed in keeping with the demands of the new century in three provinces of Kangwon, North Pyongan and South Hwanghae, thus laying a solid foundation for sustainable development of the land resource.

Sustainable management of the land for maintaining source of livelihood for the future generation is mandatory. Some of the measures required for checking the land degradation trend in the country includes: building the capacity for monitoring the impact of soil contamination from municipal waste and fertilizers; plan and design specific sites for the safe disposal of urban solid waste in order to check the land degradation; implement the program for the public awareness towards land resource conservation.

Biodiversity

Human existence and socio-economic activities are closely linked to the conservation of biodiversity, which is a crucial task in DPR Korea. For one thing, the overuse of biological resources beyond the level of natural replacement becomes a key factor in biodiversity loss. Then the process of global warming will also bring obvious effects to the biodiversity of DPR Korea.

DPR Korea is becoming well aware of the need to address the conservation of biodiversity, not only for present generations and those to come, but also for the national, regional and global benefits to be derived from any effort to protect biodiversity.
The government places great emphasis on the following steps:

- Completion of legal mechanisms for both biodiversity conservation and sustainable utilization;
- Build-up of facilities for natural resource management;
- Establishment of education, training and the necessary information management systems; and
- Access to international cooperation.

The contradiction between protection and development in DPR Korea is being overcome by incorporating a plan for biodiversity conservation into the overall plan for land management. Along with the government efforts, following measures to be undertaken to conserve the biodiversity resources of the country: inventory and evaluation of national biodiversity resources; establishment of the biodiversity resource center to conserve and protect the biodiversity wealth of the country; rehabilititation and management of the degraded ecosystem; and improvement of the marine reserves.

Recommendations

The conflict between socio-economic progress and a path of truly sustainable development is likely to be further aggravated unless emerging issues can be settled in time. The recommendations related to priority issues are discussed in the concerned section in this chapter. But to address the overall environmental issues of the country, the measures includes:

- Environment-related laws and regulations should be formulated and existing laws and regulations upgraded, to meet the demands of sustainable development;
- Mechanisms for environmental management, and their functions, should be improved and intensified;
- Financial investment should be encouraged in the environmental sector by all possible means;
- A study on environmental science and technology should be focused on the country's identified problems;
- Monitoring and statistical systems should be set up to assess the state and quality of the environment at the country level; and
- Environmental data and information available will be used as a basis for preparing national policies and plans.

Finally, both bilateral and multilateral international cooperation in the environmental field should be encouraged.

Part V ANNEXES

ANNEX I ACRONYMS AND ABBREVIATIONS

AOX	Absorbable organic halogen
APMP	Alkaline peroxide mechanical pulp
CBD	Convention on Biological Diversity
CCT	Clean Coal Technology
CSB	Central Statistics Bureau
DPR Korea	Democratic People's Republic of Korea
EDC	Environment and Development Center
FAO	Food and Agriculture Organization
IUCN	International Union for Conservation of Nature
GIS	Geographic Information System
MLEP	Ministry of Land and Environment Protection
Mtoe	Million ton of oil equivalent
NCCE	National Coordinating Committee for Environment
NGO	Non Government Organization
RRC.AP	Regional Resource Center for Asia Pacific
SoE	State of the Environment
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

ANNEX II PRIORITY PROJECTS

PROJECT PROPOSALS ON FOREST SECTOR

Project 1: Preparation of Strategy for Sustainable Management of Forest

Executing agency:	Ministry of Land and Environment Protection
Implementing agency:	Academy of Forest
Duration:	2 years
Budget:	US$ 385,000

General Background

Forest area in DPR Korea is about 8.9 million hectare, accounting for 73.2 percent of the total land area.

As a typical temperate forest, it is characterized as a mountainous forest belonging to Manchuria-Japanese mixed forest zone in terms of biological and geographical zone.

About 40 percent of forest is closed forest, however, there are a few rare trees in the rest of forestland.
In the consequence of non-sustainable development of forest and the poor forest sciences and technologies, progress has not been made in forest industry, so a number of environmental issues such as soil erosion and natural disasters have arisen and forests do not contribute to sustainable socio-economic development.

Recent provisional hardships in national economy give rise to continuous destruction and degradation of forest ecosystem.

From these contexts, to develop a strategy for sustainable forest management will lay down a significant basis for contributing to not only possible environmental issues like water fostering, prevention of soil erosion control, mitigation of global warming, biodiversity conservation and reduction of natural disasters but also sustainable socio-economic development.

Objective

The project objective is to make contribution to strengthening forest functions in terms of land and environment protection, economic and social basis and sustainable socio-economic development.

Activities Planned

The following activities are planned to direct to:

- Assessment of current status and functions of forest resources
- Selection of technologies and strategy for degraded forest ecosystem rehabilitation
- Selection of technologies and strategy for sustainable management of forest land.
- Selection of technologies and strategy for sustainable management of forest biological resources.
- Integrated sustainable management strategy of forest ecosystem

Project 2: Demonstration Project for Establishing and Managing Firewood Forest

Executing Agency: Ministry of Land and Environment Protection
Implementing Agency: The Peoples' Committee of North Hwanghae Province
Duration: 2 years
Budgets: US$ 1.25 million
General Context

In DPR Korea, rural inhabitants meet their energy demand for cooking and heating by firewood.

Above 7 million cu. m of firewood is consumed annually, resulting in negative consequences like degradation of forest and ecosystem, flooding, land erosion, by which livelihood of inhabitants surrounding forests are inevitably affected.

Objective

This project aims at preventing degradation of forest ecosystem and soil erosion, and improving local residents' subsistence, through establishing a demonstration firewood forest with high productivity and suitable to specific local condition; managing this unit in a sustainable manner and disseminating successes attained.

Activities Planned

The following activities are planned to focus on:

- Survey on suitable area for establishment of firewood forest
- Selection of sound and health tree species
- Drawing up a plan for afforestation/ reforestation
- Establishing demonstration firewood forest in a selected area
- Training for firewood forest management

Project 3. Creation of the Information Center for Forest Resources Management

Executing Agency: Ministry of Land and Environment Protection
Implementing Agency: Forest Technology Center
Duration: 2 years
Budgets: US$ 288,000
General Context

The forest of DPR Korea is characterized as a typical temperate forest with diverse constitution of species and the unmanageable condition.

While, owing to high population density of the country, man derived impact on forest resources is also significant.

To secure the forest information management on a correct and swift basis becomes a question of key importance in the forest resource management.

Now the forest sector should be introduced to modern technologies dealing with forest information on computer.

Objective

The objective aims at establishing 1) a basis of long-term planning for sustainable development of the forest through evaluating the state of forest and its variable trend cross the country by building up the forest information center equipped with modern facilities, and 2) a material and technical foundation to introduce the satellite information analysis technology and the geographical information system (GIS).

Activities Planned

- Establishment of Forest Information Center
- Training of experts for dealing with forest information
- Procurement of associated equipment including desk-top computers

Project Proposals for Conservation and Management of Water Resources

Project 1: Establishment of Integrated Pollution Monitoring System of the Taedong River

Executing Agency:	Ministry of Land and Environment Protection
Implementing Agency:	Environment and Development Center
Duration:	2 years
Budgets:	US$760,980

General Background

The Daedong River is the third longest one with its length 450.3 km and the area of the river's water basin is 20,247 km^2. It flows into the Sea via Pyongyang, joining some tributaries like the Biryu, Nam and Jaeryong rivers.

In the vicinity of its water area, there are located major big cities like Pyongyang, Sunchon and Nampho, as well as big factories/plants and enterprises such as Sunchon Vinalon Complex , Hwanghae Iron Complex and Kangson Steel Complex.

The Taedong River has also much significance in developing national economy like industry and agriculture in its area, as a major water supply source for improving the people's living standard around the river as well as water transportation alike.

There are several water gates incluiding Mirim gate and Sunchon gate in the Taedong River.

The industrial and urban development within its basin lead to deterioration of water quality and reduction of water resources available, thereby exerting significant impact on water ecosystem.

The key challenges in management of Taedong River include the followings:

- Degradation of forest areas in Taedong River basin,
- Water pollution and damage in biodiversity by development within river basin,
- Weakness of self-purification due to flow of the river and cut off sea water.

It is expecte that the subsequent effects would be expanded with further economic development in this area.

Nevertheless, regular monitoring system on water pollution is still not established.

The government directs its endeavor to effective utilization and pollution prevention of the Taedong River but these efforts are not successive owing mainly to the scarcity of financial resources.

To conserve water resource of the river from being affected while promoting economic development along with Taedong River basin, it is necessary to establish the integrated monitoring system toward water quality of the river and increase investment to the river management.

The emerging barriers are as follows:

- Insufficient institutional arrangement for integrated monitoring of water pollution in Taedong River.

At present, water pollution of the river is surveyed and analyzed by Environment and Development Center (EDC), but EDC is poor in institutional capacity.

Survey and analysis on water pollution in the river requires to create monitoring and measuring posts in the river basin to analyze water quality profile on a regular basis.

What is more, activities undertaken by the integrated monitoring unit under EDC, being charged with above mentioned works, are mainly addressed to measure air pollution but partially for water pollution.

- Lack of equipment and facilities for monitoring and analyzing water quality in Taedong River and limitation in indices of water pollution to be analyzed.

Objective

Overall objective of this project is to help capacity building for sustainable water resources conservation/utilization of Taedong River, to facilitate environmentally sound water development. This objective also aims at laying down a firm basis in the future to use water resources in a sustainable manner with a view to protecting water quality and biodiversity in either the Taedong River or other major rivers and streams at a country level.

This project will help make substantial contribution to achievement of environmental benefit at a global level through preventing possible pollutant leakage flowing via the Taedong River into international waters.

Project 2: Workshop on Water Conservation-related Public Awareness

Executing Agency:	Ministry of Land and Environment Protection
Implementing Agency:	Environment and Development Center
Duration:	2 weeks
Budget:	US$ 4,000

General Background

Water conservation and management is of significance for sustainable development at the country level.

The broad participation the public to sustainable water development is a part of water conservation and management. From this requirement, a scientific and technical workshop is needed to organize addressing themes on the importance as well as global trend of water resources conservation, and scientific study and technical development relating to water resources conservation in the country and through this opportunity a societal basis should be established for sustainable development of water resources by the build-up of public awareness toward water resources conservation.

Activities Planned

The following activities are planned to direct to:

- A scientific and technical workshop on water resources conservation will be arranged in the Grand People's Study House in the presence of 50 persons from EDC, Ministry of LEP, and Institutes concerned- Institutes of Municipal Management and Science, Ministry of Municipal Management, Sanitary Institute under the Ministry of Pubic Health, Institute of Geography, The Academy of Science- together with the Association of Water Conservation under the Union of Korean Nature Conservation, NGO
- Superior scientific and technical research result and lessons learnt in the workshop will be broadly introduced and propagated through TV, newspapers and radios to build pubic awareness for water resource conservation.

Project 3: Pilot project for the treatment of municipal wastewater and its recycling.

Executing Agency:	Ministry of Municipal Management
Implementing Agency:	City Management Departmenr under the People's Committee of Pyongyang City
Duration:	3 years
Budget:	US$ 2.5 million

General Background

In Pyongyang city, hundreds of thousands cubic meter of sewage from households is treated in several sewage treatment sites including Pyongchon, Kumchon, and Ryongsong site every day.

However, the Pyongchon site, is equipped with old fashioned facilities and treats the sewage with low purification efficiency, contaminating its surroundings with odor.

Besides, most of the sewage is treated without recycling.

Activities Planned

The activities expected in the project are as follows.

a) Modernization of Pyongchon Sewage Treatment Site.
b) Introduction of biotechnological sewage treatment technologies.
c) Designing and establishing treated waste water-recycling process.
d) Training on waste water treatment and recycling.

Project 4: The pollution prevention of the Amnok River by the introduction of the APMP (Alkaline peroxide mechanical pulp) process in the reed pulp production.

Executing Agency:	Ministry of Chemical Industry
Implementing Agency:	Sinuiju Chemical Fibre Complex under the Ministry of Chemical Industry
Duration:	2 years
Budgets:	US$ 915,000

General Background

DPR Korea, put forward the prevention of water pollution by the waste water from pulp industry as an important task and, has exerted great efforts to conserve Amnok river from the discharge of waste water from the pulp and paper mills sited on the bound water area between Korea and China.

All pulp mills sited on Amnok river have used the chlorine as bleaching agents and discharged a lot of absorbable organic halogen (AOX) into Amnok river, influencing adverse effects on ecosystem in Amnok river.

Now, it is a priority to introduce APMP process instead of the chlorine-bleaching powder in bleaching of reed pulp.

Introduction of APMP technique to reed pulp production is of great importance for conservation of water resource and biodiversity of Amnok river, the international water resource.

There are about 75 kinds of the absorbable organic halogen (AOX) in the waste water from the chlorine bleaching process of reed pulp.

1.5-4.7kg of AOX per 1 ton of pulp are generated from the process of the chlorine bleaching.

Now, in order to reduce the discharge of AOX, Oxygen-bleaching technique is widely introduced in pulp industry of many countries.

Objective

The main objective of this project is to introduce APMP process of reed pulp to Sinuiju Chemical Fibre Complex, which is sited on Amnok river, to create the model of APMP process.

Activities Planned

- The consultant service necessary for transfer of technique related.
- Procurement of full-set of the alkaline hydrogen peroxide generator with 2t/day, double screw refiner and other analysis equipment related

Proposals on Air Environmental Protection

Project 1: Establishment of Integrated Air Environmental Monitoring System

Executing Agency:	Ministry of Land & Environmental Protection
Implementing Agency:	Environment & Development Center
Duration:	2 years
Budgets:	US$ 720,000

General Background

DPR Korea has commissioned the analysis on air environment mostly in the central areas, of Pyongyang City since the early of 1980s.

The existing air pollutant monitoring indices include SO_2, NO_x, precipitation dust, suspended matters, 3.4 Benzphyren, and CO, however, in the absence of relevant equipment, simply 7 fixed monitoring posts and 2 transfer monitoring posts are available for the air pollutant analysis.

The poor equipment for air pollution monitoring is considered barriers in expanding the number of monitoring posts and analytical indices.

The pressing task is establishing an integrated air environmental monitoring system in Pyongyang, and to disseminate it to all provinces and main towns of the country.

Objective

The objective aims at building up integrated air pollution monitoring system to assess air pollution status and its trend in Pyongyang City in order to create a basis for developing measures for air pollution prevention and to disseminate obtained experiment to main cities.

Another objective is to improve the scientific reliability for environmental planning through supplementing analytical indices of air environment.

Activities Planned

- Establishment of 20 Air Pollution Monitoring Posts in Pyongyang City
- Introduction of computer networks into air pollutant monitoring posts
- Procurement of equipment for auto monitoring of air pollution

Project 2: Introducton of Updated Dust Collector in Pyongyang Thermal Power Plant

Executing agency:	Ministry of Electricity and Coal Industry
Implementing agency:	Pyongyang Thermal Power Plant
Duration:	2 years
Budget:	US$ 2,270,000

General Background

All thermal power plants in DPR Korea are equiped with dust collectors such as wet scrubber and dry scrubber based on old technique of 1950's. Some power plants have introduced several dust collecting techniques including Venturi scrubber and Floating Ball scrubber, but their efficiencies are under 98.6 percent.

So, dust concentration in flue gas from thermal power plant exceeds State environmental standard(0.1 mg/m3) by several times.

Objective:

The objective of the project is to introduce modernized dust collecting technology to improve dust collecting efficiency in Pyongyang Thermal Plant, and build the capacity to design and product electric dust collectors.

Activities Planned

The following activities are planned.

- Purchacement of a set of electrical dust collector with the capacity suitable for 210 tonnes per hour boiler.
- Training of related techicians.

Project 3: Scientific Workshop on Air Protection in Main Town Cities

Executing agency:	Ministry of Land and Environment Protection
Implementing agency:	Korea Nature Conservation Union
Duration:	2 weeks
Budget:	US$ 5,000

General Background

To date, air pollutant issue is not much critically addressed in Pyongyang city as well as some main town areas.

However, the air in ambient of Hamhung and Nampo cities and certain industrial blocks has gotten heavy pollutant from which substantial socio-economic impacts are followed as well.

In Pyongyang City, there is an air monitoring system in normal operation, but not in the other cities of the country. Information dissemination on municipal air quality monitoring is necessary for research and increasing this practice in other cities

Objective:

The objective is to disseminate successes and information from studies on air monitoring, technical development related to air monitoring equipment, and lessons from those, in order to prevent air pollution in major cities.

Activities Planned

- A scientific and technical workshop on air protection will be held in the Grand People's Study House with 50 participants from EDC, Institutes such as Institute of Municipal Managerial Science, The Sanitary Institute, Institute of Meteorology and Hydrology, Association of Atmospheric Protection and etc.
- Public awareness will be more facilitated through mass media like TV, newspaper, radios on superior scientific and technical research results and lessons learnt from scientific and technical workshop.

Proposal on land resources conservation

Project 1: Capacity Building for Monitoring and Surveying Soil Contamination from Municipal Waste Fertilizing

Executing Agency:	Ministry of Land & Environmental Protection
Implementing Agency:	Environment & Development Center
Duration:	2 years
Budgets:	US$ 520,000

General Background

For the purpose of reducing significantly the disposal cost of urban organic wastes in the recovery and recycle manner, and utilizing treated organic wastes usefully for agricultural production, both the sludge of treated sewage and the domestic solid waste are widely used as an organic fertilizer in agricultural sector.

Several tens of thousands tones of sludge and municipal solid waste discharged from Pyongyang City are now manured as an organic fertilizer in farm lands around the city every year.

Farms in vicinity of Pyongyang City manure 3~4 t per tonnes per hectare year of sludge from sewage treatment sites and 10~15t per hectare year of solid waste (of majority of which is coal ash).

Utilization of organic waste from cities into farm land has contributed to reduction of municipal waste which needs to be treated and to increase of agricultural production through improvement of physi-chemical feature of farm land.

Lack of analytical equipment and experts related to land and crop pollution by heavy metal is a main barrier in establishment of measures for land conservation from municipal waste manuring.

Objective

The objective is to secure the sustainable utilization of land resources by establishing a material and technical basis in the Environment and Development Center (EDC) in order to analyse soil contamination by the municipal wastes fertilizing.

Activities Planned

- Procurement of modern analytical equipment-atomic absorption spectrometer and gas chromatography- and conventional analytical appliances
- Training experts on soil and crop contamination analysis

Project 2: National Scientific and Technical Workshop on Soil Conservation

Executing agency:	Ministry of Agriculture
Implementing agency:	Academy of Agricultural Science
Duration:	3 weeks
Budget:	US$ 6,000

General Background

Soil resource conservation is one of the important requirements for sustainable agricultural development while currently the build-up of public awareness for soil conservation becomes one of the crucial components in soil resources conservation. Particularly either natural disasters like draught and flooding affected by climate change or land amelioration recently implemented on a large scale require broad public participation including farmers for sustainable development of land resources.

Objective

The objective is to lay down a basis for sustainable development of land resources by enhancing public awareness toward land resources conservation.

Activities Planned

- A national scientific and technical workshop on soil conservation will be arranged in the Grand People's Study House under the participation of 50 officials from EDC, Ministry of Land and Environment Protection and relevant Institutes like Soil Institute under the Ministry of Agriculture, Institute of Agro-Meteorology, the Bureau of Meteorology and Hydrology and agricultural fields.
- Superior scientific and technical study results and lessons learnt in the workshop will be propagated through mass media such as TV, newspapers and radios to enhance a public awareness.

Proposals on Biodiversity Conservation

Project 1: Inventory and Evaluation of Biodiversity Resources.

Executing Agency:	Academy of Sciences
Implementing Agency:	Branch Academy of Biology
Duration :	4 years
Budgets:	US$ 300,000

Objective

The objective aims at 1) upgrading inventory of biological resources and 2) proceeding all-round assessment available on biological resources in DPR Korea.

Justification

All-round assessment of biodiversity is needed since both biodiversity strategy and action plan is prepared without “Country Study” on the profile of biodiversity.

Activities Planned

- Investigation of the state of species and distributions, by areas, of either animals and plants or population of micro-organism for which much researches have not been conducted.
- Preparation of taxonomic list on community of plant by areas
- Arrangement for regular survey on structure and function of important ecosystem
- Monitoring and evaluation of possible risks to biodiversity
- Assessment of economic value of biodiversity
- Compilation and release of full inventory of biological resources and evaluation report on biodiversity

Project 2: Survey and Control on Biodiversity

Executing Agency:	Academy of Sciences
Implementing Agency:	Branch Academy of Biology
Duration:	2 years
Budgets:	US$ 570,000

Objective

The objective is to establish a socio-economic basis for biodiversity conservation through intensified survey and control for biodiversity conservation.

Rationale

Incomplete monitoring system for biodiversity and shortcomings, that is, capability and equipment plus experiences are critical barriers arisen in monitoring and control over adverse impacts on biodiversity.

Activities Planned

Following activities to address associated issues involve:

- Set-up of proper monitoring system for forest fire
- Completion of monitoring system for noxious insect and contamination
- Set-up of powerful supervision system for overuse of resources, degradation of biodiversity as well as its loss, and
- Replenishment and perfection of laws and regulations concerning biodiversity conservation.

Project 3: Rehabilitation of Degraded Forests

Executing agency:	Ministry of Land and Environment Protection
Implementing agency:	Academy of Forest Science
Duration:	3 years
Budget:	US$ 765,000

Objective

The objective is to rapidly rehabilitate the forests degraded by natural disasters happened in recent years and to build capacity to expand varieties of young trees needed up to 1~1.5 billion degrees per annum.

Activities Planned

Following activities are planned to focus on:

- Selection of options for rehabilitation of degraded ecosystems.
- Upgrading of existing 10 nurseries for 2 million hectare of afforestation and intensifying the scientific study on sapling breeding.
- Personal capacity building in forest sector.
- Afforestation/reforestation for creating bio-corridors in degraded ecosystem between natural conservation areas

Project 4: Improvement in Management of Marine Reserves

Executing agency:	Ministry of Land and Environmental Protection
Implementing agency:	Ministry of Fishery
Duration:	2 years
Budget:	US$ 364,000

Objective

The objective is to conserve the biodiversity within marine resource reserves as well as to improve its managerial capacity.

Activities Planned

The following activities are included to:

- Set up the infrastructures in major marine resource reserves
- Make managerial provisions associated with marine resource reserves
- Survey and observe the biodiversity and its variation in marine resource reserves on a regular basis
- Enhectarence the public awareness on significance of marine resource reserves among local inhabitants
- Personal capacity building

ANNEX III LIST OF PARTICIPANTS OF THE NATIONAL TRAINING ON SoE DATA COLLECTION AND REPORTING

Bangkok, Thailand

23 -27 July 2001

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Pyongyang, DPR Korea

9-10 January 2002

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