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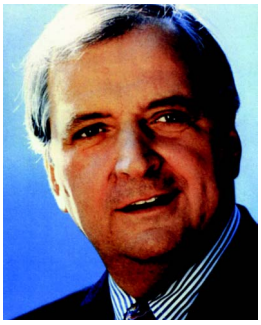


FOREWORD

Executive Director
United Nations Environment Programme

United Nations Environment Programme (UNEP) is mandated to assess regularly the major environmental developments and trends at global level. The publication of the Global Environmental Outlook series, GEO-1, followed by GEO-2000, the Millennium Report on the Environment, and the most recent one, GEO-3 - Past, Present and Future Perspectives involved participatory assessment process to review the state of the world's environment and to chart a new process for global environmental policy. The diversity and magnitude of environmental problems are outlined, with a call for more complete and precise analyses of the poorly understood linkages between human actions and environmental outcomes. Although the number of policy responses is growing, low priority continues to be afforded to the environment in national and regional planning. GEO-3 stressed the need for improving policy performance monitoring at the international level and within the civil society; strengthening international environmental legislation and compliance; changing trade patterns to benefit the environment; harnessing technology for the environment; valuing environmental goods and services; and participatory resource management through strategic partnership between governments, communities, the private sector and NGOs.

While GEO-3 report provides an opportune brief for the 2002 World Summit on Sustainable Development (WSSD) to be held later this year in Johannesburg, South Africa, the publication of State of the Environment of Mongolia-2002 is also timed to facilitate the national input and contribution to the Summit.

In 2000, UNEP Regional Resource Centre for Asia-Pacific (UNEP RRC.AP) collaborated with the Ministry of Nature and Environment of Mongolia to carry out a process on strengthening national capabilities on environment assessment and monitoring, including the preparation of the Mongolian SoE 2002. The report presents the critical challenges that the people of Mongolia face in safeguarding their environment and moving towards a sustainable future.

The Ministry of Nature and Environment, which is the national implementing agency, has played a very crucial role in carrying out this participatory assessment process soliciting input from various government sectoral agencies and research institutions. Around 20 agencies and 50 individuals were involved and contributed in the process.

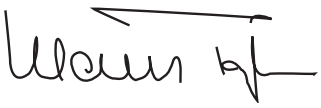
The report aims at providing guidelines for environmental action planning, policy setting and resource allocation for the coming decades, based on a sound analysis of the state of, and trends in, the nation's environment. Five priority key issues for the state of environment report for Mongolia have been identified in consultation with the Ministry of Nature and Environment and analyzed following "pressure-state-impact- response" (PSIR) analytical framework.

The five key environmental issues identified for Mongolia are: (1) land degradation, (2) desertification, (3) deforestation, (4) loss of biodiversity, and (5) urban air pollution. Mining industry, livestock overgrazing, and various natural causes have led to significant land degradation in the country. Similarly, climatic variations, overgrazing, forest clearance, burning of vegetation mass, and vehicular operations have contributed significantly to the desertification problem. Forests resources have been increasingly degrading over the past few years, due to timber cutting, forest fires, pests and diseases, causing ecological stress and accelerating natural disasters in some regions. The biodiversity resources are facing substantial and increasing threats from factors like growing population, coupled with urbanization, economic development, and an increasing per-capita demand for natural resources. Burning of coal and woods in the households in urban cities, rising number of vehicles and also the emission from thermal power plants have been the major sources of air pollution, causing acute respiratory diseases in some urban localities.

While natural resource base such as mining, forestry, animal husbandry, and tourism provides a great opportunity for economic development and prosperity in Mongolia, there is a need of considering appropriate policy packages, determined actions, and ecologically sound technologies, to ensure environmental security and sustainability for the present as well as future generations.

We hope this assessment will provide a sound basis for the development of action plans, the next stage of the planning process, policy setting and resource allocation for the coming decades to improve the state of the environment of Mongolia and the welfare of her people, as we progress in the twenty-first century.

UNEP will continue to provide leadership in the region for the preparation of environmental assessment reports at national, sub-regional, and regional level and the capacity building necessary to support these assessment activities.



Klaus Töpfer
United Nations Under-Secretary General and Executive Director
United Nations Environment Programme
June 2002

FOREWORD

Minister of Nature and Environment
Government of Mongolia

The Rio Earth Summit in 1992 has formulated an action plan, Agenda 21, (a multifaceted) process to address a full range of development and environmental issues involving Governments, international organizations and major stakeholders for the sustainable development. The Agenda 21 determines actions for the solving issues such, as socio-economic sustainable development in developing countries; definition of sustainable use concepts; efforts concerning human health, urbanization and settlement, climate change and water resources; policies concerning land use, energy and air, minimizing use of toxic chemicals and wastes; protection of biological diversity, conservation of fragile ecosystems, development of sustainable forest resources management as well as the establishment of the mechanisms for such issues.

Mongolia's economic reform and environmental policy development coincide with the implementation of decisions taken adopted in at the Rio Conference. The crucial environmental and natural resource problems that faced by Mongolia are the degradation of urban environment, especially air quality, water pollution and supply and waste disposal, land degradation and other natural resources degradation and the underlying critical needs for institutional strengthening and capacity building. Other environmental problems include locally severe environmental degradation from mining and resources extraction, natural disasters and depletion of our local heritage including biodiversity.

Mongolia through its Constitution, 1992, has assured or guaranteed the right of citizen's to live in healthy and safe environment and stated that public shall own the land and natural resources and protected by the state. Based on this fundamental principle Mongolia is guided by sustainable and eco-oriented socio-economic development policy in harmony with the nature. Creation of legal basis for the environment and natural resources protection and rehabilitation are to pay more attention of the Mongolian Government, which are included to the package of 25 environmental laws, passed by the State Great Khural since 1994. In addition to this nearly 23 Environmental National Programs on protecting biological diversity, Combating desertification, Water and on Special protected areas and others were approved during this period and currently under the implementation.

Mongolia also has joined to 10 International Environmental Conventions since 1994. The main trend of Mongolian development in the 21 century is based on the principles of sustainable development. In order for Mongolia to reach sustainable development, it has to shape a social economy policy, which will provide a sustained growth in its GDP; this can be achieved through the introduction of ecologically sound technology and the production of quality products that can meet the needs of population. In 1997, government policy on ecology was developed and deliberated by the Parliament. The document is aimed to establish legal and economic bases for achieving ecological balance which is a central ideal of Mongolian sustainable development for the next twenty years. Within the government action plan included 11 main objectives and 3 of them are environmental priority issues included: a) to provide sustainable development, ecological balance; b) promote of the land reform; and c) mitigation of air, water, soil and environmental pollution in the major towns. The implementation of the good governance on human security Program of the Mongolian Government for the period 2001-2004 will be important step for the activity and the Policy for future sustainable development of the country.

The present ***State of the Environment Report: Mongolia*** broadly covers the five priority issues pertaining to environment, which includes land degradation, desertification, deforestation, loss of biodiversity and urban air pollution. In addition, other issues relating to economic and social development in the country are also included. This report will be a valuable document for all concerned with environment and development. This will also help in environmental policy, planning and decision-making.

The Ministry is grateful to Director, UNEP RRC.AP and his team for financial support and kind assistance to produce the SoER Mongolia report. The Ministry is also gratefully acknowledged the contribution of other government agencies for their active participation in the successful completion of the report. Finally, endeavor of all colleagues in this Ministry towards completion of the report is greatly appreciated.

ULAMBAYAR BARSBOLD

MINISTER OF ENVIRONMENT, MONGOLIAN GOVERNMENT

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

Part III KEY ENVIRONMENTAL ISSUES

LIST OF FIGURES

Page

PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

Part III KEY ENVIRONMENTAL ISSUES

LIST OF MAPS

LIST OF THE PHOTOS

Page

PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

PART III KEY ENVIRONMENTAL ISSUES

Part I EXECUTIVE SUMMARY

PART I EXECUTIVE SUMMARY

One of the mandates of the UNEP (United Nations Environment Programme) is to assess regularly global state of the environment. As a part of this larger initiative, UNEP has undertaken several activities to strengthen environmental monitoring and assessment capabilities at national, sub-regional and regional level. The objectives of the State of Environment (SoE) reports produced under these initiatives are to increase the awareness and understanding of environmental trends and conditions, to provide a foundation for improved decision making at all levels, and to facilitate the measurement of progress towards sustainable development.

The SoE report prepared for Mongolia broadly covers five priority issues pertaining to the environment, identified by the Government of Mongolia through a consultative process following the UNEP guidelines. In addition, other cross cutting issues addressing economic and social development are also included. The five priority issues are (1) land degradation, (2) desertification, (3) deforestation, (4) loss of biodiversity, and (5) urban air pollution. The report on the priority issues was prepared following the PSIR (Pressure- State-Impact- Response) framework. The various issues are discussed in different chapters of the report.

With 1.5 people per square kilometer, Mongolia has one of the lowest population densities in the world. Mongolia has a population of 2.3 million people spreaded over an area of 156.412 million ha and its population growth rate of 1.8% per year is one of the highest in East Asia. Urban population growth has been accompanied by a rapid growth in natural resource consumption. Its transition into a market economy has accelerated the risks of damage to the hitherto well-managed environmental resources. The country's environment resources offer great potential for expanding economic opportunities- in mining, forestry, animal husbandry and tourism. However, many areas of concern are emerging highlighting the need for integrating comprehensive policies of sustainable development into the national development strategy and most importantly, ensuring effective implementation considering both the economic development and environmental conservation. The five priority issues identified are discussed below.

1.1 LAND DEGRADATION

Land degradation has been identified as one of the priority concerns in Mongolia. Causes of land degradation in Mongolia can be divided into two categories - human induced and natural causes. Natural causes include droughts with frequency of 2-3 years, natural drying, deficit in soil moisture, very thin layer of fertile soil, specifics of mechanical composition of soils, strong wind in spring and autumn season and dust storms. During the last 40-50 years human activities have significantly contributed to land degradation. These include- impact due to rapid development of farm land, mining industry, changes in traditional livestock husbandry, overgrazing, specially around settlement areas and water points.

Farmland degradation in Mongolia is one of the serious issues. Livestock grazing is the primary human use of natural areas in Mongolia. Twenty-five million livestock graze 117 million ha of pasture, approximately 75% of the nation's territory. Economic hardships resulting from the present socioeconomic transition has brought increased pressure on grazing lands. Especially in desert steppe regions where soils are thin, excessive grazing has led to erosion of topsoil, compaction of subsoil, and eventually to the replacement of the most edible plant species by less edible species. According to research estimates, 25% of Mongolia's pastures are threatened by land degradation. Due to overgrazing, the diversity of plant species in areas near town centers has fallen by as much as 80%. As a result of overgrazing, Mongolia's over 30 million livestock lack pastureland. The lack of pastureland results in malnutrition, loss of livestock heads and overall reduction of animal products.

As of today, 126.3 million ha or over 70 % of the total pastureland areas have been degraded. Almost half a million ha of land, which has been used for agriculture during the last 40 years, has been eroded and the fertility has decreased by 20 %. Crop yield has also reduced due to fact that the farmland soil fertility has decreased by about 20%. For instance, wheat yield has now reduced to half compared to that of 1980s.

Protection of land resources from degradation or depletion has always been an issue for consideration by the Mongolian Government. The Central Committee of Mongolian People's Revolutionary Party and the Counsel of Ministers jointly adopted two resolutions: one in 1974 on "Urgent measures to protect soil from erosion"; and the other in 1981 on "Introduction of soil protection system in farm land management". Further to this, in 1995, Mongolia adopted a package of Land Laws to regulate land relations in market economy conditions.

- There are about 20 Environmental Programmes undertaken by the government to combat land degradation and desertification. These include:
  - State Policy on Ecology, 1996-2000;
  - Mongolia's Action Plan 21 (MAP 21);
  - National Water Programme;
  - National Forestry Programme;
  - National Programme on Natural Disasters Mitigation; and
  - Government Action Plan 2000-2004.
- Mongolia is working towards implementation of projects to reduce land degradation and erosion by
  - Rehabilitation of land resources affected by mining operations
  - Combating desertification and sand movements
- In1995, Mongolia adopted a package of Land laws to regulate land relations in market economy conditions.

1.2 DESERTIFICATION

Mongolia is a country, which experiences serious drought and desertification. More than 40% of the territory is composed of arid and desert areas. There are estimates that 90% of Mongolia's territory is vulnerable to desertification and about 70% is already degraded to varying extents.

Desertification is characterized by - (i) desertification of vegetation cover, (ii) desiccation of wetland ecosystems and (iii) increase of sand area. Causes of desertification can be divided into two categories, i.e., natural causes and anthropogenic causes. Researchers estimate that only 13% of the desertification is caused by natural factors whereas anthropogenic factors have contributed to rest 87 %.

Among the major cases are mentioned climatic variations which may lead to natural disasters that, through interaction with human factors, will lead to accelerated degradation at local level. For instance, desertification in the Gobi ecological zone is reported as being caused primarily by increasing aridity of climate and grazing impacts associated with livestock. The anthropogenic causes are overgrazing, wind and water erosion of cultivated soils and abandoned farmlands, intentional burning and vehicle tracks.

Mongolia's most affected drought regions are the Central and Southern regions. In these regions, over 40-50 days with arid conditions are recorded every year and droughts are frequently observed during the first stage of plants' growing period.

The size of area covered by sand in Mongolia has increased by 0.038 million ha (8.7%) during the last 40 years. Around 1 million ha of land has been covered with vehicle tracks and around 0.6 million ha of land has been severely eroded due to military and technical activities.

As desertification continues to affect more land, it is now very critical that over 70 % of pastureland has been degraded and depleted. Vegetation growth rate has already decreased by 5 times and the number of plant species has reduced up to 6 times. The yield from severely degraded pasture has decreased by 5 times.

The efforts of Government of Mongolia to combat desertification are reflected in over 20 programs and action plans as mentioned earlier. Apart from this, following measures have been taken:

- Mongolia signed the "UN Convention to Combat Desertification" in 1996 and ratified it in 1997. It approved a National Action Plan to Combat Desertification by its resolution 193 in 1996.
- Mongolia has concluded 7 intergovernmental and over 20 inter ministerial agreements with neighboring and other countries to protect the environment and cooperate in combating desertification.
- Since 1990 there are 14 projects being implemented with total costs of US $ 24.6 million with assistance of international donor community.

- Other measures include creation of information-monitoring network and strengthening of national capacity and organizational structure by establishing National Committee to Combat Desertification and National Center to Combat Desertification.

1.3 DEFORESTATION

The current total forest area in Mongolia is 13 million hectares (less than 10 % of the total land area), of which the area for potential commercial forestry totals about 5 million hectares. Management of the forest resources of Mongolia suffers from several weaknesses such as unregulated over-use and inadequate protection. Impact of human interference over the years has resulted in forest loss and forest degradation. Some 1.6 million ha of forest area have been lost between 1974 and 2000 due to fire, overgrazing, mining activities, improper and illegal logging and also due to pests and diseases causing severe ecological stress in some regions. There have been over 700 species of forest pests registered in Mongolia that spread every year and damage the limited forest resources.

Annual afforestation is low, compared to the area of critical land to be reforested and the reported annual rate of deforestation. Quality of forest plantations is poor, mainly due to lack of adequate maintenance and care. Poor management and outdated technology employed in timber industry has led to use of only 60 % of the total harvested timber in a profitable way. Harvesting practices are wasteful and inefficient.

On the production front, the annual volume of logging have fallen from about 2.2 million cubic meter in mid-1980s to 0.5 million cubic meter in year 2000. It has been influenced by many factors like institutional and policy changes, privatization of production enterprises, decentralization of decision powers, reduction in the area designated as utilization forests by reclassification into protected areas and prohibition of clear felling in the natural forests etc. During the last 10 years the institutional base and structure of forestry changed several times and it has lost its identity as a key sector. Responsibility for forestry has been split, fragmented and scattered in different ministries, agencies and departments.

The problem of dwindling forests and its ecological consequences are being severely felt in the form of flash floods, lowering of groundwater level, spread of desertification and loss of biological diversity.

The Government of Mongolia has formulated many laws and policies for protection of forests. These include:

- Law on Forests, 1995;
- Law on Protection from Forest and Steppe Fires, 1996;
- Law on Levying Fees on the Harvest of Timber and Firewood - it strengthened the implementation of earlier two laws by creating an economic incentive for conservation of forests;
- These laws have been supported by 30 important regulations and resolutions including "Rules for Forest Management", "Rules for Estimation of Damage caused by Forest and Steppe Fires", "Procedures for collection, stocking and selling Forest Seeds", "Instructions on Timber Felling" etc; and
- Forest protection policies are formulated in three fundamental documents: "Basic Orientation of the Government on Ecology", 'National Action Programme to Combat Desertification" and "National Action Programme on Protection of Biodiversity".

1.4 LOSS OF BIODIVERSITY

Mongolia's territory ranges from the super-arid desert in the South to moist Taiga forest in the North, and from rolling steppe grasslands in the East to alpine terrain and glaciated peaks in the West. This varied terrain contains a wide array of ecotypes, many exhibiting unique characteristics found nowhere else on the globe. This unique, varied, and substantially undisturbed territory supports a wide diversity of living organisms, many of which are endemic to Mongolia. Mongolia harbors the last remaining populations of a number of species internationally recognized as threatened or endangered, including the snow leopard, Argali sheep, wild ass, saiga, bacterian camel, Gobi bear, and others.

Mongolia's diverse and distinctive vegetation includes an important part of Asia's plant life. More than 3000 species of vascular plants, 927 lichens, 437 mosses, 875 fungi, and numerous algae have been recorded. Many other species, however, remain to be classified. Mongolia's flora includes almost 150 endemic plants and nearly 100 relict species. Over 100 plant species are listed in the Mongolian *Red Book* as rare or endangered.

Like its vegetation, Mongolia's fauna represents a mixture of species from the northern taiga of Siberia, the steppe, and the deserts of Central Asia. Fauna includes 136 species of mammals, 436 birds, 8 amphibians, 22 reptiles, 75 fish, and numerous invertebrates.

However, Mongolia's biological resources are facing substantial and increasing threats. Growing population coupled with urbanization, economic development, and an increasing per capita demand for natural resources, have put enormous pressure on land and natural resources. At the same time, the recent transition from a centrally controlled economy to a free market economy has opened the country's natural resources to free enterprise and market forces. Increasing economic activity such as mining, land cultivation and crop farming, and the production of wild and domestic animal products for internal consumption and export, have resulted in the disturbance hitherto undisturbed natural areas and the loss of wildlife habitat. Inadequately controlled or illegal hunting, and predator eradication programs also contribute to pressures on wildlife and on the natural balance in many areas.

- Since 1994, Mongolia has concentrated its efforts on the establishment of a legal foundation to regulate on biodiversity protection and its wise use. In addition, many programmes and action plans are formulated to protect biodiversity. These include:
  - In 1995 and 1996, the "Law on Natural Plants", "Law on Plant Protection", "Law on Hunting", "Law on Fees for Harvesting Forest Timber and Fuel wood", "Law on Natural Plant Use Fees", and "Law on Hunting Reserve Use Payments, and on Hunting and Trapping Authorization Fees" were adopted. In addition, over 20 Regulations and Resolutions have been endorsed to support those laws.
  - It also adopted " Law on Special Protected Areas" in 1994 and "Law on Buffer zones of Special Protected Areas" in 1997.
  - In 1996, Biodiversity Conservation Action Plan was adopted. The Parliament approved " The National Program on Special Protected Areas" in 1998 and its Implementation Plan for 1998-2005 was adopted by the Government in 1999.
- Today Mongolia has designated 48 protected areas, which cover about 20.5 million ha of territory in 19 *aimags* (province) (roughly 13.1 % of the whole country's territory). Also, 115 areas encompassing 1.13 million ha of land are under local protection. During the last 10 years the number of protected areas increased more than three times.
- The Mongolia Biodiversity Project has been a collaborative effort to conserve Mongolia's biodiversity. It has been funded by the Global Environmental Facility (GEF) through the United Nations Development Programme and the Mongolia Government.
- Mongolia is seeking external assistance in addressing biodiversity issues in terms of:
  - conservation and cultivation of rare and very rare species of flora and fauna; and
  - improve management of special protected areas and develop eco-tourism

1.5 URBAN AIR POLLUTION

Air quality is a significant environmental problem in urban areas of Mongolia, particularly in Ulaanbaatar. Primary sources of air pollutants in Ulaanbaatar include: three thermal power plants, about 200 small and medium sized heating boilers, about 75,000 traditional *gers* (tents) and wooden houses, and over 48,120 automobiles. Topography and meteorology exacerbate ambient air quality conditions in the country, particularly in Ulaanbaatar.

Corresponding to a rise in number of vehicles, concentration of nitrogen dioxide (NO_2) has been increasing over the years. SPM (Suspended Particulate Matters) concentration reaches its maximum in April in the presence of strong winds. It is reported that air pollution in Ulaanbaatar during wintertime causes acute respiratory diseases such as tuberculosis and other lung diseases.

Mongolia adopted Law on Air (Pollution) Act in 1995. Substantial activities are being undertaken to replace old household stoves with advanced ones under the assistance of GEF/World Bank.

The government has planned to seek donor assistance for the rduction of air pollution in capital city and other towns through

- local manufacturing and utilization of gas emission filters and catalyzing tools, establishment of special laboratory for control and analysis of transport vehicles.
- manufacturing, promotion and distribution of cost efficient and low smoke stoves for households living in a ger (tent).

PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

2.1 GENERAL BACKGROUND

2.1.1 Socio- economic Development

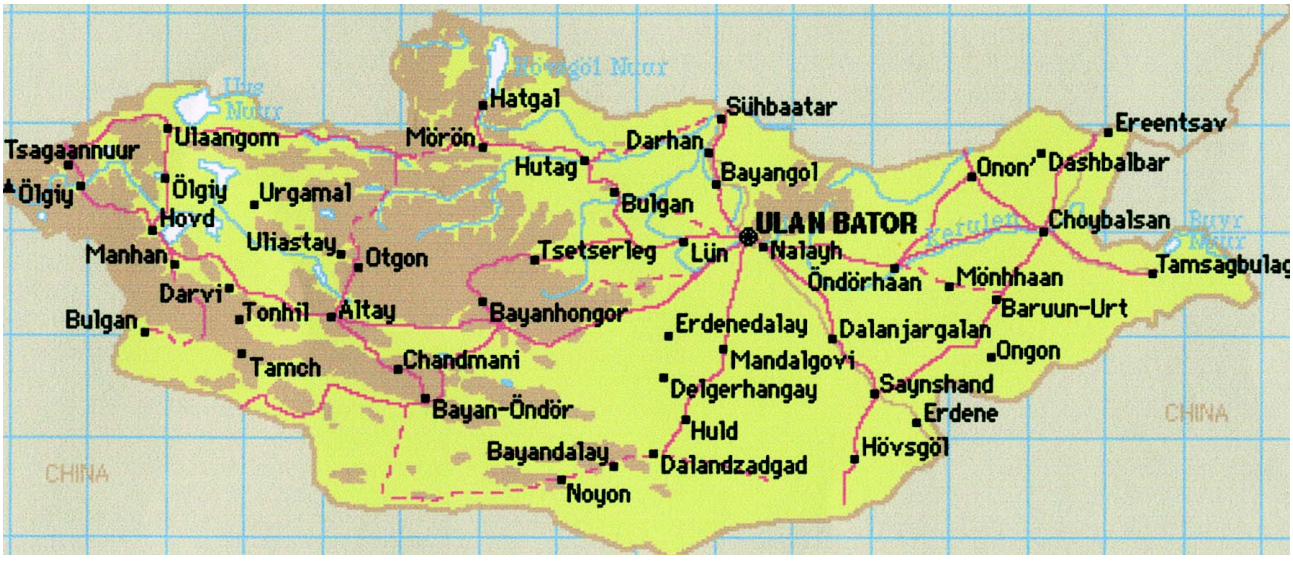
Population- Mongolia is a sparsely populated country, landlocked between the Russian Federation to the north and the People's Republic of China to the east, west and south. Mongolia has a population of about 2.4 million people spread over an area of 156.412 million ha. About 57 % of the population lives in urban areas. The population has doubled in the last twenty-five years, with a strong trend towards urbanization. Mongolia's population density, at 1.5 persons per km^2 is one of the lowest in the world. The growth rate at 2.9 %, one of the highest in Asia, has been reduced to 1.4 % during the current economic transition into a market economy. The crude birth rate is estimated to be 20.4, whereas the crude death rate is estimated to be 6.5 per 1000 and the infant mortality rate to be 32.8 per 1000 live births. The total fertility rate is estimated to be 2.2 children per 1000. The average life expectancy at birth is estimated to be 64 years. Mongolia's labor force reached 1.37 million by the end of 2001 of which 62 % are economically active. Map 2.1 presents the territory of Mongolia showing the capital city of Ulaanbaatar and other major cities.

Economy- Apart from the permafrost, the thin topsoils having low fertility limits crop production. Although, semi-nomadic herding of cows, horses, sheep, goats and camels provide about 70 % of agricultural production, overgrazing is rampant especially near areas of human settlement causing pressures on environment. Unsustainable uses of Mongolia's natural resources - its soil, surface, and ground water, forests, grasslands, wildlife and fish, is quite evident. There are indications that in some parts of the country pressures on the environment (and the local system) have exceeded permissible limits.

Of the total employment force of 900,000 people, 48 % is in agriculture, 12 % accounts for industry and the rest for other sectors. Per capita GDP in 1998 was US $ 452.

2.1.2 Climate and Topography

Climate- Mongolia lies in a transitional zone at 42^0 - 52^0 N, between the boreal forests of Siberia and the Gobi desert, spanning the southernmost border of the permafrost and the northernmost deserts of Central Asia. Large distances and high mountain chains separate the country from the oceans. It has an extreme continental climate with marked differences in seasonal



Map 2.1 *Map of Mongolia*

and diurnal temperatures and low precipitation. Mean annual observed precipitation ranges from 38.4 mm at Ekhiin gol in Bayanhongor aimag (province) to 389.3 mm at Dadal in Hentii *aimag*. Most of the rainfall occurs in summer, between June and August. Mean monthly temperatures for the last thirty years range from -11.8^{0}C (January) to 25.2^{0}C (July) at Ekhiin gol, the warmest place, and from -32^{0}C (January) to 12.8^{0}C (July) at Rinchinlumbe, the coldest place in Mongolia.

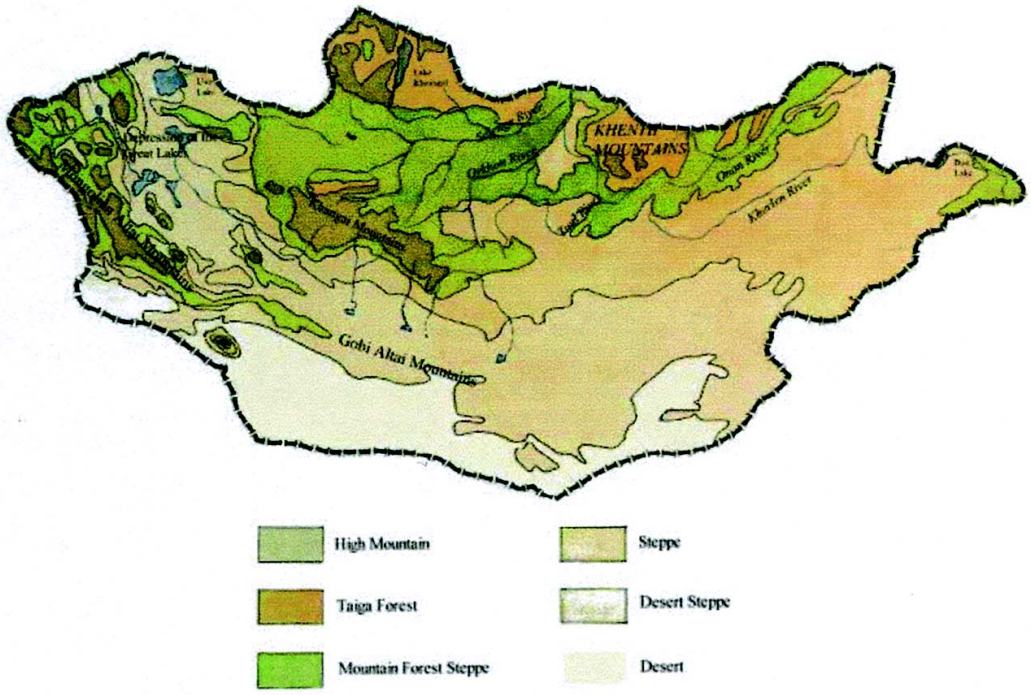
Topography- Although most of the country is flat, with rolling hills, there are several significant mountain ranges, notably the Altai, Khangai, Knentii and Khuvsgul. About half of the land is at an altitude of about 1,400 m or more above mean sea level. The altitudes range from 560 m (above sea level) at the lowest point of Khokh Nuur in the eastern steppes, to the highest of 4,374 m (above sea level) at Khuiten peak in the Altai Mountains.

Administratively, the country is divided into 21 *aimags* (province) each of which is divided into *sum* (territorial administrative unit subordinate to district) and *bag* (the smallest administrative unit in rural district). The capital city consists of districts and khoroo (blocks/ subdivision of district in city).

2.1.3 Ecosystem

Mongolia's position, size and topography have resulted in a unique assembly of ecosystems or natural zones. Studies of the flora and fauna of the country, together with climatic and geographic data, have resulted in the classification of Mongolia into 6 broad ecological regions, 16 provinces and 47 bio-geographical zones. Mongolia also has been divided into 6 broad vegetation zones (Alpine, Taiga, Forest-Steppe, Steppe, Desert-Steppe and Desert), that are discussed in the following sections. Ecosystems are fragile and extremely vulnerable to many forms of economic exploitation. Figure 2.1 distribution of these vegetation zones.

The different types of vegetation zones are described in the following part.



Map 2.2 *Topography of Mongolia*

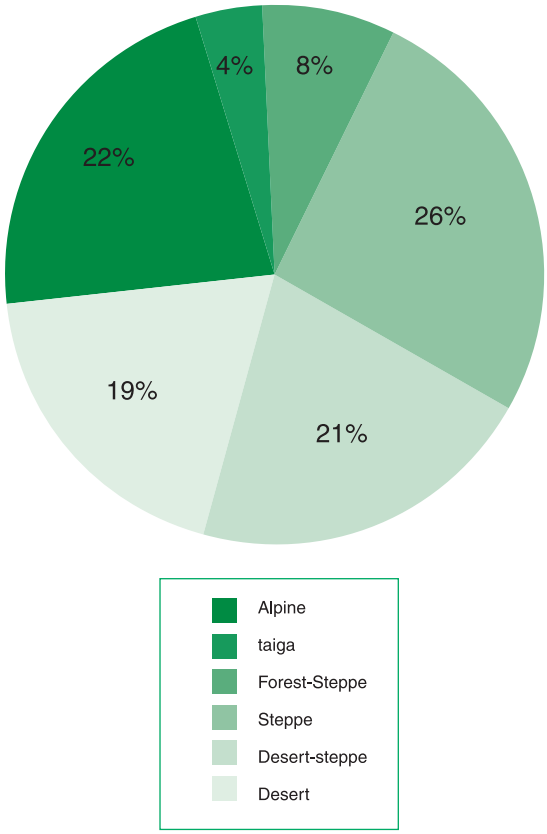


Figure 2.1 *Vegetation zones in Mongolia*

Alpine: High mountains rising above the tree line occur in the Altai, Khangai and Khentii and Khuvsgul ranges. As seen in photo 2.1, the tops of these mountains are relatively flat, with few sharp peaks. Vegetation consists of low shrubs and herbs, sedges, mosses, algae and lichens, and there are few birds and mammals living at this altitude.

Photo 2.1 *High mountain zone*

Taiga: Mountain taiga forest covers areas of the Khuvsgul and Khentii mountains, the area north of the Tarbagatai Mountains, the upper reaches of the Orhon river, and the Khan Khokhii range. It is the southern edge of the Siberian taiga, the largest continuous forest system in the world. Photo 2.2 shows typical taiga forest zone.

Photo 2.2 *Taiga (Forest) zone*

Forest-Steppe: This zone lies between the steppe and the taiga, in the Khnagai and Altai mountain chains, including parts of Orhon and Selenge river basins and Khyangan Mountains of eastern Mongolia. Coniferous forests are found on the northern slopes, while the southern slopes are covered with open steppe vegetation as seen in the Photo 2.3.

Photo 2.3 *Mountain Forest Steppe Zone*

Steppe: The steppe zone extends from the western Great Lakes Depression past Khangai and the middle Khalkha highlands to the steppes of Khentii, Dornogobi and Dornod. As seen in photo 2.4, it is characterized by flat plains and rolling hills covered in feather grass and shrubs.

Photo 2.4 *Steppe Zone*

Desert-Steppe: Mongolia's desert-steppe or semi-desert ischaracterized by a dry climate with mean annual precipitation of 100-125 mm and vegetation dominated by low grasses and shrubs. Many of Central Asia's endemic plants occur in this zone as seen in Photo 2.5.

Photo 2.5 *Desert - steppe zone*

Desert: Desert occurs predominantly in the south. The Mongolian desert is extremely dry, with mean annual rainfall lower than 100 mm, and some areas remain without rain for several years at a time. High winds and dust storms are frequent in spring and summer. There are oases with poplar, but for the most part the desert consists of bare sandy plains and rocky mountains as seen in the photo 2.6.

Photo 2.6 *Desert zone*

2.2 NATURAL RESOURCES

2.2.1 Land

Land Resources

With its territory of 156.412 million ha, Mongolia occupies 17th place by the size of territory and first place by per capita land resources (65 ha) in the world. Per capita agricultural land in Mongolia (53.8 ha) accounts for 20 times over the world's average. As per the Provision 10 of "Land Law" of Mongolia, land is classified in six categories as stated below:

1. Agricultural land
2. Urban land
3. Roads and Communication land
4. Forest land
5. Water land
6. Land reserve

Land classification in the year 2000 is shown in Table 2.1.

Table 2.1: Land Classification of Mongolia in million ha, (Year 2000)

Total area	Agricultural land	Urban land	Roads and communication land	Forest land	Water land	Reserved Land
156.412	130.54	0.416	0.3367	18.292	1.667	5.157
	(83.5 %)	(0.27%)	(0.22%)	(11.72%)	(1.06%)	(3.16%)

Note: *Parenthesis shows the percentage of total area*

Categories of classified land

The land occupied under various categories include (as of 2000):

Agricultural land: The agricultural land is further classified into:

- pastureland : 127.307 million ha (97.5 % of the total agricultural land)
- hay field : 1.986 million ha (1.5 %)
- crop/farm land : 0.806 million ha (0.6 %)
- abandoned land : 0.367 million ha (0.3 %)
- land occupied by agricultural constructions and facilities : 0.071 million ha (0.05 %)

Photo 2.7 *Pasture land*

Urban land: The urban land category amounts to about 0.416 million ha. of territory. The land of this category is increasing year by year due to increasing land allocation to individuals and economic entities for their extended business activities.

Roads and Communication land: This land covering the territory allocated for transportation and amenities like energy, heating, water supply, communication, and transport purposes outside urban and settlement areas is increasing year by year.

Land reserve: This category covers land not allocated for use or possession by individuals, economic entities or organizations, or land in remote and rocky areas. The area can change when some land use is transferred from or to this category.

Minerals Processing and Mining

Mongolia is rich in mineral resources: 8000 mineral deposits bearing over 600 mining sites have been discovered - including coal, iron, tin, copper, molybdenum, gold, silver, tungsten, zinc, tin, lead, phosphates, fluorspar, uranium and nickel. In addition, over 200 deposits of construction materials (marble, granite, etc.) have been discovered and these are currently in operation. The Erdenet copper-molybdenum mine and ore-processing complex, which produces annually about 0.4 million tons of copper concentrate for export, dominates the mineral sector.

Other substances like oil shale, and semiprecious stones (agate, lapis, lazuli, garnet) are also found in Mongolia. Of 200 known coal deposits, 32 have been exploited of which 13 sites are now closed. There are many large deposits of low-grade brown coal that cannot be used in some coal-fired installations as it has high sulfur content and air pollution potential. One uranium mine is under exploitation at present in Eastern *aimags*.

Construction materials: There are over 120 pits from which construction materials are mined.

The extraction, processing and exports of copper, molybdenum, gold, coal and flourspar are the most economically significant activities in the mining and minerals sector. Earning from the copper concentrate and cathodes produced at Erdenet, for example, account for at least 50 % of Mongolia's hard currency earnings.

Most of the mining activity in Mongolia is of open pit type as seen in photo 2.8 and photo 2.9, and no reclamation activity has taken place (except that which is being done under the World Bank financed coal

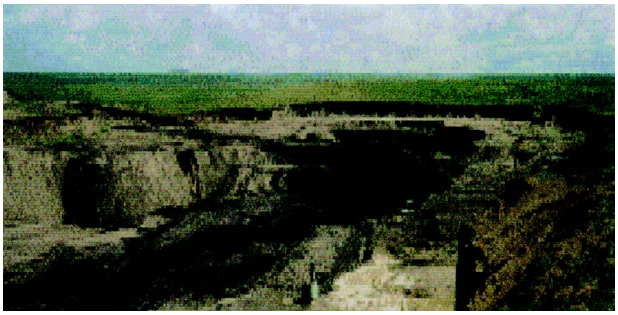


Photo 2.8 *Open mining*

Table 2.2: Deposits and Mines

Mineral resource	Mining sites/ deposits	Reserves -Amount in million tons	Description
Coal	200	125,000	In 1996, there were 12 mines for black coal and 7 for brown coal. The largest mines are Baganuur, Shariingol, Mogaingol, Tevshiin Gobi, Shivee Ovoo Tsaidam and Aduunchuluun.
Copper and Molybdenum	100 deposits	Copper- 0.009 Molybdenum -250	2 of the deposits are particularly economically attractive:the Erdenet Ovooand Tsagaan suvrag deposits. Over 20 million tons of ore is extracted annually from Erdenet Ovoo, and exports of copper and molybdenum have increased, respectively, from 351 and 3.3 thousand tons in to 3.8 million tons in 1999.
Zinc and lead	30 mines	0.0039	
Tin	12 deposits	16	Deposits are located in the Khentii province.
Tungesten	20 deposits	220	Found mainly in the western province of Bayan-Ulgii
Gold	120 mines	0.000170	Gold mining began on a large scale in the 1990's and is found in both ore and placer forms.
Silver	2 mines	10	Main deposits are in Asgat and Mungun-Undur
Flourspar	360 deposits	0.018	Main deposits are in Khentii and Dornogobi provinces. Flourspar is one of Mongolia 's main exports by volume.
Phosphorous	20 deposits	24	Mainly found in the Khovsgul region.
Zeolite	20 deposits	Unknown	Enough deposits to meet internal demand and for export.
Iron	250 deposits	0.600	Enough internal demand but currently very little is mined
Uranium	100 deposits	1.4	Under exploration in Dornod province, and mining techniques are under experimentation.
Rare metals	7 mines	400	Small amounts of various rare earth elements have been identified
Oil	4 deposits	0.411	Discovered in southern Mongolia

Source: *ADB-Project and MNE, 1999*

project at Baganuur).

According to Law, all open pits must be reclaimed but that is not enforced. Gold mine operators in Zaamar region indicated that they were more likely to come under pressure from the community to perform reclamation activities than from state inspectors. The pits and piles of overburden preclude use of the territory for other economic activity, such as grazing.

Open pits create unproductive scars on the landscapes and their associated spoil dumps are subject to wind and water erosion, thus negatively affecting air and water quality and the productive capabilities of the surrounding countryside. Water resources are negatively affected by the mining practices used in Mongolia. Withdrawals from the Tuul river that are used for gold placer mining in Zaamar region, for example, reduce the flow in the river.

Moreover, sedimentation from erosion of the piles of overburden alters the biophysical nature of the river. Similarly, the overuse of ground water in the region where gold , flourspar is mined (Khentii) has reduced

Photo 2.9 *Mining operations*

the number of springs and oases and has put many wells out of uses.

Erdenet, the mining company, had to pay US $ 500,000 per year in fines in the last several years for violations of Environmental regulations (MNE/UNDP/GEF, 1998-1999) There are questions about the safety of the dam at the waste water reservoir associated with Erdenet. The dam is simply built up to meet the continuously rising sludge/liquid levels. The reservoir is full of sludge (the complete composition is not known) and must be exerting a tremendous amount of pressure on the dam. Waste water (untreated and polluted) is released to the Khatgal river by the processing plant when there are power outages. Chemicals used in some metallurgical processing in Mongolia also threatens the natural environment and human health. Some of the environmental concerns and issues are discussed below:

- Sulfuric acid is used to extract copper, which produces cathodes using low grade copper ore from the Erdenet mine, very close to the city. Erdemin company was temporarily closed for not complying with all of the mitigation measures that were identified in its Environmental Impact Assessment (MNE/UNDP/GEF, 1998-1999). Although the sulfuric acid extraction process is supposed to be a closed system, occasional leaks do occur.
- Sulfuric acid is also being used experimentally in Dornod to mine uranium. A joint venture Russian-Mongolian company is using sulfuric acid to extract uranium from mined raw ore, and also to extract uranium from the ground by pumping sulfuric acid into the ground.
- Cyanide is used to process gold ore in Umnigobi. According to some official reports, there have been reports of birds dying near the gold mining operation in Umnigobi. There is a lack of systematic and reliable environmental monitoring and survey at these sites.
- The cement plant and iron smelter in Darkhan (which mainly processes scrap iron) also produce air and water pollution.

Response

Since 1995, those applying for exploration and mining permits are required to get an Environmental Impact Assessment done. From January 1998, a resolution was passed mandating that all existing enterprises (including mines) must have an EIA prepared before the end of the year 2001. Operators of mining and exploration ventures are also required by law to submit an environmental management plan to the *aimag* or sum (province) Governor. In order to cover environmental liabilities, mine operators are required by the Minerals Law of Mongolia to place 50 % of their environmental protection budget in a special account in the local Government. This would cover damages done to the environment that are not appropriately dealt by the mining operators. However, none of these laws are enforced.

The pits and spoil dumps occupy over 775.6 ha of land. From this site, about 56,800 cu.m of topsoil has been pre-stripped and stockpiled, which amounts for 4 % of the total topsoil of the area. Soils are variably sandy and sandy-loam with few stones or rocks, and the terrain includes steep slopes of 32 to 35

degrees with heights of 30 to 40 meters. Extensive wind and water erosion characterize the spoil dumps.

Reclamation activities include technical and vegetative reclamation:

- Technical reclamation: Filling pits, shaping slopes and covering with soil-forming materials; and
- Biological reclamation: Ameliorating soils, establishing vegetation and implementing a five year management plan to ensure a stable vegetation system.

In addition to reclamation, steps are taken to control dust created mainly along the haul roads, draggling and loading shovels, drilling, spoil dumps and coal handling.

2.2.2 Fresh water

Freshwater Resources

There are more than 3,800 rivers and streams with regular run-off in Mongolia. The total length of the river network is about 6,500 km. There are 186 glaciers of a total volume of 62.5 km^3 and 3500 lakes covering total surface area of 15,600 km^2 (surface area of each exceeding 0.1 km^2) with a total volume of 500 km^3 and 8,000 river lets. Table 2.3 presents the details of surface water resources in Mongolia.

There are three major drainage basins: rivers in the west drain to the enclosed Basin of Central Asia; rivers in the north drain to Arctic Ocean Basin; and rivers in the east drain to Pacific Ocean Basin. The details about area covered within them are given in Table 2.4.

Table 2.3: Types of Surface water

Surface water	Number	Length (km)	Area covered, sq.km
Rivers	3811	67080	
Lakes	3500		15640
Glaciers	187		540
Springs	6899		
Mineral waters	250		

Photo 2.10 *Lake fresh water resources*

The potential water resources of the country are estimated to be about 36.4 km^3. Of this, the surface water resources are 22.0 km^3 and the usable

Table 2.4: Watershed distribution

Name of basin	Area ('000 sq.km)
Arctic Ocean	320.0
Pacific Ocean	197.0
Enclosed Basin, of which: - With permanent run off - Without permanent flow	 426.0 621.0
Total	1564.0

Photo 2.11 *Fresh water is the basic livelihood for the herds community*

groundwater resources are 12.6 km^3. These are shown in maps 2.2 and 2.3. About 78% of the river run-off is formed on 36 % of the territory in northern, western, and north-eastern mountainous areas and 22 per cent is formed on 64 % of the territory in the south of the country.

Water balance is distributed as follows:

• Total annual precipitation	360.0	km^3
• Total annual run-off	36.6	km^3
of which:		
- Surface run-off	24.6	km^3
- Ground water flow	12.0	km^3
• Total soil moisture	202.0	km^3
Total evaporation	190.0	km^3

On an average, the annual amount of water resources per capita is 17,300 m^3. However, it ranges from 4,500 m^3 per capita in the Gobi area to 46,000 m^3 per capita in northern and central areas.

Total mean annual precipitation over Mongolia is estimated to be 360 cubic km. of water or 230 mm per year (nationwide average); about 90 % of this is lost through evapotranspiration, 4 % infiltrates to aquifers, and 6 % contributes to surface flow.

At present, there are 107 guards and 17 stations acting at 70 rivers, 1 spring and 9 lakes. Guards and stations undertake studies on water regime, quality and composition. They take measurements on water biology with 54 indices, evaporation with 8 indices and water pass-over with 81 indices. In fact, these measurements are three times lower than the world average.

Mongolia's total surface run-off reaches 69.5 cu.km in the year of 5 % probability (high flow) and goes

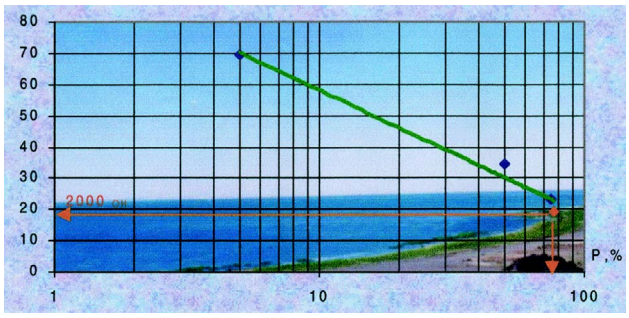


Figure 2.2 *Annual water resources with different probability, cubic km /year*

down to 23 cu.km in the year of 75 % probability (low flow) as seen in Figure 2.2.

In 2000 (77 % of probability) 19 cu.km of water was formed in the territory of Mongolia. Mongolia's annual surface run-off has been increased since 1988 and reached its maximum of 78.4 cu.km. Figure 2.3 shows the annual surface run off in Mongolia.

Water quality is found to be good in mountainous areas of Mongolia. Mongolia is a country through which the world watershed line crosses. Rivers and surface streams originating in high mountain areas carry absolutely clean water.

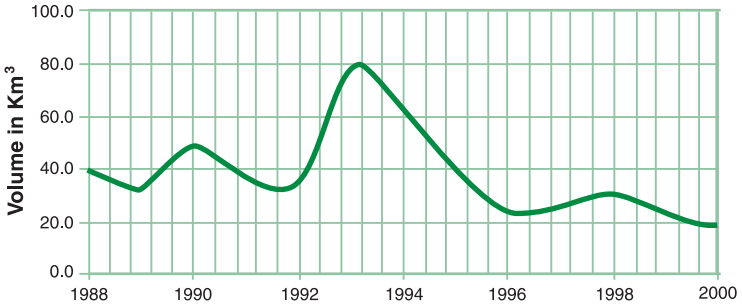
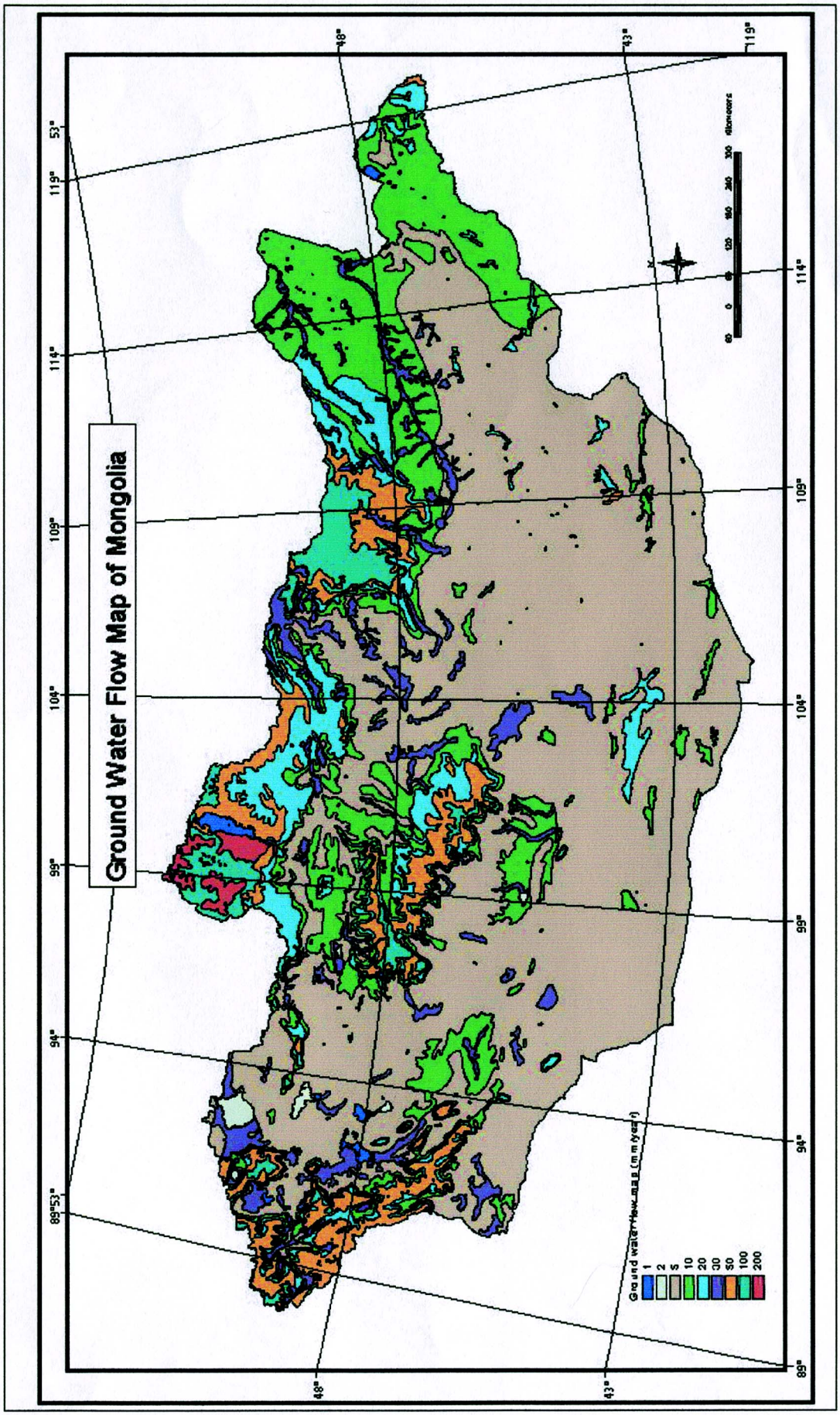
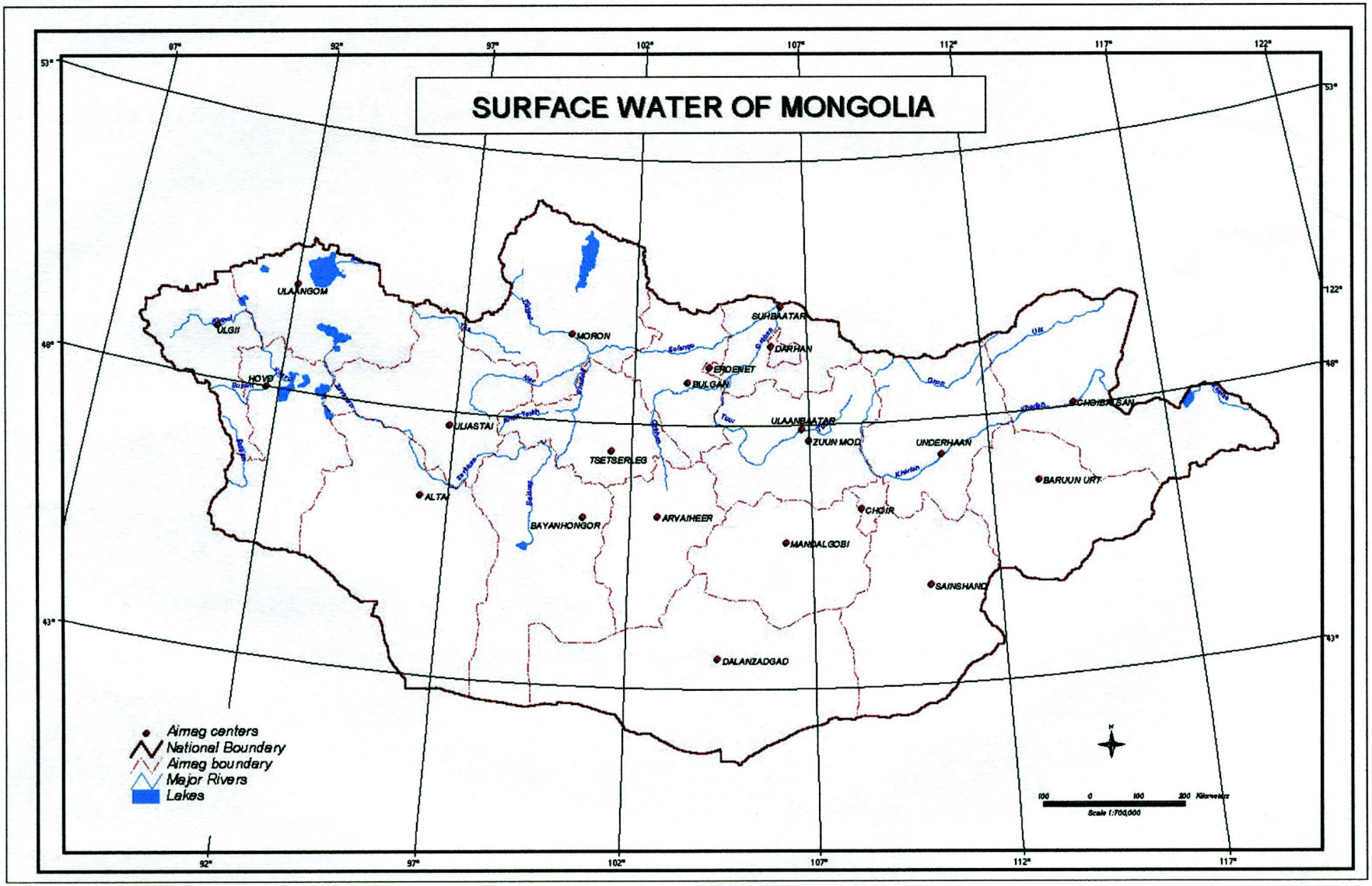


Figure 2.3 *Mongolia's annual surface run-off in cubic km/year*



Map 2.3 *Ground water flow in Mongolia*



Map 2.4 *Surface water bodies of Mongolia*

Water Use

Consumption of fresh water has increased three times between 1960s and 1980s. At the beginning of 1990s, over 300 enterprises, 140 agricultural irrigation systems and other large consumers all together consumed 671 million cu.m. of water, 70 % of which was withdrawn from groundwater and the rest from surface water. However, water consumption has decreased over the last decade due to economic failure in the on-going transition period.

Photo 2.12 *Tes River in Western Mongolia*
*(**Source:** E. Erdenebayar)*

Annual water use in Mongolia is estimated to be about 500 million cu.m., the distribution of which is shown in Figure 2.4.

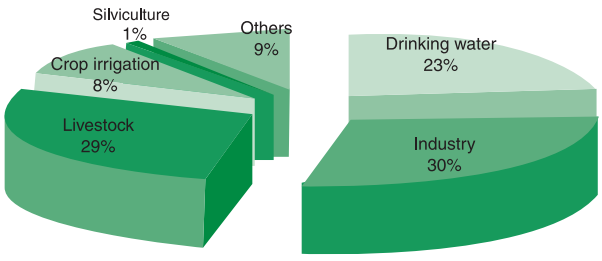


Figure 2.4 *Water uses distribution*
*(**Source:** MNE-2000)*

Water supply from the underground sources is about 80% of total water consumption. 30.8% of population of Mongolia are supplied with water from centralized water-supply system, while 24.8% are supplied from water transportation service, 35.7% are from water supply points and 9.1% are from springs, rivers and snow water respectively. Drinking water is supplied from different sources as shown in Figure 2.5.

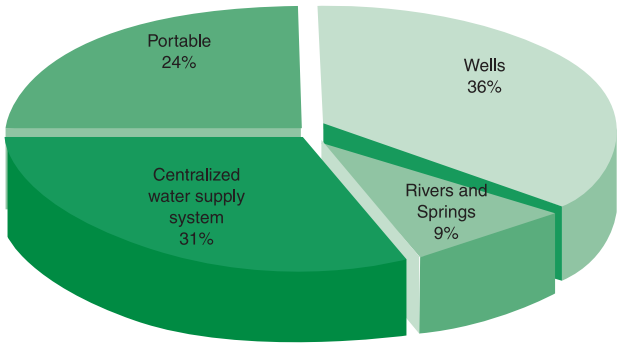


Figure 2.5 *Drinking water supply sources, in percentage*
*(**Source:** MNE 2000)*

In desert and semi-desert areas, water supply is often a problem. Practically, no surface water is available except some oasis. Groundwater is found to be highly mineralized and saline due to natural factors. This causes essential problems for drinking water supply, and its use often brings health problems to local people. Currently about 30 *sums* in this area are in extremely difficult position with regard to water supply. Pasture cannot be used in many places due to absence of water supply.

Water consumption per capita in Mongolia is 3 to 4 times lower than the world average. According to studies, water consumption of population living in the *Ger* districts of large cities, *aimag* centres and big settlements is equal to 8 to 10 liters per person per day, which is 4 to 5 times lower than the acceptable sanitary norms. However, water consumption in Ulaanbaatar exceeds the average of that in the developed countries. It shows that there is a significant unnecessary waste of water. There is irregular repairs and maintenance service in the municipal water supply lines. If drinking water continues to be wasted in this way, the capital city drinking water supply is likely to face severe problems in near future.

Before 1990s, there were over 48,000 wells mostly used for herders' water supply and livestock watering throughout the country. Today about 40 % of those wells are out of use due to lack of maintenance and absence of ownership.

Water consumption for irrigation purpose has dramatically reduced since the beginning of 1990s due to economic failure during the transition period. There were more than 140 irrigation systems in the country before 1990. Adequate use of irrigation systems has not been formed as no activities on establishment of irrigation systems, repairs and technical renovation were carried out since 1990.

As a natural factor, the uneven distribution of water resources throughout the country together with the uneven seasonal distribution of rainfall affects the utilization of water resources in Mongolia.

Most of machinery and equipment used by water and canalization enterprises were installed in 1960s and capital and current repairs have not taken place since then due to lack of funding (about 80% of all the equipment has been in use for more than 10 years). Water-supply facilities and equipment are badly worn and has caused increased waste in pure water. Therefore, introduction of water counters and economic leverage for proper use of water are becoming an urgent issue to be addressed.

A number of multi-stage measures have been implemented over the last 20 years with the purposes of solving out the issues on water supply and expansion of service range in compliance with future outlook of cities and settlements' development. As a result of those measures capacity of water-supply construction has been increased six times by constructing 330 wells, 107 pumped stations along with 783 km of water-supply line. Water supply capacity reached 0.55 million cubic meter per day while the capacity of water refining facility increased four times enabling about 0.4 million cubic meter of waste water getting refined per day.

It is necessary to solve the problems of water supply in 170 *sums* out of total 345 *sums* and settlements in the country. However this issue was resolved only in 70 *sums*. At present, local community uses water from pastureland irrigation facilities or from other water sources for drinking and household purposes.

In the future, water sources exploration and survey should be undertaken in order to improve water supply in all the *sums*.

Lack of funding sources and qualified management along with factors such as slow progress in repairs and reconstruction, non-compliance with planned actions, improper use of equipment and funding are the main obstacles for expansion and renovation activities at the *aimag* and towns' water supply facilities.

Although the Water Law, Water Use Fees Law and some 20 other legislative regulations have been passed, none of them are being strictly enforced. However some of these laws need further updating.

Water resources depletion

Mongolia's water resources are very susceptible to the pressures of over-utilization for human activity. The increasing water consumption has resulted due to expansion of population, production, and enterprise activities. A considerable waste in the use of water in some regions of the country has also put pressure on the water resources. The deterioration and pollution of water sources near the large cities and settlements has negatively impacted the living environment of human population. Water run off in the Tuul, Haraa and Herlen rivers are decreasing and the rates of pollution in these rivers have exceeded the permissible limits by several times. This has been mainly due to the intensive timber work carried out in the water-feed zone of these rivers without proper management.

It is reported that groundwater tables are lowering over time and some wells and springs are also drying up. These effects are also observed seasonally, for example in Ulaanbaatar, which typically experiences insufficient supply of municipal water system in March or April each year due to lowering of groundwater levels at supply wells.

Water quality is also a problem in many areas. Most cities and large towns do contain centralized sewage collection and treatment facilities. At the beginning of 1990s, 110 treatment plants were operating throughout the country. In late 1980s, 96 % of the total wastewater was treated. However, this has reduced up to 65.6 % in 1995 and up to less than 50 % in 2000 due to lack of maintenance during the economic failure. In 1990, the total amount of wastewater was estimated to be 133.8 million cubic meter. No reliable data is available after 1993 to compare with that of 1990.

Photo 2.13 *Forest patches on the mountain top*

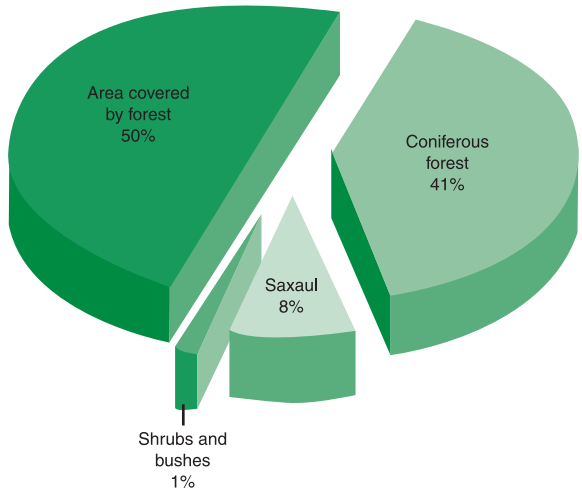


Figure 2.6 *Forest area*
*(**Source:** MNE 2000.)*

Although, about MNT 250 million is allocated from the state budget annually, the problem of water pollution is not decreasing. Negative impact is still felt due to weak control on performance of construction, expansion, and repairs works of water supply facilities.

2.2.3 Forest

The recorded forest resources of Mongolia accounts for about 11.6 % of its land area. Area actually under closed forest is only about 8.1 % equal to about 12.9 million ha. which is a substantial resource compared to that in many countries. The natural regeneration of Mongolian forests is slow, and fires and insects often damage the forests.

Mongolia's forest resources consist of more than 140 species of trees and shrubs and bushes, and it is seen from figure 2.6 that 81.2 % of the forest area is covered by natural coniferous forest, 15.8 % by saxauls (Haloxylon ammodendron), and 3.0% by shrubs and bushes.

Of the total forest land of Mongolia, 91.2 % or 16.68 million ha. is forest area, and 8.8 % or 1.60 million ha is non-forest area.

Of the total forest resources of 1379.2 million m3 in Mongolia , 58.8 % is Siberian Larch, 5.2 % is pine, 7.7% is cedar, 8.8 is Siberian Spruce and Fir, and 16.0% is saxaul. Other species like birch, poplar and willow and shrubs are spread in small quantities as seen in Figure 2.7

Photo 2.14 *Forest Patches*

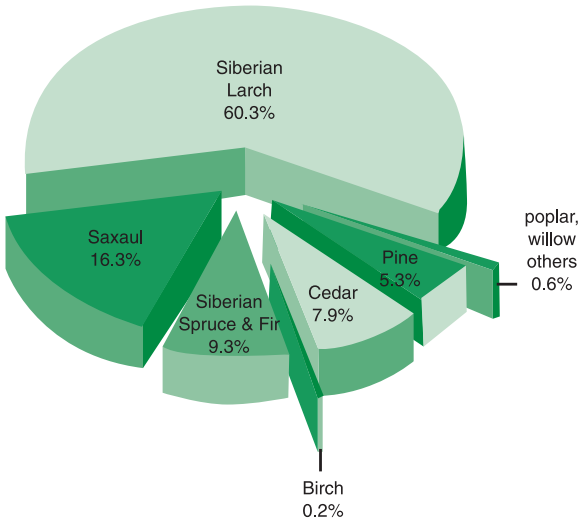


Figure 2.7 *Percentage of species in the total forest land in hectares.*
*(**Source:** MNE)*

2.2.4 Biodiversity

Animals

Mongolian fauna is relatively rich in animal species which inhabit different habitats of the country's variable natural zones, such as forests, steppes, deserts, and high mountains. The Mongolian fauna includes many species which are common in Siberian Taiga, European forests, or West Asian and Triennia deserts. But there are also species which are endemic to the steppe and deserts of Central Asia, and are common in Mongolia. In addition, Mongolia is one of the richest countries in the world by prehistoric remains of various animal species. The species composition of Mongolian fauna is given in Table 2.5.

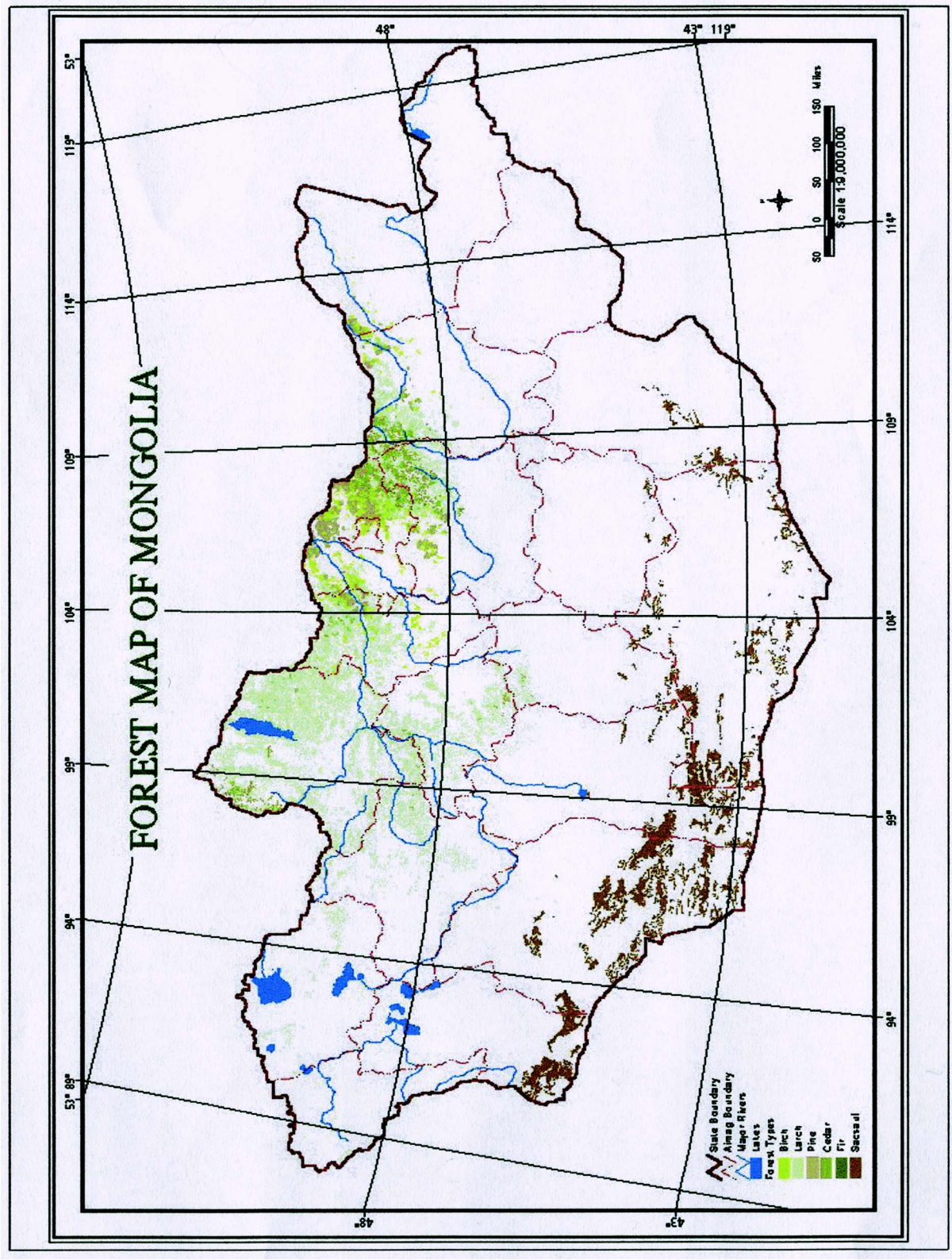
Photo 2.15 *Asiatic Ibex*

Photo 2.16 *Moose found in the taiga and mountain forest steppe regions*

Photo 2.17 *Takhi (Horse of Prejivalskii)*

Mammals: Altogether 138 mammalian species belonging to 73 genera, 22 families, and 8 orders, out of which, 13 are insectivoruos, 12 chiropters, 6 lagomorphs, 69 rodents, 24 carnivores,2 perissodectyls, 1 tylopods and 11 artiodactyls, exist in Mongolia.

Birds: 449 species belonging to 193 genera, 56 families and 17 orders have been recorded so far in Mongolia. More than 330 species from this total are migratory, and the remaining 119 species inhabit Mongolia year round. 322 species nest in spring in Mongolia, and more than 10 species, nesting in the Tundra and in Arctic Ocean coasts, stay over winter in Mongolia. Approximately, 50 species migrate through Mongolia and 20 species are observed here occasionally.



Map 2.5 *Forest area in Mongolia*

Table 2.5: Mongolia's share of fauna in the world species

Animal Species	Number of Mongolia's fauna species	Number of world fauna species	Mongolia's share (in %)
Mammals	138	4,327	3.19
Fish	75	85,000	0.09
Birds	449	9,881	4.54
Amphibians and Reptiles	28	10,500	0.27
Insects	13,000	1,000,000	1.30

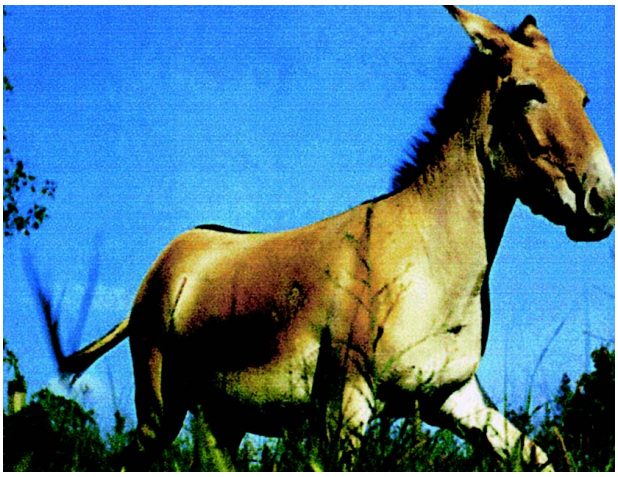


Photo 2.18 *Mongolian Ass*

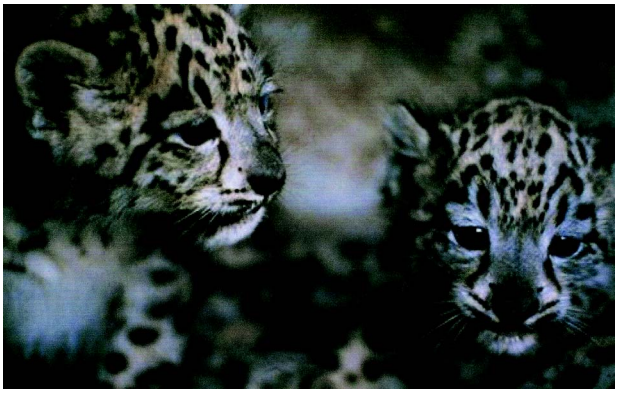


Photo 2.19 *Snow leopard Cubs*

Photo 2.20 *Bird in the steppe region*

Molluscs have also been registered in Mongolia.

Although the study has just started, 456 species of parasites have been found. They include 88 Monogenea species, 31 Trematoda species, 115 species of Cestodea, 201 species of Nomatoda, 18 species of Acanthocephala and 2 species of hirudinea.24 species of Protozoa that live on fish have been registered. They include 1 species of Hymenostomata, 7 species of Peritrichida, 1 species of Parasitomonadina, 13 species of Myxosporodia and 2 species of Coccidiomorpha.

As seen from the table 2.5, Mongolia shares 4.54% of world bird species and 3.19% of world mammal species.

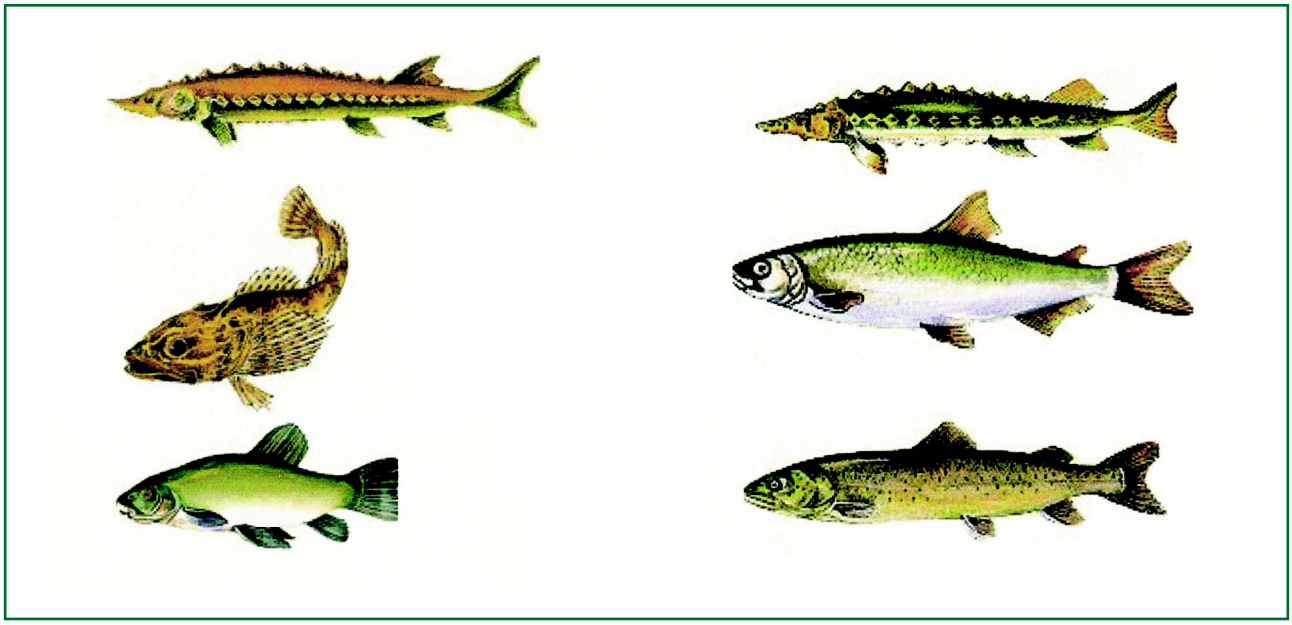


Photo 2.21 *Red Book listed sketches of Fish species of Mongolia*

Plants

Detailed plant collections have still not been made for some regions so it is likely that there are over 3,000 species of flowering plants in Mongolia. Table 2.6 shows the number of vascular and lower plants that exist in Mongolia.

There are 845 species of medicinal plants, 68 species of soil-binding plants, and 120 species of important food plants in Mongolia.

The factors threatening the Mongolian biological diversity are climate change, desertification, forest insects and disease; pasture harmful insects and unsustainable human activities. The Mongolian biodiversity resources have declined in recent years.

Photo 2.22 *Red Book listed Mamals of Mongolia*
Source: *http://www.owc.org.mn/ibook/0019/theredbook/english.html*

Table 2.6: Composition of Vascular and lower plants

Plants	Family	Genera	Species
Vascular plants	128	662	3,000
Moss	59	191	445
Lichen	53	175	930
Fungi	28	136	920
Algae	76	221	1,236

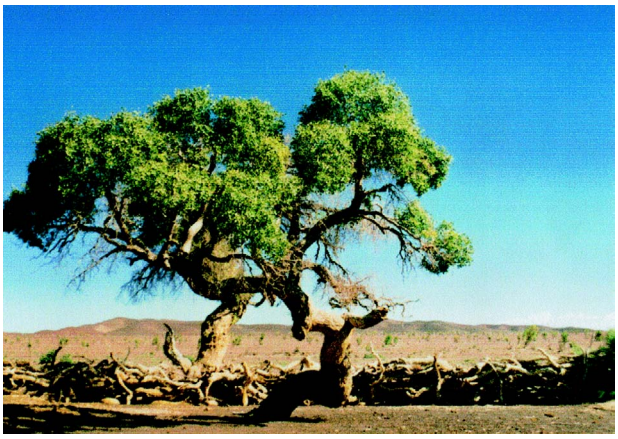


Photo 2.23 *Populus Diversfolia, a rare species tree with different leaves in one leaf*

2.3 ENVIRONMENTAL CONDITIONS

2.3.1 Atmosphere and climate change

The climate of Mongolia is harsh continental with sharply defined seasons, high annual and diurnal temperature fluctuations and low rainfall. Because of high altitude, it is generally colder than other countries of the same latitude. Average annual temperatures are around 8.5^{O} C in the Gobi and -7.8^{O} C in the high mountainous areas. The extreme minimum temperature is -31.1^{O} C to -52.9^{O} C in January and the extreme maximum temperature is 28.5^{O} to 42.2^{O} C.

The annual precipitation is low, averaging 200-220 mm and ranging from 38.4 mm per year in the extreme south (Gobi desert region) to 389 mm per year in limited areas in north. Most precipitation occurs in June, July and August; the driest months are usually from November to March.

Droughts in the spring and summer occur once in every five years in the Gobi region, and one in every ten years over most other parts of the country. Mongolia has an average 3,000 hours of sunshine annually, which is well above the amount received by other countries of the same latitude.

Climate change studies in Mongolia clearly demonstrates that Mongolians should be concerned about climate change resulting from anthropogenic emissions. These studies suggest that during the last 60 years the average temperature in Mongolia has increased by 1.56^{O} C. These temperature increases are stronger in winter months and in mountain areas of western and northern Mongolia than in the Gobi and steppe areas. The maximum temperature increases of 3.6^{O} C were observed in the winter season.

The annual precipitation has decreased over 1940's to mid 1980's, but witnessing increasing tendency since mid 1980's in most areas, except the Gobi desert area. It is expected that the severity and frequency of agricultural drought in the Gobi desert area, and also floods due to rain in the central and northern parts of the country may increase with climate change.

According to the results of studies based on General Circulation Models (GCM) scenarios, in case of Mongolia, the annual mean temperature might be increased by about 1.8^{O} C- 2.8^{O} C in the first quarter of the 21st century with greater increase in winter (1.4^{O} C- 3.6^{O} C) and smaller in summer (1.0^{O} C- 3.0^{O} C). In the second quarter this increase will continue and be twice as much as been predicted for the first quarter. An increase in total precipitation by 20%-40% can also be expected over the same period. According to GCMs scenarios, the prediction of significant increase of precipitation amount in period up to 2040 might be declined in the period between 2040 to 2070.

In general, the changed climate with increased temperature and precipitation amount in 2040's, may be to some extent a pleasant condition for vegetation growth, but during 2070's, the increased temperature followed by the same or decreased precipitation might negatively affect vegetation growth.

It is expected that the natural zones in Mongolia may be changed under climate change. The forest area may be decreased and the steppe zone may move forward to the forest steppe. Also desert may extend its area to the north. Particularly, it has been predicted that the high mountains tundra and taiga may decrease by 0.1%- 0.5% till 2020 and by 4%- 14% before 2050. The area of forest steppe may decrease by 3% in the first quarter of the 21st century, and by 7% in the second. Desert steppe area might decrease by 7 %, while the desert region may extend its area up to 13%.

As the atmosphere is one of the very changeable elements of ecological system a change in it will have negative impact on the level of soil moisture, heat supply, vegetation cover and the habitat of herbivorous animal.

According to the statistics of 1970's, a damage of 5-7 billion Tgs was caused annually because of several natural factors such as: changes in hydrological and meteorological phenomena, natural disasters, and after all, the incidences of heavy snow (i.e. *Zud*) and drought.

During the drought periods in desert zone the wild life and domestic cattle die in large numbers due to depletion of subsoil water level and drying of wells and lakes.

2.3.2 Forest and Steppe Fires

Mongolia is one of the most steppe and forest fire prone countries in Asia due to its low humidity, dry climate and strong winds in the driest seasons. According to scholarly studies, 55.3% of the country's territory is referred to as a forest and steppe fire-risk zone. In particular, a substantial portion of the area covered with forests belongs to a high forest fire risk zone. 98.52% of the forest areas of Mongolia are classified as of 1 and 2 categories of fire risk. Under the conditions of the country, the probability of forest and steppe fires drastically rises in dry spring (from March to May) and autumn (from September to November) periods. Over 60 % of forest fires fall upon April to May months. The frequency of fire occurrence due to human factors has increased during the last few years as seen in Figure 2.8

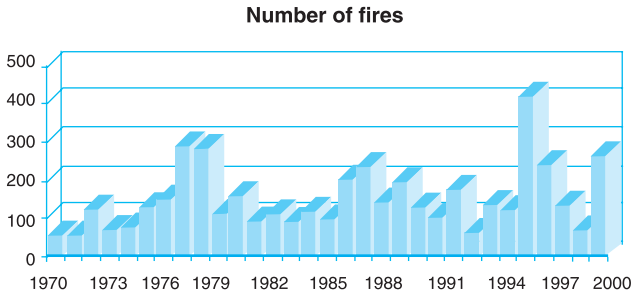


Figure 2.8 *Number of forest fires*

There are many negative impacts due to the increased frequency of fire occurrence such as deterioration of natural resources, changes in soils and pasturelands composition, loss of biodiversity and increase in greenhouse gas emissions.

During the last 10 years, 1833 steppe and forest fires were recorded in Mongolia, which killed 42 people, burned 41.4 million ha. of pastureland and 7.1 million ha. of forest. A typical forest fire is seen in photo 2.24.

In 1996 and 1997, the highest number of wild fires occurred causing maximum damages. In 1996, 417 fires were registered, which affected a forest area of 2.3 million ha. and pastureland area of 7.8 million ha. The damage was estimated to be 1.13 billion Tgs. In 1997, 239 fires occurred in the territories of 98 *sums* of 14

Photo 2.24 *Forest fire*

aimags, which affected a forest area of 2.71 million ha. and 9.73 million ha. of pastureland. Figure 2.9 represent the forest and pastures affected by wild fires.

Maximum number of forest fires occur in spring and autumn due to the increased dry climate. However, careless activities by humans is also a major cause for increase in occurrence of forest fires. In 2000, 264 fire incidences occurred in 96 *sums* of 15 Provinces occupied by steppe and forest The damage caused was over 130.8 hectares of forest, pasture land of 667.8 hectares, and a loss of 471.0 million Tgs of economic entities of the country.

2.3.3 Solid waste

Solid waste management is one of the most serious concerns, especially in the capital city and provincial towns in Mongolia. During the last ten years, the process of urbanization has accelerated due to migration of people from the countryside to settlements including Ulaanbaatar. Solid waste problem is evident in the heaps of waste accumulated on the outskirts of the cities, towns, sums and other populated areas. There are 497 waste dumping sites throughout the country, covering areas of 0.031 million ha. However, the estimates for total generation of solid waste in Mongolia is not available.

In Ulaanbaatar, an average of 0.5 million cu.m. of solid waste is generated annually whereas there is no waste processing system. Wastes are collected from apartments and ger areas on a daily basis and transported to three open dumps in the outskirts of the city. Until 1990, open burning of the waste was used for disposal. However, the practice has been ceased due to the public concerns about the air quality. It is estimated that there are over 200 big and small waste points and over 60,000 open toilets in Ulaanbaatar. Waste composition of Ulaanbaatar is given in Table 2.7 and the wastes generated by different sources in Ulaanbaatar is shown in Table 2.8.

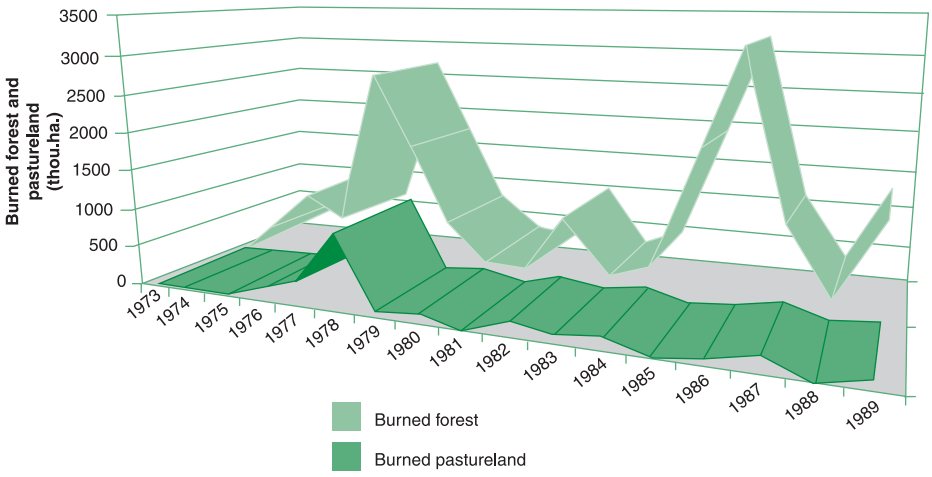


Figure 2.9 *Forests and pastures affected by wild fire*
*(**Source:** MNE 2000)*

Table 2.7: Solid waste composition

Waste type	Percentage (%)
Paper	25.20
Plastic bags and cardboard boxes	9.19
Plastic materials	2,90
Rubber	0.30
Cotton	2.50
Glass	4.41
Cans	5.54
Aluminum	0.44
Copper and Brass	0.25
Metals	2.46
Remains of skin	0.60
Wood and wooden products	1.51
Remains of plants	2.64
Remains of vegetables	2.61
Bones	4.48
Ash	21.38
Powder coal	3.67
Soil and stones	7.96
Others	1.98

Table 2.8: Wastes generated in Ulaanbaatar annually

Waste sources	Tons
Ger areas	86,406
Apartments	45,615
Streets squares and gardens	6,117
Industries and economic entities	30,391
Others	25,844
Total	194,433

Open burning takes place at all the three dumpsites, either by auto-ignition or by the fire ignited by the scavengers for heating or by the disposal crew to reduce the volume of waste. In most cases, infectious hospital waste is burned in open air at special sites on the dumpsites. The smoke from open air burning at these dumpsites is very contaminated and includes relatively high concentrations of dioxins.

There are no adequate treatment facilities for the wastes in Mongolia. Also there are no special treatment facilities for hazardous waste and also for pathological waste generated from hospitals (usually buried at a graveyard) and for infectious waste (this is dumped or burned at the dumpsites).

The Government pays a considerable attention to reduce both waste generation and waste pollution. The Government approved "Waste Reduction Program" which is currently under implementation by municipal and provincial town offices.

Mongolia seeks possible foreign assistance to improve waste disposal in the capital city, specifically in the following aspects:

- build a plant for collection, classification and recycling of urban solid wastes;
- improve supply of special trucks for solid waste collection and transportation; and

- demolish existing waste disposal sites hazardous for human health and establish new special sites for efficient and safe waste disposals.

2.3.4 Natural Disasters

Natural disasters in Mongolia can be classified by their origin as geological (earthquake, soil heaving), atmospheric (drought, zud, etc.) and biological (epidemics, etc.).

Geological disasters in Mongolia primarily are in the form of meteorological hazards such as blizzards, heavy snowfalls, dust storms tornadoes, zud (severe winter conditions), rainfall floods, flash floods and spring floods along with earthquakes. The natural disasters also include forest and steppe fires, droughts, desertification, etc. The classification of natural disasters prevailing in Mongolia is shown in Table 2.9 and also their intensity and occurrence in Table 2.10.

Table 2.9: Classification of natural disasters

Major hazards	Minor hazards
Blizzard	Lightning
Heavy snowfall	Insects (pests)
Zud	Plague
Dust storm	Epidemic diseases
Flood (three types)	Ecological hazards
Earthquake	Industrial hazards
Wildfire	Toxic chemical substances
Drought, desertification	Radiation
	Accident (traffic)

Zud

Zud is a phenomenon in severe winter conditions when livestock begins to weaken and perish in great quantities, as it is unable to have access to grazing. In winter and spring, formation of thick snow cover due to heavy snowfall combined with low temperatures and frequent strong winds prevents access to grazing pasture. This phenomenon is called "*zud*" (severe winter conditions). According to historical data, it occurs mostly during a period from late October till the end of November and late March till early April.The major causes for occurrence of "*zud*" are high frequency of snowfall, coupled with longer duration and enormous amount of precipitation. Duration of snowfall lasts from 24 hours to 2-5 days, sometimes it is as long as for 13 days. During the "*zud*" period the temperatures are low with strong blizzards raging for a long while.

Table 2.10: Comparative intensity and occurrence of natural hazards

Hazards	Intensity (%)		
	High (severe)	Medium	Low
Blizzards	12.7	26.2	61.1
Heavy snowfalls	18.5	29.7	51.8
Dust storms	24.2	26.4	49.4
Zud (combination of severe cold winter with heavy snow)	3.80	13.4	19.2
Rainwater flood	10.9	4.8	54.3
Flash floods	80.0	15.0	10.0
Spring flood (dibaish flood)	80.0	28.0	64.0
Earthquakes			
Forest and steppe fires			
Droughts and desertification	7.6	22.7	20.7

Photo 2.25 *Dead bodies of sheep caused by Zud*

Photo 2.26 *Red Cross relief assistance for the Zud victim herd community*

Magnitude of a disaster caused by *Zud* is evident in the loss of over 8 million heads of livestock, i.e. one third of the national herd of Mongolia in 1944-1945.

As can be seen from the historical sources, zud that extended to more than a half of the country's territory were recorded in 72 B.C., and then in the years of 1308, 1337, 1340, 1450, 1608, 1626, 1821, 1825, 1839,

1884, 1875, 1891, 1901, 1935, 1944, 1949, 1953, 1956, 1963, 1966, 1967, 1987, and 1992. Surveys conducted since 1640 in the eastern regions of Mongolia (former Tsetsenkhan, Tusheet khan *aimags*) show that *zud* events covering over 75% of the territory of the country occur once in 20-22 year-period. However, non- occurrence of *zud* event even in one *sum* is very rare. *Zud* events can happen in any part of the country. There is a 3-year cycle of *zud* occurrence in Khangai-Khovsgol mountain region and Mongolian Eastern steppe, which is regarded to be comparatively snowy for Mongolia. A 10-year cycle in the Gobi-desert region also occurs.

Drought

Over 90 % of Mongolia's territory is referred to as arid, semi arid, moderate arid and moisture deficient regions. 41.3% or 0.647 million square kilometers of its territory is occupied by a Gobian desert region which makes the issue of drought and desertification of special prominence.

Drought regularly occurs once in 10 years in the country's forest steppe and steppe zone and in a 2-year cycle in the desert zone. According to the historical sources, the drought occurred in Mongolia in 68 and 46 B.C. and in years 1248, 1254, 1337, 1372, 1727, 1827, 1952, 1854, 1860, 1882, 1884, 1885, 1892, 1927, 1935, 1941, 1944, 1946, 1951, 1968, 1970, 1972, 1980, 1986, 1988, 1989, 1991 and so on. According to a drought assessment index (derived by D. A. Ped) the drought occurrence shows a tendency to increase in Mongolia since 1940.

Winds and storms

Blizzards

Blizzard is one of most disastrous meteorological phenomenon that in a very brief time causes greatest damages to an economy with grassland animal husbandry (next to drought and desertification phenomenon with respect to its harmful consequences). Damages and losses recorded during post blizzards are given below:

- During a heavy blizzard on April 15-21, 1980 which extended to a half of Mongolia's territory, the wind speed reached about 40-55 meter per second and the blizzard lasted over 60-70 hours killing 43 persons and 0.9 million cattle.
- The blizzard in March 19-22, 1987 that occurred on the territory of Khentii, Sukhbaatar and Dornogobi aimags claimed the lives of 19 people and 37 thousand cattle
- The snowstorm that occurred on January 18-22, 1988 on the territory of Dornod, Khentii, Sukhbaatar and Dornogobi aimags continued for 30-37 hours claiming 6 lives. 114 people who were tendering their cattle had to stay overnight in the outdoors due to which 5 people froze to death, 30 gers (national dwelling) fell down, 3 buildings' roofs were blown off with the wind, nearly 10 thousand head of cattle perished and 720 cattle pens were blocked with snow
- During the heavy blizzard raged on May 5-6, 1993 covering the territories of 6 central aimags of Mongolia, 16 people lost their lives and about 100 thousand cattle perished

Dust storms

Mongolia is regarded as a country where dust storms are rather very common. The dust carried with the winds from the Central Asiatic Gobi desert has definite impacts upon the countries of Eastern Asia. On the other hand, the dust raised and carried away by the wind is considered as one of the major causes of soil erosion. Violent dust storms sometimes hamper the driving of cattle to another pastures and the road traffic. People staying overnight in the steppe are frequently lost and froze to death. The Mongolians call a strong dust storm that can be seen in the Mongolian Gobi as "*ugalz*" (simoom). In the Mongolian Gobi the number of dust days is 30-60 per year. The dustiest place in Mongolia is the Mongolian sand's southern edge where annually the amount of dust days accounts for 660 hours.

On November 27-30, 1991 when a strong dust storm with gusts achieving 28-40 meter per second swept through territories of the country's 12 aimags, approximately 51.5 thousand square km of arable lands were left bared without topsoil so that there were no possibilities for livestock grazing on the pastures. According to the estimates provided by the meteorological institute's research worker D. Jamiyanaa, annually 4,000 tones of sand and dust are being carried away into the atmosphere out of an area of 1 square km in the region of Zamyn-Uud.

Strong wind

Annually strong winds with gusts speed up to over 15 meter per second occur in the Gobian region for 30-76 days, in the steppe region for 30-76 days, in the forest steppe region for 5-15 days, in the Khangai, Khovsgol, Khentii alpine taiga regions for 1-5 days.

Usually strong wind (tornado) is recorded to last for about 1-2 hours in winter and summer seasons and 3-6 hours in spring and autumn seasons. Although, the maximum wind speed exceeds 40 meter per second in the Gobian and steppe region, wind overgrows into a tornado (with speed > 40 meters per second) to occur anywhere on the territory of Mongolia. The wind with maximum speed was recorded on April 16, 1980 in the surroundings of Ulaanbaatar on top of Morin-Uul reaching 55 meters per second. The most disastrous tornado occurred on June 33, 1997 on the territories of Arkhangai, Ovorkhangai, Tov and Bulgan *aimags* with a speed of 28-34 meters per second uprooting many supports of high transmission lines and many gers and damaging properties of more than US $ 100 million to the citizens.

Flood

Floods occurring in Mongolia fall into rainfall, flash and spring floods, which are discussed in following sections.

Rainfall flood

In a rainfall flood, the river waters overflow against its banks due to heavy precipitation in the river's basin region. According to the historical data, heavy floods took place in the years of 1751, 1785, 1800, 1830, 1854, 1864, 1867, 1869, 1897, 1910, 1911, 1915, 1922, 1927, 1932, 1936, 1938, 1940, 1966, 1967, 1972, 1976, 1993, 1995 and 1997. According to hydrological study, the precipitation flood has a 4-6, 9-11, 22-26, 40-50, 67-70 year- cycles.

The rainfall flood causes great damages when it happens in more densely populated areas. During July 11-12, 1966, the water level of the river of Tuul increased by 3.12 meter against its usual level and a flood occurred overflowing the capital city's industrial region. Damages caused were to the tune of 300 million Tgs, i.e. 7.5 million US$ and 130 people lost their lives. In 1993 floods were recorded in Uvs, Zavkhan, Gobi Altai, Bayankhongor, Arhangai, Bulgan, Selenge, Khentii *aimags* when scores of bridges were crushed and many households whose gers were built around the river banks were swept away with the floodwater (the rough estimates of damage were over 1.0 million US$).

Spring flood

It takes place usually in the rivers originating from the Mongolian Altai, Khovsgal, Khangai ranges. This type of flood usually occurs in the spring when following heavy snowfalls the thawing of snow-capped mountains ice and snow goes on intensively and snow melts.

Flash flood

Flash flood is one of natural disasters, which claims an immense toll of human lives. After shower rains in mountainous localities, their quaternary loosen sediments are dissolved and washed away with the rainfall water producing a flash flood. This type of flood may occur anywhere in the country. As shower rains create preconditions for this flood, it is frequently combined with foehn winds and hails.

2.3.5 Hails and lightning

Hails occur frequently in the summer in Mongolia causing considerable damage. Regions most vulnerable to hail and lightning risk are Khangai, Khentii and Khovsgal mountain regions. The information that is available concerning the damages hails caused is not complete. According to the studies conducted in 1994 on territories of Selenge, Tov, Khentii, Bulgan and Arkhangai aimags being the major granary region of the country, the harvest on 23,164 hectares of arable areas was lost due the hail and its economic damage amounted to 713 million Tgs at the rate effective at that period.

On August 4, 1984 hailstones with the size of egg fell in Khentii aimag's Bayan-Adarga *sum* and, as locals evidenced, the soil was actually turned upside down. During a hail fallen on July 31, 1972 in Orkhontuul sum of Selenge *aimag*, local people said that when big hailstones were falling down they heard a whizzing sound as if it were airplanes flying over the place.

On August 4, 1988 a strong shower rain and hail occurred in Nariinteel *sum* of Ovorkhangai *aimag* destroying 4 gers and claiming the lives of 14 people along with a loss of 200 cattle.

Mongolia is working towards prevention of natural disasters through replacement and technological renovation of equipment for weather forecasting information

Biological disasters

Though no fundamental studies have been carried out in respect of biological disasters that occur in Mongolia, they obviously cause substantial damage:

Microtus brandtii mouse: This mouse (Microtus brandtii) being an endemic Central Asiatic species is the major rodent spread over an area of 24 million hectares in Mongolia's Gobian and steppe regions that destroys grassland. The most reproductive period of this mouse which usually happens in arid and dry seasons is registered to have taken place during 1928-1929 and 1943-1944 in Eastern Mongolia, between 1955-1956 on territories of Khentii and Tov aimags, in 1964-1965 in Dundgobi and Ovorkhangai aimags. As was noted by Dr. Davaa (1968), the outbreak of this mouse with its spread to an extensive area occurs every 12-13 years.

Other insects:

1. Grasshopper, dragon-fly and meadow butterfly are widely spread on the pastures and arable areas of Mongolia and big populations of Orthoptera grasshoppers are recorded to be available on the territory of Khovd aimag's Most and Monkhkhairkhan sums. According to the 1984-1994 studies there are 56 subspecies of 35 species of 4 genera of grasshoppers and 12 species of dragonfly in Mongolian Altai's alpine pastures. The area damaged only by Orthoptera grasshopper amounts to 422.94 thousand hectares of 16 sums in Gobi-Altai, Khovd and Bayan-Olgii.
2. A substantial number of harmful pests and insects as the Siberian khur butterfly Dendiolimus superans, biir suult Orgyia antiqua, Jakobson's tooluur Erannis Jacobsoni, larch lynx's khuilagch Zeihplera griseana, etc. are spread in the forests of Mongolia destroying woods and trees. The amount of area destroyed by the swarms of insects is as much as that affected by fires as seen from Table 2.11.

Table 2.11: Area of spread of forest pests (000 hectares)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994
Area	26.6	32.2	24.0	27.0	33.1	25.2	29.1	32.6	135.0

3. Such diseases as plague, rabies, brucellosis, smallpox, meningitis and the like could turn into epidemics. Of them most serious consideration should be given to plague. Many ecologists believe that there is a cycle including such stages as: 'drought and aridisation' - 'outbreak of parasite pests' - 'development of epidemics' - 'people infected'. The plague is spread from the natural locus zones of this disease, among them are the Eastern steppe, middle steppe, Ovorkhangai's Baidrag-Tui, Bogd-Buyant, Khankhokhii-Bulnai, Kharkhiraa-Turgen, Siilkhem, Tsengel-Tsambagarav, Khokhserkh-Monkhkhairkhan (B. Avirmed et al., 1993). The plague occurrences recurred in the middle of the 1940-1950s and since mid 1960s till the 1990s its occurrence has been high.

Earthquakes

The entire territory of Mongolia pertains to be in an active seismic zone. Earthquakes of magnitude over 6 on Richter scale are recorded in Mongolia for more than 40 times during the last two decades. Earthquakes of magnitudes higher than 8 occurred in the 20th century only. Some of the major earthquakes occurred in Mongolia in the last century are presented in Table 2.12.

Table 2.12: Large-scale earthquakes in the last century

Location	Year of earthquake	Location		Magnitude (Richter's scale)	Intensity in epicenter
		Latitude	Longitude		
Unegt	1903	43.3	104.8	7.5	10
Tsetserleg	1905	49.5	97.3	7.6	10
Bulgai	1905	49.2	96.8	8.2	11-12
Mongolian Altai	1931	46.8	89.9	8.0	11
Shand	1950	51.8	100.1	7.0	9
Gobi-Altai	1957	45.0	100.5	8.1	11-12
Bayantsagaan	1958	45.1	98.7	6.9	9
Buur khyar	1960	43.2	104.5	6.7	9
Mogod	1967	48.1	103.0	7.8	10-11
Uureg lake	1970	50.3	91.3	7.0	9
Takhiin shar	1974	40.5	94.0	6.9	9

2. 4 SOCIAL AND ECONOMIC DRIVING FORCES

2.4.1 Energy

Mongolia being one of the countries having severest climatic conditions in the world, power supply has an important role to play in its economy. Apart from mining of 4,951.2 thousand tones of coal 2,078.1 million KWH of electrical energy and 6,456.8 thousand GCal of heat were produced in Mongolia in 1997.

The large geographical area of the country and its low population density makes the provision of energy services a very difficult task. This problem is unlikely to be solved for many years to come. The Central Energy System (CES) covers 6 provinces and 4 cities including the capital city.

During 8 months out of a year, the people of Mongolia need energy for space heating because of extreme cold climate. The need for heating translates in a relatively high-energy consumption per capita and per unit of GDP. In the cities of Ulaanbaatar, Darkhan and Choibalsan, there is a district heating system in operation that also provides domestic hot water. Mongolian people have been using fire for heating and cooking purposes for thousand of years. Wood and coal are used to generate fire. However, nowadays coal is used in towns and cities, whereas wood is mostly used in the countryside.

During the last decade, burning of wood has become one of the most serious and urgent environmental concern in the country. About 8 % of the territory of Mongolia is covered by forest that is only available in northern part of the country. People

living in steppe, Gobi and desert areas face serious shortage of fuel. It is acute especially in Gobi and desert areas. In the Gobi, people often use saxaul which is the only forest species growing there. Because of severe destruction of saxaul for fire-wood (energy producing purpose), desertification takes place in many areas. This is an urgent energy driven environmental problem existing in Mongolian Gobi between environment and energy.

The Government of Mongolia has given the top priority to development of the energy sector. The poor condition of most of the existing power plants and coal mines and the possibility of serious breakdown of power and heating facilities are of considerable concern to the Government because about half of the population live in urban areas and they rely exclusively on heat supplied from the central systems for their survival in the harsh winter conditions. Moreover reliable supply of energy is an essential prerequisite for economic growth. Apart from the concerns of improvement in energy efficiency and the reduction of environmental degradation, reduction of electricity imports is also viewed as a priority.

Asian Development Bank provided technical assistance to Mongolia for a Power System Master Plan Study in 1994 to provide the framework to coordinate the development of the power sector. Its major components were to review the forecasts for heat and power and prepare an integrated, least cost development program up to 2015 taking into account the energy resources available, and severe fiscal constraints which would limit power system reinforcement and expansion. The Power System Master Plan assists the Government to ensure the optimal use of scarce capital and physical resources, to ensure the efficient development of the power sector and to provide a framework to coordinate external assistance for the sector.

Centralized power supply: The electricity and heat sub-sector consists of an interconnected electricity grid (the Central Energy System-CES), district heating networks, and isolated systems. The main interconnected electricity grid supplies power to about one million people, and covers 30 % of the total land area. The electricity distribution network of the country is shown in the Table 2.13.

Table 2.13: The distribution network for electricity

Existing situation	New proposals (to be build by 2020)
Over 1,200 km long 220 kw high transmission lines	2,000 km long 220 kw high transmission lines
About 2,000 km long 110 kw transmission lines	1,700km long 110kw transmission lines
330 km long 35 kw transmission lines	7,000km long 35k transmission lines

Photo 2.27 *Thermal power plant for electricity and heating system for Ullanbatar*

Nine *aimags* receive electricity from the CES, and supply it to around 100 *sums*. Electricity supply in the remaining 12 *aimags* is decentralized (around 225 *sums*). At each of the 21 *aimags* there are Energy Utility Organizations (EUO), which operate the energy plants and provide electricity and heat to residential, commercial, administrative and industrial consumers. Tables 2.14 and 2.15 show the installed capacity of the thermal power plants.

Table 2.14: Installed Capacity of Thermal Power Plants in CES System

Power Station	Boilers (MW)	Turbine Generators(MW)	District Heating (MW)	Industrial Steam (MW)	Installation Year
Ulaanbaatar					
TES 2	80	21.5	52	65	1961-1969
TES 3	1148	148.0	640	163	1968-1982
TES 4	2450	540.0	1238	147	1983-1991
Subtotal	3678	709.5	1930	375	
Darkhanv	477	48.0	291	49	1965-1966 1985-1986
Erdenet	318	28.8	215	24	1987-1989
Total	4773	786.3	2436	448	

Table 2.15: Available Capacity of Thermal Power Plants

Power Station	Gross Electrical (MW)	District Heating (MW)	Industrial Steam
Ulaanbaatar			
TES 2	14.4		
TES 3	85.0	1.188	143
TES 4	354.0		
Darhan	24.0	177	8
Erdenet	18.0	131	8
Total	495.4	1.496	159

Decentralized power supply: The rural electricity and heat systems, irrespective of system size, consist of diesel generators for electricity supply, and coal-fired heat-only-boilers (HOB) for providing district-heating services. The capacity ranges from 60 kW generators at the smaller *sums* to multi-MW facilities at the *aimag* centers.

Eleven provinces are supplied by isolated diesel generation plants, and Dornod *aimag* (town of Choibalsan) is supplied by a coal fired combined heat and power plant (all decentralized). Table 2.16 indicates the installed and available power capacities in *aimag* centers in Mongolia.

Table 2.16: Installed and Available Power Capacities in aimag centers

Aimags	Electricity (MW)	
	Installed (MW)	Available (MW)
Ulaangom	9.2	7.1
Hovd	12.9	9.2
Olgii	5.5	4.0
Altai	9.8	7.1
Bayanhongor	7.1	5.1
Dalanzadgad	8.4	6.2
Mandalgobi	4.8	3.6
Moron	10.5	7.8
Uliastai	10.4	7.1
Ondorhaan	6.4	4.8
Baruun-Urt	6.4	5.3
Choibalsan	36.0	14.0

Isolated diesel generation plants in *aimag* centers and small diesel generators in *sum* centers provide electricity to their respective centers only. *Aimag* centers typically serve a population of between 13,000 and 29,000 people and electrification ratios are relatively high at between 64%- 92%. Per capita electricity consumption in Mongolia is low at between 250-400 kWh/year. *Aimag* centers typically have between 7-15 diesel generating sets each with a capacity of between 700 kW - 1800 kW. Most units are between 10-15 years old.

Diesel plant electrical utilization factors have been low during the last few years when diesel fuel supplies have been interrupted and ranged between 17% and 19%. Electrical efficiencies are reasonable and varied between 25% and 35%, although most *aimag* centers achieved at least 31% efficiency.

With the exception of Choibalsan, demand for district heating in aimag centers is met from small fired 'heat only' boiler plants. Boiler plants range in capacity from 200 kW to 16 MW and between 4 and 20 boiler plants (not necessarily interconnected) serve each town.

In the countryside, the situation of nomadic herders families with electricity supply is worse. Today about less than 10 % of herders is supplied with either renewable energy or small-scaled diesel generators. However, these sources of energy are used for only lighting or TV needs.

Renewable energy sources: Although the vast territory of the country does not allow to rapidly expand the CES, it has a potential to develop renewable energy resources, especially for small groups of population as well as for nomadic herdsmen in the countryside.

There is no doubt that air quality control is the most significant environmental issue associated with power generation. The most effective method of resolving existing and improving future air quality in Mongolia is to maximize the use of alternative, non-polluting energy sources that can be implemented on a cost-effective basis.

In Mongolia a variety of alternative energy sources are potentially available, each at different stages of development. Many may only be feasible for smaller installations in rural areas, or small cities or towns, rather than in a central power grid. Those alternatives need to be considered in order to minimize the need to potentially expand the central grid by developing smaller regional grids.

Mongolia is located in a region with abundant sunshine, typically between 2250 to 3300 hours each year. It is estimated that the southern part of the country receives a daily average insulation of between 4.3 - 4.7 kWh/m^3/day. Using photovoltaic modules, there can be efficient use of solar energy. Small-scale photovoltaic systems were introduced to Mongolia in the early 1980s as part of several UNDP projects to promote the use of renewable energy sourcse in rural areas. Several thousands small (9-40) photovoltaic systems have since been installed in Mongolia, mainly for nomadic livestock herders to supply their modest lighting needs.

There has been little systematic assessment or monitoring of the wind energy resource potential in Mongolia. According to meteorological data, the annual mean wind speed in the South East of the country is in the range of 4 to 5 meter per second, which is marginal in terms of potential cost competitiveness with other technologies, with the exception of very small (50 W) wind generation systems for remote areas.

As is the case for solar energy, there is considerable potential to supply the many nomadic livestock herders in the Gobi desert with small portable wind generation systems. Mongolia is in the process of developing portable wind turbine generators for use by nomadic herders in rural areas. Presently over 2 000 units are installed for 90-100 W of energy generation. Most systems are 50 W units but 100- 200 units are of 100 W capacity.

Hydroelectric power: Hydroelectric generation is one of the major alternatives to traditional combustion based generation capacity. It can potentially provide significant base load capacity without resulting combustion emissions and fuel supply environmental effects. Mongolia is currently constructing a 160 MW hydroelectric facility (Egiin Gol). A number of other promising hydropower sites have been identified in Mongolia predominantly located in the Selenge and Hovd basins.

Biogas: Biogas generation may have potential application in urban areas with associated sewage treatment plants, and potentially in the ger villages found in some urban areas where central sewage collection and treatment facilities are not provided. Although on a smaller scale, the technology also has potential application in rural areas where herders handle large numbers of cattle, horses and sheep. Mongolia has begun exploring the use of biogas generation for this application and should expand investigation of its efficient and extensive use in other applications.

Geothermal resources: Geothermal resources in Mongolia have not been investigated in detail although previous investigations have identified some 40 small hot springs in Central and Western provinces. Only at one location, near the Shargaljuut spring in Bayanhongor province, hot water is being used for the heating requirements of a health resort and greenhouses.

2.4.2. Transport and communications

There is a single 1,815 km-long main-line railway and an additional 200 km of feeder lines and side-tracks in Mongolia. Railways shared 93.4% of freight turnover, 71.2% of carried freight, 47.1% of passenger turnover and 2.0% of carried passengers.

There are over 4,000 kms long motor roads in Mongolia of which 3,325 kms are improved roads, 1,471 kms are with hard cover. Motor transport shared 6.4% of freight turnover, 28.8% of carried freight, 33.9% of passenger turnover and 97.9% of carried passengers. Of the state owned roads, there are 15600 meter-long bridges with height over 30 meters across the rivers; of which 6100 meters are constructed from reinforced concrete and the rest are wooden bridges (whose operation term is already expired and they fail to meet appropriate technical requirements). About 3,500 km long new asphalt paved roads are planned for developing the motor road network of Mongolia.

The Mongolian electrical communications network's main line's length is 12,266 km and length of the lines linking *aimags* with *sums* is 39,408 km. The radio relay lines are about 3,971 km in length.

2.4.3 Agriculture

Agriculture remains key sector in the Mongolian economy. About half of the total population of the country live in rural areas. During the current transition period (and economic failure) many factories, plants service entities in rural areas have been closed. As a result, the number of herdsmen families has substantially increased. Between 1989 and 1998 the number of herdsmen families has increased from 68,900 to 187,100. Migration from the countryside to big settlement areas has also increased.

Agriculture in Mongolia has been the key economic sector long time and will be the same for many years ahead. As of 2000, agriculture employed 48.5 % of the total work force, contributed towards 35.1 per cent of GDP and 30 per cent of total export products.

Animal Husbandry

Livestock breeding is the key traditional and ancient economic sector in Mongolia. As of 2000, this sub-sector produced 88.8 % of the total agricultural products and one quarter of the total export products.

The number of live stock has steadily increased since 1990. As of 2000, the number of livestock reached to 30.0 million heads, compared to 25 million heads in 1990. Figure 2.10 shows the increase in livestock heads. Photo 2.28 shows camel as main livestock.

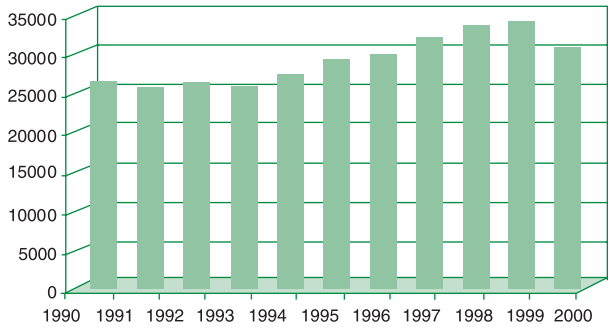


Figure 2.10 *Increase in livestock heads*

Photo 2.28 *Camels as main livestock*

As a part of the livestock, horses, cows and goats have increased rapidly whereas the number of sheeps and camels have decreased. Between 1990 - 2000, goats increased by two times, horses by 17 % , cows by 8.3 %, and sheeps and camels decreased by 9.2 % and 66.7 % respectively. Figure 2.11 shows the numbers and types of livestock.

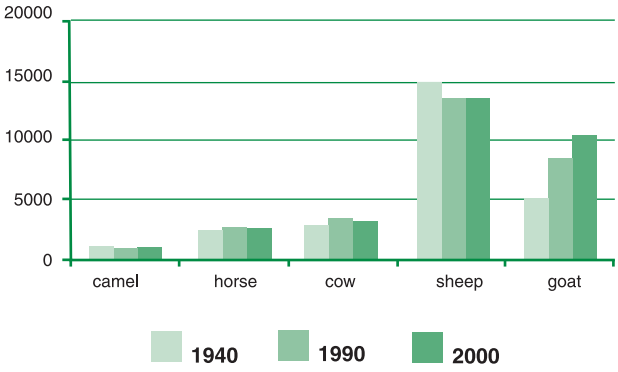


Figure 2.11 *Number of livestock*
*(**Source:** National Statsitical Office)*

Photo 2.29 *Cow used for meat and dairy purpose*
*(**Source:** E. Erdenebayar)*

The reasons for the increase in numbers of livestock are privatization and substantial decrease in meat export. The increase in the number of goats, which contributes to about 80 % of the increase in the total number of animal, is directly related to market requirement of cashmere. However, in 2000 the number of goats decreased by 803 thousands of heads due to fact that market price of goat skins with cashmere increased rapidly. The composition of livestock is shown in Figure 2.12.

Farming

Mongolians have little tradition of farming. Intensive farming started only in the late 1950s. The Government policy on meeting the domestic needs has yielded about 1.3 million ha rotational farm land. Mongolia practices crops that are harvested once a year due to its harsh climatic condition and high altitude.

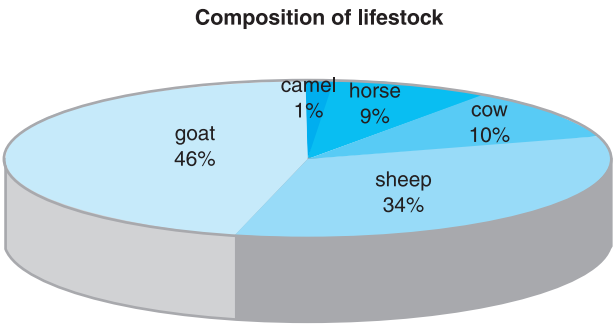


Figure 2.12 *Composition of livestock*

Between 1986 and 1990, farming was done in 0.645 million ha areas, of which 0.5 million ha was used for wheat production, 0.011 million ha. for potatoes and 0.0035 million ha. for vegetables. During this period Mongolia fully met the domestic needs and even exported the above products.

Since 1990, crop and vegetable production has dramatically decreased. As of today Mongolia uses one quarter of the rotational farm land, which supplies only 50 % of domestic needs of flour. Mongolia imports 60-90 % of potatoes and vegatables from abroad. In 2000 crop production has decreased by 5 times, of which wheat reduced by 4.2 times and potatoes by 2.2 times. Only production of vegetables have increased by 5.2 % compared to that in 1990. Crop production over last decade is shown in Figure 2.13.

The main reason in reduction of Production was decrease of farm lands

2.4.4 Mining

Currently, 15-20 % of GDP and 50 % of the country's total exports have been contributed by the mining industry. As of December, 2000, there were 1329 deposits licensed for exploration and 439 deposits licensed for utilization. As of today, there are over 200 operating mines of which 111 are gold mines, 24 metal mines, 34 coal mines, 15 salt mines and remaining belong to other categories. Mining outputs for the last 10 years are shown in Figure 2.14.

In 2000, 110 mining entities have affected 839 ha. of land, of which 426 ha of land was rehabilitated.

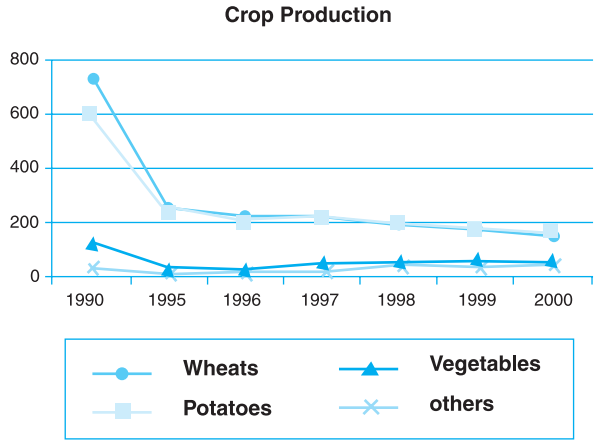


Figure 2.13 *Crop Production (in thousand tonnes)*

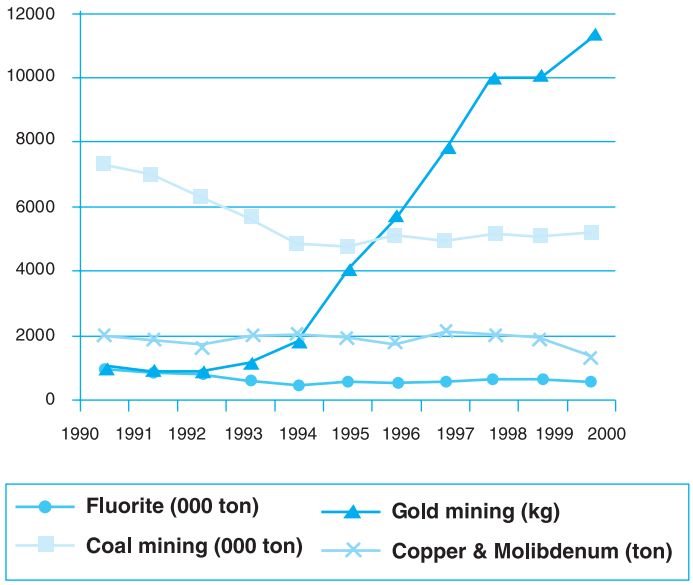


Figure 2.14 *Mining product outputs*

Oil: Mongolia has made contracts with companies from USA, Canada, Australia and China to explore oil in its territory. By now, in total 528,450 sq.kms of area has already been explored. Of the 10 contracted oil fields, Dornogobi and Tamsag oil fields are most promising. About 44,104 barrel of oil was exported to China in 2000.

Fluorite: There are 6 fluorite mining companies, namely Bor-Undur, Berh, Har-Airag, Zulegt, Orgon, and Hajuu Ulaan, mine which produced about 597.1 thousand tons of fluorite in 2000.

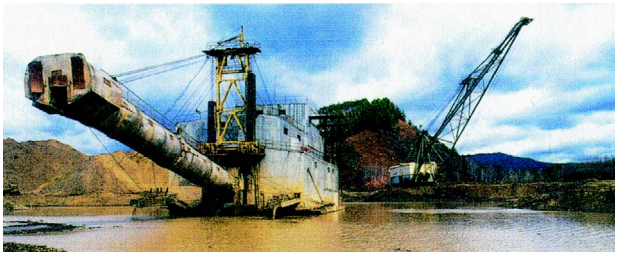


Photo 2.30 *Mining Operation uses heavy machinery*

Gold: There are over 150 licensed gold mines in Mongolia, of which 111 operated in 1999 and mined out approximately 10 tons of gold.

Coal mining: There are 40 coalmines in operation producing approximately 4.9 million tons of coal annually.

Copper and Molybdenum: Erdenet copper mining factory is one of the 10 biggest in the world. Its annual production of copper ore is 22.23 million tons with an extraction of 0.126 million tons of copper and 0.0019 million tons of molybdenum. Many other metals and minerals resources deposits including silver, lead, zinc, iron and uranium are under exploration.

2.4.5 Poverty

The extensive poverty in Mongolia has emerged in the context of a fundamental restructuring of its policy from a socialist to a market economy since 1990. The evolution of the transition process has lead to the specific character of the deprivations that poor people face. During the period of transition there has been a sharp decline in the standard of living and even sharper rise in the extent of poverty, estimated to affect about one-third of the population in 1994. In order to find solutions to the challenges faced by poor people, the Government of Mongolia formulated a plan of action in partnership with academia, professionals, NGO and other civil society organizations in the country, and partners of international cooperation.

As a response, in 1994 a National Programme for the Alleviation of Poverty (NPAP) was designed as a multi-sectoral poverty reduction programme with the main goal of reducing poverty from the officially measured rate of 36.3 % to 10 % of the population by the year 2000.

The Government is committed to provide substantial financial support to NPAP to ensure its success. National Poverty Alleviation Council has also been established to oversee and monitor the implementation of NPAP. At the same time, the Local Poverty Alleviation Councils chaired by Provincial Governors have been established in all the provinces.

Within the NPAP, a new mechanism has been established, i.e., the Poverty Alleviation Fund or PAF. This mechanism covers activities pertinent to all components and reflects fully the operational principles pursued for the NPAP as a whole.

However, substantial decline in poverty has not occurred in spite of so many programs including the NPAP. Although the actual implementation begun in 1990s, the official poverty rate was still 35.6 % at the end of 2000.

As of today, 41 % of the poor lives in aimag centers, 23 % in *sum* centers, and 12 % in the capital city. The typical settlement of ger in the countryside is seen in photo 2.18. Households headed by single mother account for 23.6 % of all poor households.

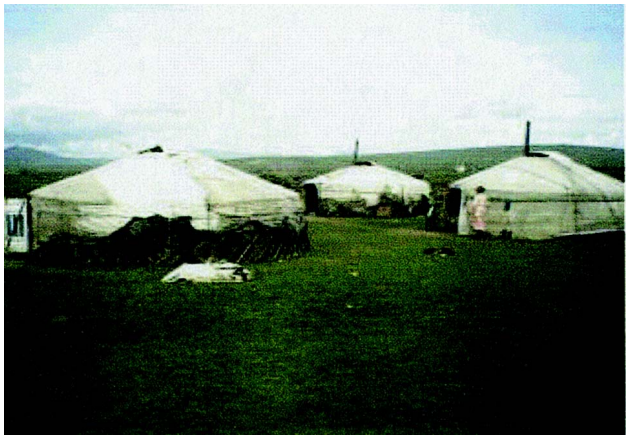


Photo 2.31 *Ger- typical settlement in the countryside of Mongolia*

2.4.6 Public Health

Number of diseases are increasing due to the worsening environment in Mongolia. Air, water and chemical pollution causes majority of diseases, especially in urban areas.

Air pollution is probably the most serious problem in Ulaanbaatar, especially during winter time. Incidences of respiratory diseases grow dramatically during heating period.

There is a marked deterioration in the quality of water drawn from wells. Disposal of the household wastes, animal manure, fertilizer, and solid wastes in drinking water sanitary zone pollutes the well water. Water from 10% of the wells (used by population for drinking and household needs) is not of the drinking quality and is beyond hygienic and safety standards.

Diseases like jaundice and dysentery have been increasing by 2.3 and 1.4 times respectively over the last few years. This can be attributed to the high level of environmental pollution, poor quality of water supply and lack of awareness about public hygiene.

Quality of water used by 38.5% of total population settled in towns and villages throughout the country for drinking and domestic use is unable to meet safety standards and sanitary requirements.

Water in many places of Mongolia is extremely hard. More than 80 *sums* in 16 aimags have difficulties with regard to the quality and composition of drinking water. Although there are more than 100 sewage treatment facilities with the total design capacity to clean 131 million cubic meter of water, more than half of these facilities do not function properly.

There are 120 waste water treatment plants operating throughout Mongolia. The effluent from these is unable to meet the standards due to the difficulties they experience with maintenance of worn out equipment, high cost of maintenance and repairs. As of 1995, some 35% of domestic wastewater and industrial effluent was released to the environment untreated.

Although there are no permanent large-scale sources for radioactive contamination in Mongolia like nuclear power stations, but it is strategically situated between two nuclear powers, namely the Russian Federation and China. So far, there is no relevant information concerning the consequences of nuclear tests made during the 1960s on the territories of Kazahkstan and China.

According to the general assessment made by the National University's Radiation Control Laboratory with respect to the rate of radioactivity in the atmosphere over Mongolia, it is established to be equal to 12-17 mcrad/hours. The content of radon in the atmosphere is about 2.2 bc/m^3 in the summer but in the winter with the start of heating season it is recorded to be twice of the summer. The complex beta activity of the atmosphere is likely to grow to 2.4 mbc/m^3 in the winter from 0.5 mbc/m^3 in the summer. After the Chernobyl nuclear plant accident in 1986 it rose to 264 mbc/m^3, which was as much as 200 times in comparison with the normal background and only after 25 days it was registered to drop to its usual rates.

The utilization of large quantity of coal (in Baganuur, etc.) could have potential impact on air environment and human health.

During the last few years increasing number of chemical substance and products are being used in Mongolia. In 1990 about 1,000 kinds of chemical substances were used in Mongolia. According to a survey carried out in 1994, around 1,297 enterprises and business entities have used 3,774.3 tonnes of chemical substances of 2,765 kinds (including more than 10 thousand pharmaceutical substances and preparations). About 52.4 tonnes of chemical substances waste were disposed in open land fill sites, 68 tonnes were released into the atmosphere, 790 tonnes into the water and 600 kinds of chemical substances were released in the soil. Apart from this, over 100 tonnes of chemical substances, which fail to meet relevant requirements for use, were being stored in warehouses. According to the national standards, the chemical substances currently in use have potential to affect human health. About 350 kinds of substances affect the nervous system, 720 are harmful for the skin, 650 have asphyxiating effects, 543 affect emotionally (fear), 130 affect the mental faculties, and about 2,300 have general impacts. During the last decade 8 cases have been registered of large-scale poisoning related with the application of chemical substances or their storage leaving 587 people sick and 17 persons dead.

The storage and protection of chemical substances has been inadequate. For instance, out of total chemical substances used on the country, about 56.7% are stored in properly designed warehouses, 20.8% in warehouses

not designed for this purpose, 11.7% are kept outdoors, and 9.8% lie in offices and premises. In Ulaanbaatar toxic substances like chlorine and ammonium hydrates are stored in large quantities. A greater attention has to be paid towards handling and disposal of these toxic substances.

Tables 2.17 and 2.18 show main causes of morbidity and total number of diseases linked to environmental quality in Mongolia.

Table 2.17: Leading causes of morbidity

Name of diseases	Number of cases	Rate per 100,000 population
Diseases of respiratory system	201,501	8,293.19
Diseases of digestive system	119,969	4,937.57
Diseases of genito-urinary system	113,045	4,652.60
Diseases of circulatory system	69,798	2,872.68
Injuries and poisoning	57,784	2,378.22
Mental and behavioral disorders	28,153	1,158.69
Diseases of skin and subcutaneous tissues	29,865	1,229.16
Infectious and parasitic diseases	27,405	1,127.21
Diseases of ear and mastoid process	18,191	748.69

Table 2.18: Prevailing diseases linked to environmental quality

Name of diseases	Number of cases	Rate per 100,000 population
Respiratory diseases	144,184	1,237
Diseases of digestive system	16,296	85

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PART III KEY ENVIRONMENTAL ISSUES

3.1 LAND DEGRADATION

3.1.1 Introduction

Although Mongolia is considered to be one of the few countries that have maintained its and wildlife, there have been significant changes in the quality of its land resources. The reasons for the changes include; the traditional methods of land use have changed, the altitude is comparatively high, the vegetation is not dense and is short, the climate is harsh and dry, the growing seasons are short, and the soil is thin and light. These problems are exacerbated because no serious land protection measures have been taken in spite of intensive use of land for traditional uses, particularly grazing. Mongolia can no more afford to continue with traditional extensive or open approaches to the use of the land.

3.1.2 Pressure

Causes of land degradation in Mongolia can be divided into two categories: human- induced and natural causes.

Natural causes include droughts with frequency of 2-3 years, natural drying, deficit in soil moisture, very thin layer of fertile soil, specifics of mechanical composition of soils, and strong wind in spring and autumn and dust storms.

Human causes include effects raised from rapid development of farm land, mining industry, changes in traditional livestock husbandry, and overgrazing, specially around settlement areas and water points.

Farmland degradation in Mongolia is one of the serious issues, which should be urgently tackled. A considerable amount of farmland has been degraded or abandoned because of slow action on transferring farmlands to individuals and economic entities for their long-term use or possession. As of today, most of the farmland is out of use and abandoned.

Producing over 50 % of the country's total exports, mining is one of the rapidly growing and leading industrial activity in Mongolia. Mining is causing substantial soil destruction. No proper rehabilitation measures are being taken by enterprises during or after mining.

Along with the reduction in number of water points in the pastureland, the traditional pastureland use is experiencing a change. There is a high chance of pastureland depletion as herders have started to live near the wells and springs with large population of animals. About 3.5 million ha of pastureland is considered to be badly deteriorated and another 5 million ha is deteriorated moderately. Consequently, improper use of pastureland causes soil erosion and reduction of soil humidity and therefore natural vegetation and process of soil revitalization are endangered.

Overgrazing is particularly severe near settlements and administrative centers where herdsmen are settling in order to have access to markets under the new free-market economy. Increased freedom of movement has resulted in people moving to better grazing land, especially in the central regions, that are now becoming overcrowded. Particularly, near Ulaanbaatar there is severe overgrazing due to the increase in numbers of cattle owned by city residents, from 180,000 in 1990 to 280,000 head today, exacerbated by cattle being driven to market from distant *aimags*. Traditional grazing-land management was abandoned during the years of the cooperative campaign, even then, large numbers of cattle were kept near the administrative centers without consideration of carrying capacity.

3.1.3 State

Total land area of Mongolia is 156.5 million ha of which 118.4 million ha (75.8%) is capable of agricultural production and pastoral livestock production. Cultivated land occupies 1.35 million ha of the total land area. Over 57% of total arable land is located in the north-central *aimags* (provinces) of Tov and Selenge and the northeastern *aimag* of Dornod.

The *aimags* forming the arid Gobi region of Mongolia have only 1% or less arable land. Amount of arable land in other *aimags* ranges between 1.1% and 9.5%. Arable soils are characteristically dark chestnut soils that are typical soils evolved with steppe vegetation. Organic matter content is 3% to 4% with pH ranges from 6.0 to 7.0. Soils are shallow (average depth of 30 cm) even in the crop producing aimags of Tov and Selenge where conditions are most suited for intensive agricultural production. In these *aimags,* only valley bottomland and lower slopes of hills are cultivated because of greater soil depth and higher soil moisture retention. Principal crops produced on cultivated land are cereal grains (wheat has comprised approximately 80% of total cereal grain production since 1960; other cereals are barely, rye and oats which are used primarily as green chop silage for feeding dairy cattle), potatoes and vegetables.

Native pastureland suitable for pastoral livestock production occupies 117.147 million ha. High mountain (including alpine) pasture types comprise 27.1% of total pastureland area and occur primarily in the northwestern and north-central *aimags*. Grass steppe pasture types comprise 22.8% of total pastureland area and occur primarily in the northeastern and north-central *aimags*. Desert-steppe pasture types comprise 19.5% of pastureland area and occur primarily at lower elevation in the northeastern *aimags* and in the northern part of the southern Gobi *aimags*. Desert pasture types comprise 19.4% of grazing land area and occur primarily in the southern part of the Gobi *aimags* along the border with the Inner Mongolian Autonomous Region of China. The distribution and occurrence of the major pasture types in Mongolia have in the past provided optimal conditions for implementing pastoral grazing management strategies.

As of today, 126.3 million ha or over 70 % of the total pastureland areas have been degraded. The total area of the damaged or depleted land is estimated to be 121.7 million ha of which 91.7 million ha are eroded by the combination of wind and water, 21.1 million ha eroded by water, 1.0 million ha are considered damaged, and 7.9 million ha are covered by sand as a result of human activities. About 8.6 million ha of pastureland has been severely degraded due to intensive use of pasture all around the year.

Photo 3.1 *Overgrazing and uncontrolled activities initiate the degradation process*

Almost half million ha of land which has been used for agriculture during the last 40 years has eroded and the fertility has decreased by 20 %. The size of pastureland damaged by grasshoppers reached 0.423 million ha of land and plants in these areas are becoming extinct. Due of mismanagement or improper use of farmland, soil fertility is often lost or destroyed by even single windstorm or flood event.

3.1.4 Impacts on Environment

Land degradation has caused substantial impacts on to agricultural production, especially crop yield and animal production. Crop yield has also reduced due to fact that the farmland soil fertility has decreased by about 20%. Wheat yield has now reduced to half compared to that of in 1980s.

As a result of overgrazing, Mongolia's over 30 million livestock lack pastureland. The lack of pastureland has resulted in malnutrition, loss of livestock heads and in reduction of animal products, there by affecting the country's economy.

3.1.5 Policy Responses

Protection of land resources from degradation or depletion has always been a key issue for consideration by the Mongolian Government. Several initiatives with regard to control the land degradation are discussed below:

- The Central Committee of Mongolian People's Revolutionary Party and the Counsel of Ministers jointly adopted two resolutions: one in 1974 on "Urgent measures to protect soil from erosion", and the other in 1981 on "Introduction of soil protection system in farm land management".
- During the implementation of these two resolutions, the old destructive technology of farming was replaced by new advanced one, which has saved substantial amount of soil from loss. Forest belts were built around many farmlands. The use of farmland has shifted to that on rotational basis.
- Mongolia is working towards implementation of projects to reduce land degradation and erosion by
  - Rehabilitation of land resources affected by mining operations; and Combating desertification and sand movements
- In1995, Mongolia adopted a package of Land Laws to regulate land relations in market economy conditions.
- While these laws are enacted, Government of Mongolia has started a process to renew land policies and is providing innovative land policies for sustainable management of land resources. To realize the new innovative land policies, the Government has re-drafted "Land law" and "Law on Land Fees" which are endorsed by the Parliament on 7th June 2002 (communication with MNE, 7th June 2002).
- The " Law on Land, 1995 " has specific provisions towards land use protection in its articles such as-
  - Article 51: Pasture, its rational use and protection
  - Article 52: Rational use and protection of hayfields
  - Article 53: Rational use and protection of cultivation areas
  - Article 55: State Certificate on land characteristics and quality and its procedures. According to this, the state certificate shall include following indicators:
    - Thickness of fertile soil layer;
    - Contents of decomposition;
    - Soil pollution and chemical pollution;
    - Changes in vegetation cover;
    - Changes in land surface characteristics; and
    - Changes in the composition of pasture and hayfield plant species, etc.

3.2 DESERTIFICATION

3.2.1 Introduction

Inadequate environmental protection has lead to desertification and degradation of land in Mongolia. However, environmental protection does not mean keeping all natural resources out of use and not use them for national economic and social development.

Mongolia signed the "UN Convention to Combat Desertification" in 1996 and ratified it in 1997. The Government of Mongolia approved National Action Plan to Combat Desertification by its resolution 193 in 1996. Although adoption of the National Action Plan is only one among all required measures, which need to be taken, it however, is a clear example of government's special attention to desertification problems.

Researchers and scientists have estimated that 90% of Mongolia's territory is vulnerable to desertification. Causes of desertification can be divided into two categories: i) natural causes and ii) anthropogenic causes. Researchers estimate that only 13% of the desertification is caused by natural factors whereas anthropogenic factors have contributed towards 87 % of all cases.

3.2.2 Pressure

Climatological variations are a major cause which may lead to natural disasters that, through interaction with human factors, will lead to accelerated degradation at local level. For instance, desertification in the Gobi ecological zone is reported as being caused primarily by increasing aridity of climate and livestock grazing.

Though world community might have accepted climatic changes as a reality, it is difficult to analyze its appearance at specific locations such as in Mongolia. Results of research presented at two recent workshops of a Mongolian-Chinese network of meteorological scientists suggest a rise in temperature and precipitation. Other scientists claim, however, that drought is a cyclical phenomenon, but that its duration may have become longer and deeper.

Anthropogenic causes are:

- Overgrazing- In Mongolia, ecologically degraded pasture exists primarily as a result of livestock concentration and other causes associated with human activities. In some locales, livestock grazing is the cause of degradation of land resources due to the attempts to intensify human activities and livestock production around water sources. Cultivation of marginal soils to produce livestock supplementary feed and reduction of areas capable of producing high forage yields by conversion to marginal human food crops have added to the problem. It is also apparent from observations of Mongolian pasture resources that major areas of pasture remain in relatively pristine environment condition relative to vegetation composition and structure and stability of the biological system. Livestock induced degradation of biological systems is most pronounced at locations where climatic, topo-edaphic, vegetation, and human influences create 'convergence' of rate factors that lead to accelerated degradation. With some exceptions, even areas most degraded appeared to be ecologically capable of responding to livestock management strategies thatreduced concentration of livestock.
- Wind and water erosion of cultivated soils and abandoned farm lands;
- Intentional burning;
- Vehicle tracks: This may seem negligible in a vast country like Mongolia, but it can easily be observed that most valleys are marked by the formation of these tracks. The vegetation is very vulnerable to (even one passage can be seen for a long time) the tracks. Both factors are combined to drive gully erosion that often starts at tracks, thoroughly changing the hydrology and productivity of entire valleys.

Rodents and insects also cause serious damage to natural vegetation, notably in forest lands, which in combination with other negative factors has aggravated the situation.

Degradation caused by anthropogenic factors is common to all ecological zones of Mongolia. Cropping induced soil erosion, disturbances from mining and industrial activities, and deforestation are most prevalent in the forest steppe and grass steppe ecological zones. These also have great and fast impact on stability of biological systems in desert steppe and desert ecological zones. Although, degradation from livestock grazing, trampling and vehicular disturbance of vegetation and soils are spread throughout Mongolia, the effect is much more severe in the desert steppe and desert ecological zones (because of the nature of soils and lack of moisture). The generally arid nature and unstable soils makes the two ecological zones susceptible to anthropogenic degradation, not only in actual impacts but also in limiting opportunities to stabilize or reverse the rate of degradation.

As one of the world's most arid region, Mongolia has the high rate of drought occurrence. Mongolia's central and southern regions are the most affected regions by droughts. In these regions, over 40-50 days with arid conditions are recorded in a year. Droughts are frequently observed during the first stage of plants' growing period. The most drought-prone region of Mongolia is the Gobian desert region where severe droughts occur once in 2-3 years. Though uneven and with lesser frequency, the drought occurrence is also observed in the forest and steppe zone. Annual trend of increasing occurrence of drought in Mongolia is being observed.

3.2.3 State

Mongolia is a country, which experiences serious drought and desertification. More than 40% of the territory is composed of arid and desert areas, 70% of which are degraded (a recent report estimates that 21% of the country is moderately affected by degradation, and 4% severely to very severely). Information obtained from the Botanical Institute of the Mongolian Academy of Sciences indicates that most *aimags* have a high percentage of pastureland with moderate and high degradation. However, degradation of natural grazing land is less apparent in traditional, extensive pastoral livestock production areas. Both an increasing frequency of drought and an increasing rate of desertification in combination with effects of climate change severely affect arid and semi-arid areas, leading to degradation of pastureland.

Current desertification has three main aspects including:

i) desertification of vegetation cover,
ii) desiccation of wetland ecosystems and
iii) increase of sand area.

Other aspects of desertification include decrease in soil fertility and wildlife population, which are not always noticed by the people and are not properly studied.

41.3% of the country's total territory (including 19.5% of Gobian and 21.8 % of deserts) is occupied with Gobian deserts. The extent of soil erosion and degradation of the territory of Mongolia is divided into three categories as follows:

a) pasture occurrence and desertification ;
b) erosion in Arable areas; and
c) lack of forests, etc.

a) Pasture occurrence and desertification: It is observed that towards south, yield output is lower from the grassland whereas, the forest and steppe zone's yield output is as high as 3-18 times than that in the Gobian region. Most of Mongolia's pastures being erosion-prone are likely to be affected by desertification. One third of the total grassland areas are prone to degradation and erosion.

In the Gobian desert, the rate of desertification is low for 76% of region, moderate for 20%, high for 3% high and extremely high for 1%. The territory within 15-16 million ha in the surroundings of the large cities, settlements and wells is highly exposed to erosion and degradation.

The amount of areas covered with sand has increased in 1990 by 18 thousand ha as compared with that of 1941. With the area of sand increasing and new sand dunes appearing, the process of desertification keeps on extending further. Since 1942, a total of 60 wells and 160 cattle pens have been sand-drifted. It is seen that the process of sand shifting to the Gobian pastures is intensifying.

The area covered by sand in Mongolia has increased by 0.038 million ha (8.7%) during the last 40 years. Sandy areas make up about 90% of the Gobian desert region. A decrease by 25-33% of the discharge of such rivers as Baidrag, Taats, Tui and Ongi, and over 80 small rivers and streams, their tributaries, flowing from the north to the south in the Gobian zone is recorded. It is the major cause of drying up of 5 Gobian lakes.

The water deficiency in the arid dry Gobian region has affected negatively the vegetation cover as seen in the lowering of yield output substantially and decrease in the plant diversity. Over 1 million ha of pasture areas are exposed to erosion and the grassland yield in 1990s decreased making up just a half of that recorded in 1960.

b) Erosion in Arable areas: The total amount of arable areas has risen during the last 30 years as much as 10 times, constituting 1.34 million ha. The arable areas are highly exposed to erosion and degradation. According to the study carried out in 1991 covering 90% of the total arable areas (1,206.4 thousand ha), the erosion rate of 46.5% was moderate. As the arable areas continue to be affected by erosion and degradation processes, their fertility rates diminishes. The amount of organic substances (humus) has been reduced by 29.3%-48.7% in the erosion-exposed areas. At present, more than half of the total arable areas are left fallow. Around one million ha of land has been covered with vehicles tracks and around 0.6 million ha of land has been severely eroded due to military and technical activities.

c) Lack of forests: Just 8.1% of the country's territory is covered with forests. During a period from 1974 to 1994 the forest area has shrunk altogether by nearly 6 million ha which was associated with the logging activities, impacts of pests and frequent forest fires.

3.2.4 Impacts

The signs of degradation in Mongolia include the classical signs of desertification and land degradation observed in other areas of the world prone to desertification. It includes signs such as dramatic increase in number of dust storms in recent years, increase in flash floods, decrease in yields of agricultural produce, declining fertility rates in livestock, increase in deforested and denuded land, decrease in biodiversity, and lowering ground water tables, etc.

As desertification continues to affect more land, it is now very critical that over 70 % of pastureland has been degraded and depleted, vegetation growth rate has already decreased 5 times, and the number of plant species has reduced by 6 times.

As area of pastureland has decreased by 6.9 million ha during the last 30 years, the yield from severely degraded pasture has decreased by 5 times.

The declining productivity leads to increased pressure on the remaining resources and migration into urban areas. The tendency to return to a rural life style during the onset of the transition period has been reversed as noted in the past.

3.2.5 Policy Responses

Identifying desertification as a major cause leading poverty and hunger, UN Convention to Combat Desertification (CCD) was developed and signed by many countries affected by serious desertification. Mongolia signed the Convention in 1994 in Paris. The CCD calls for all signatory countries to address the problem of desertification in their countries by drafting a national Plan of Action to Combat Desertification. Apart from UNCCD, economic transition, political change, and over exploitation of natural resources, particularly, the rangeland, made it necessary for Mongolia to develop and implement a National Plan of Action to Combat Desertification (NPACD).

Within the context of UNCCD, the preparation of the NPACD as the basis for obtaining external assistance and mobilizing internal assistance is the first phase of the implementation of the Plan itself. The Ministry of Nature and Environment of Mongolia is the government body to implement both the Convention and the Action Plan through its National Committee to Combat Desertification.

Efforts to combat desertification in various degrees are reflected in over 20 programs and action plans like Ecological Concept, Mongolian Action Program for the 21st Century (MAP-21), National Water Program, National Program on Forestry, National Program on Natural Disasters Reduction and well as in Government Action Program 2000-2004.

The NPACP has three implementation phases:

- First, focusing on creating legal environment to strengthen relations between central and local government organizations, and policy coordination on decentralization;
- Second, aiming to create desertification monitoring capacity, identify areas being severely degraded, and to weaken desertification process; and
- The last phase is dedicated to complete all required activities and to strengthen national capacity.

Other measures to combat desertification include:

- Study of physical, biological and socio-economic factors of desertification and creation of information-monitoring network: Scientific institutes of Mongolian Academy of Sciences and the Institute of Meteorology and Hydrology are conducting scientific studies on desertification factors. Several projects have been or are being implemented on vegetation cover of deserted areas, ecosystem features, climatological factors, and water supply;
- Information and monitoring on desertification is being incorporated in hydro meteorological and satellite monitoring andinformati on network;
- Strengthening of national capacity and organizational structure: National Committee to Combat Desertification consisting of 11 members, representatives of different ministries, scientific community and NGOs are established;
- National Center to Combat Desertification has recently been established at the Institute of Geo-Ecology;
- Mongolia has been designated a country to be in charge of the implementation of the theme " Drought reduction and strengthening of capacity to combat desertification" within the Convention to Combat Desertification;
- Public participation and awareness raising: Broad range activities have been conducted to involve people in combating desertification and to raise awareness among local communities;
- Two International Seminars have been conducted in cooperation with the Secretariat of the Convention to Combat Desertification in 1995 and 1997. A series of national seminars have also been conducted at both national and local levels to raise public awareness;
- International cooperation: Mongolia has already concluded 7 intergovernmental and over 20 interministerial agreements with neighboring and other countries to protect the environment. Many of these agreements have important provisions cooperate in combating desertification. Since 1990, there are 14 projects being implemented with total costs of US $ 24.6 million with assistance of international donor community;
- Since desertification was severe due to cutting of saxaul for household purposes in the whole Gobi region, it is now prohibited for logging, and only local community is allowed to cut saxaul for firewood in areas where they live;
- As of today, about 20 million seedlings and 7-8 million seeds are planted in the 40 permanent nurseries annually for restoration purposes.

3.3 DEFORESTATION

3.3.1 Introduction

Unlike forests located in more temperate or tropical climates, the growth rate of Mongolia's forests is slow because of the relatively harsh Central Asian climate with its dry and windy characteristics and short growing season. The climate conditions also result in a dryer forest cover, which could be highly susceptible to fires.

The forests in Mongolia grew mainly along the southernmost fringe of the Great Siberian boreal forest and the Central Asian steppe desert. It played an important role in maintaining naturally balanced water conditions in rivers and streams. It also helps in prevention of soil deterioration, amelioration of the climate, control of the greenhouse gasses, reduction of harmful emissions, and preservation of permafrost in its ecologically important form. As closed forests cover accounted for only 8.1 %, Mongolia is included into the group of countries, which has low forest resources as determined by the FAO.

Forests resources in Mongolia have been increasingly degrading over the past few years, due to timber cutting, forest fires, pests and diseases, causing severe ecological stress in some regions. It has also affected the social and economic conditions.

3.3.2 Pressure

Since 1972 Stockholm conference, reforestation has been successfully carried out by the forestry entities and timber companies in Mongolia. During this period number of nurseries equipped with technical facilities such as tractors, vehicles, tracks and other required tools have been established.

One of the causes of forest depletion in Mongolia is forest fire. The number of forest fires varies from year to year, but it has been occurring each year. Areas affected by forests fires during the last ten years are shown in Figure 3.1.

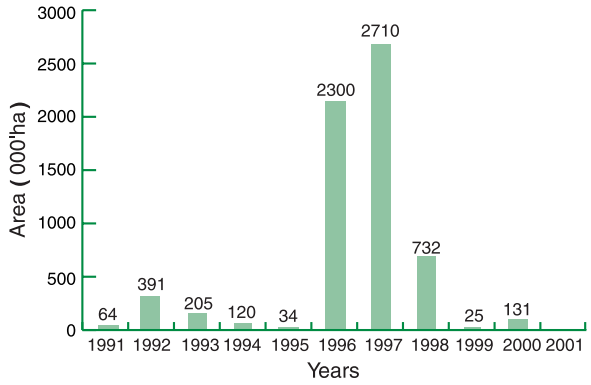

Figure 3.1 *Areas affected by forest fires, 1991-2000*

Mismanagement of pest control also has led to deforestation, pests are spread over 400,000 ha. of forest area and forests over 300,000 ha have already loss their ability to grow. There have been over 700 species of forest pests registered in Mongolia, of which 315 species belonging to 168 genera and 56 families have banned spread every year. Till 2000, pests spread over 1.2 million ha of forests land. Figure 3.2 shows the forest affected by pests between 1991-2000.

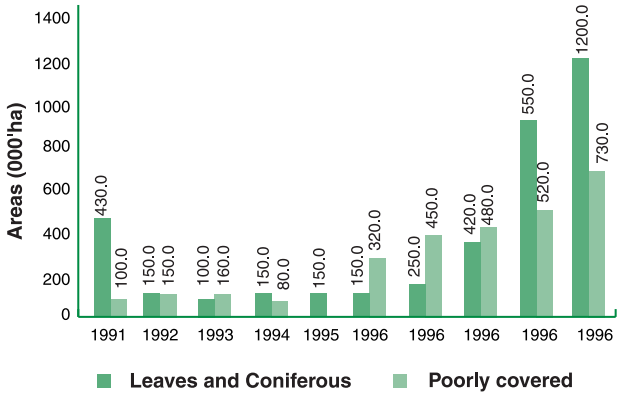

Figure 3.2 *Forest areas affected by pests between 1991-2000.*

Since 1990, when Mongolia's economy started receding, big timber factories split into smaller ones and presently there are about 500 small forestry entities in operation. This coupled with increasing environmental concerns, led to reduction of timber export. During 1980s average timber export in Mongolia was approximately 2 million cubic meter per year, and in 1990s, it reduced to about 0.8 million cubic meter a year. Figures 3.3 and 3.4 show the details of timber preparation and exports.

Photo 3.2 *"Logging operation, Tsetserleg, Arkhangai Aimags"*

Poor management and outdated technology has led the timber industry to use of only 60 % of the total harvested timber in a profitable way. Harvesting practices have been wasteful and inefficient. The country uses 1.3 million cubic meters of wood and about 1000 tons of saxaul a year as fuel.

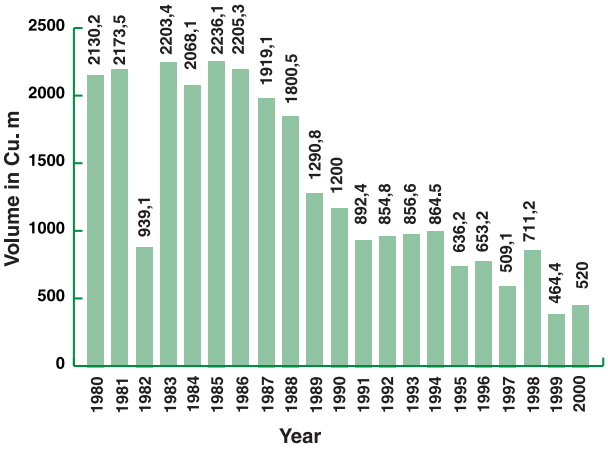

Figure 3.3 *Timber preparation (last 20 years)*

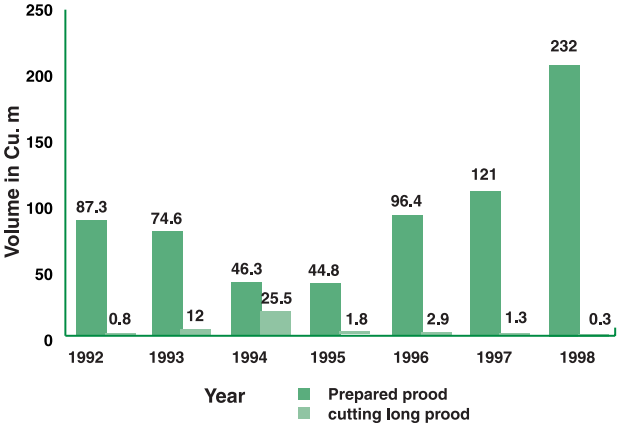

Figure 3.4 *Timber export*

3.3.3 State

Presently total forest cover in Mongolia is 13 million ha (less than 10 % of the total land area), of which the area for potential commercial forestry is about 5 million ha. The forests estate comprise of about 10 million ha of natural coniferous forest, 3 million ha of saxaul forest in the desert regions, and just 1200 ha of forest belts and plantations. Around 10 % of the forest cover has been lost in the last 20 years due to inappropriate logging and forest management, unregulated cutting of domestic fuel wood and fire and insect damage.

The forest plays a crucial role in the protection of soil cover and water resources. In Mongolia, it primarily consists of conifers and saxauls, which are distributed unevenly in the country and mostly found in mountainous areas.

Management of the forest resources in Mongolia suffered from several weaknesses, such as unregulated over-use and inadequate protection. Impact of human interference over the years has resulted in deforestation and forest degradation. Some 1.6 million ha of forests have been lost during the period 1974-2000 due to fire, overgrazing, mining activities, improper as well as illegal logging.

Annual afforestation was low, compared to the area of critical land to be reforested and the reported annual rate of deforestation. Quality of forest plantations was poor, mainly due to lack of adequate maintenance and care.

On the production front, the annual volume of logging has fallen from about 2.2 million cubic meter in mid-1980s to 0.5 million cubic meters in 2000. It has been influenced by many factors, like institutional and policy changes, privatization of production enterprises, decentralization of decision powers, reduction in the area designated as utilization forests by reclassification into protected areas and prohibition of clear felling in the natural forests.

The wood based industry in Mongolia was an important economic sector, which at its peak level in 1985, employed more than 20, 000 people, and accounted for 18 % of the industrial production of the country. The sector has now collapsed, due to problems related to difficulty in procuring raw material, old and outmoded machinery and technology lack of spare parts of equipment and low quality and high cost of production. Employment in wood industry has fallen to about 3,000. The contribution of the forestry sector to the GDP has gone down from 6 % in 1989 to just 0.32 % in 2000.

During the last 10 years the institutional base and structure of forestry section has changed several times and it has lost its identity as a sector. Responsibility for forestry sector has been split, fragmented and scattered in different ministries, agencies and departments.

According to statistics, about 5.8 million ha of the forests land have been damaged by fires during 1996-1998 and lost much of their ecological significance. At present, 0.15 million ha of forests land urgently needed to be restored. Only about 5000 ha are being restored annually depending on the financial capacities of the states. At this rate 25 years would be required for reforestation of the damaged 150,000 ha. In order to strengthen actions to restore areas damaged by fire, establishment of nurseries in Khentii *aimag* and Ulaanbaatar city has been planned based on the grant from the government of Hyogo province, Japan.

The survival of replanted forests within their first year ranges from 60% and 90 % depending on the weather conditions. Restoration, inventory and maintaining services such as watering and cleaning out from the weeds are required in the replanted forests during the first 2 years.

3.3.4 Impacts

The problems of dwindling forests and its ecological consequences have been severely felt in the form of flash floods, lowering of groundwater level, spread of desertification and loss of biological diversity. Although these problems arising from deforestation have been real and critical, there was no estimation available in Mongolia. The impact of illegal cutting trees has also been increasingly felt in the last 3 years. Enforcement of forests laws and related National programs needed to be implemented.

3.3.5 Policy Responses

A legal foundation for forests protection in terms of the proper utilization of forests products and restoration was created through the enactment of the "Law on Forests" in 1995 and the "Law on Protection from Forest and Steppe Fires" in 1996 passed by the Parliament of Mongolia. Furthermore, the enforcement

of the "Law on Levying Fees on the Harvest of Timber and Firewood" strengthened the implementation of these two laws by creating an economic incentive for conservation of forests. According to these laws, not less than 70 % of income from timber harvesting shall be used for the protection and restoration of forests, as well as, for the prevention of forest fires and for the control of harmful insects in the forests.

The above laws have been supplemented by around 30 important regulations and resolutions including "Rules for Forest Management", "Rules for Estimation of Damage caused by Forest and Steppe Fires", " Procedures for collection, stocking and selling Forest Seeds" and "Instructions on Timber Felling".

At the same time, forest protection policies were formulated in the three fundamental documents. - "Basic Orientation of the Government on Ecology", 'National Action Programme to Combat Desertification" and "National Action Programme on Protection of Biodiversity". Accordingly, annual plans have been made on implementation of these laws and put basic guidelines into practice.

With the reforestation activities, the national experts, specialists and forest engineers have developed new technologies on collection of the standard seeds and their replanting processes. They have also established the first replanted forests and forest strips in the country. Presently reforestation has been carried out in capacities of replanting over 20 million standardized seedlings and in the 0.005 million ha a year. Afforested and reforested areas have been presented in Figure 3.5.

Reforestation activity in Mongolia was started in 1971. During the period of 1972-1998 the reforestation was carried out in 0.076 million ha areas in the country and 50 % of it was replanted young forests. Although the positive results were shown to the activities, some of these replanted forests have been damaged by fires, infectious diseases, and grazing by the livestock. So far, an area of about 0.084 million ha has been planted However, the replanted areas have reduced due to the reforestation that faced other problems such as increasing cost of products, use of outdated equipment and facilities, and less interests of professionals in the field.

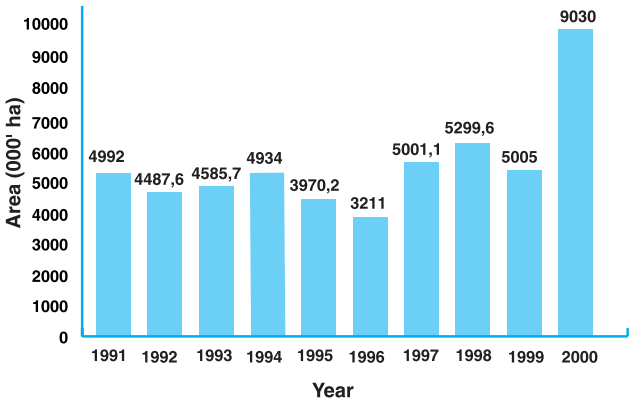

Figure 3.5 *Afforested and reforested areas, 1991-2000*

The Mongolian Law on Forests, 1995 deals with protection, proper use and restoration of forests. It classifies the forest resources according to their ecological and economic importance into- Strict forest zones, Protected forest zones Utilization forest zones

The protection measures include provisions for fire protection, protection from disease and harmful insects, cleaning of forests and control on prohibited activities and harvest volumes.

The Law on Fees for harvest of forest timber and fuelwood regulates the fee requirements for harvest of forest timber and fuel wood by citizens, economic entities and organizations.

3.4 LOSS OF BIODIVERSITY

3.4.1 Introduction

Mongolia's territory ranges from the super-arid desert in the south to moist Taiga forest in the north, and from rolling steppe grasslands in the east to alpine terrain and glaciated peaks in the west. This varied terrain contains a wide array of ecotypes; many exhibiting unique characteristics found nowhere else on the globe. This unique, varied, and substantially undisturbed territory supports a wide diversity of living organisms, many of which are endemic to Mongolia. Mongolia harbors the last remaining populations of a number of species internationally recognized as threatened or endangered, including the snow leopard, Argali sheep, wild ass, saiga, bactrian camel, mazalai bear, and others.

However, Mongolia's biodiversity resources are facing substantial and increasing threats. Factors like Mongolia's growing population, coupled with urbanization, economic development, and an increasing per-capita demand for natural resources, have resulted in expansion and intensification in land use by people and domestic animals, and in increasing pressure to develop and utilize the country's natural resources. At the same time, the recent transition from a centrally controlled economy to a free market economy has opened the country's natural resources to free enterprise and market forces. Increasing economic activity such as mining, land cultivation and crop farming, and the production of wild and domestic animal products for internal consumption and export, have resulted in the disturbance hitherto undisturbed natural areas and the loss of wildlife habitat. Inadequately controlled or illegal hunting, and predator eradication programs also contribute to pressures on wildlife and on the natural balance in many areas.

Mongolia seeks to sustain and escalate to the extent possible the standard of living for its people through economic development and growth of free enterprise. However, it also recognizes the importance of its biodiversity heritage as a significant component of the world's overall biological diversity, as an economic resource, and as a source of spiritual enjoyment for people.

3.4.2 Pressure

Loss of biodiversity can be attributed to many factors as discussed below:

Climate change: The continuation of global climate change has already had a negative impact on soil moisture, temperature, vegetation cover and the habitats of herbivorous animals. During the last 50 years or so, the average annual temperature in Mongolia has increased by 0.7^0C. This drop in the average temperature has resulted in a variety of changes including serious impacts on the growth of natural and cultivated plants. The annual growing season in Mongolia lasts for only about 120 days which is not sufficient for the stable growth of plants, and if the growing season becomes shorter, many plant species will be threatened with extinction and this condition will pose a threat to the survival of many herbivores.

Desertification: Desertification deteriorates the environment and reduces its biological resources. It worsens the environment and conditions for the normal propagation of plants, hence reducing resources for rare animals and plants in the desert and desert-steppe zones.

Harvesting: Nomadic herdsmen and urban Mongolians utilize wildlife in a variety of ways, including direct use of meat, skins, and other animal products. Other activities include commercial marketing of skins, commercial marketing of fish and fish meat, large-scale harvest of gazelles for the commercial market (till mid-1990s), and sport hunting of game and trophy species by Mongolian and foreign sportsmen.

Some 59 mammal, 128 bird, and 30 fish species are utilized for commercial purposes and for direct subsistence. According to government estimates, over 2 million terrestrial animals are harvested annually. Commercial exploitation of fish began in the mid-1950s, with the main fishery industries located on Boir, Buun Tsagaan and Ugii lakes. It is estimated that fish product reserves are approximately 3000 tons, distributed among the country's largest 20 lakes.

Marmot is the animal, which is harvested, in a large quantity every year. According to the rough estimates, there 0.7-1.3 million of marmots were harvested during 1999-2000.

Foreign hunters harvest some valuable and rare animals every year on special licenses. In 2000, 40 Argali, 259 ibex and 69 gazelles were licensed for foreign hunters, and 50 saker falcons were exported alive.

Over 100 species of medicinal plants are used for producing about 200 medicines.

In the crop sector, strip cultivation is practiced on about 170.0 ha. Arable land used during last 30 years, became a subject to erosion and deterioration. The plant diseases, insects and weeds are spread due to outdated methods of farming and traditional methods of crop protection and cultivation.

Industrialization: Since the 1960s, the increasing use of energy, construction of new power stations, and the intensive use of strip mining methods have seriously been contributing to the deterioration of the habitats of various species.

As of December 2000, across the country, 1329 economic entities obtained licenses, 429 obtained utilization licenses, and 110 entities conducted mining exploration. Of the 839 ha of land eroded during utilization, only 426 ha of land has been restored. 10.4 tones of gold was mined from an area of 5796.3 ha and in the process 1148.4 ha of land was eroded.

3.4.3 State

Although research regarding the plants, insects and animals of Mongolia is not yet completed, preliminary studies indicate that there are over 3,000 different species of plants in Mongolia, out of which 845 are medicinal ones, 68 are soil-strengthening plants, and 120 are edible plants. The mammals living in Mongolia include: 14 species are animals feeding on insects, 12 species with wings, 4 species of rats, 3 species of hares, 65 species of rodents, 22 species of carnivorous animals and 14 species of hoofed animals. Of 426 different species of birds, 108 are transitory birds, 74 species are non-migrant and 231 species are migratory birds.

The Mongolian Red Data Book lists 7 mammals, 6 birds, 2 amphibians, 4 reptiles, 2 fish, and 17 plant species found in Mongolia as endangered. There only about 25-30 heads of Gobi bear and 400-1500 heads of Bactrian camel left in Mongolia according to recent inventories. The status (number) of other key animal species is given in Table 3.1.

Table 3.1: Status of key animal species

Species	Number
Gobi bear	25-30
Bactrain came	l400-1500
Saiga	5280
Elk	40 000
Rain deer	662
Argali sheep	3059
Ibex	10700
Wild Ass	17172
Gazelle	2 000 000
Sable	200

Threats to biodiversity identified in the ecoregion include overgrazing, deforestation, poaching and illegal trade of endangered species, mineral exploitation, construction projects, and uncontrolled tourism.

3.4.4 Impacts

Political and economic developments in the 20th century have accelerated through urbanization, industrialization, and privatization. Economic opportunities are abundant here, but their realization presents a potential threat to biodiversity. The tremendous social and economic upheavals in recent years have also put pressure on traditional lifestyles. This development has been accompanied by serious environmental degradation. Current socio-economic difficulties have also led to a sharp decrease in the funding available for activities of nature conservation.

3.4.5 Policy Responses

Since 1994, Mongolia has concentrated its efforts on the establishment of a legal foundation to regulate on biodiversity protection and its wise use. In 1995 and 1996, the "Law on Natural Plants", "Law on Plant Protection", "Law on Hunting", "Law on Fees for Harvesting Forest Timber and Fuel wood", "Law on Natural Plant Use Fees", and "Law on Hunting Reserve Use Payments, and on Hunting and Trapping Authorization Fees" were adopted.

In addition, over 20 Regulations and Resolutions have been endorsed to support those laws. In 1996, Biodiversity Conservation Action Plan was adopted in Magnolia.

Today Mongolia has designated 48 protected areas, which cover 20.5 million ha of territory in 19 aimags (roughly 13.1 % of the whole country's territory). Also, 115 areas encompassing 1.13 million ha of land are under local protection. According to a scientific survey, about 40 % of the area that is home for threatened and endangered wildlife and plant species, has been taken under state special protection. Mongolia is expected to extend the Protected Areas Network and improve the management of these areas. This is needed in order to safeguard its statement of contributing to global environment protection by subsuming 30 % of its total territory in the Protected Areas Network, which it made at the UN Conference on Environment and Development in Rio in 1992. The typy of protected areas of mongolia are shown in Figure 3.6.

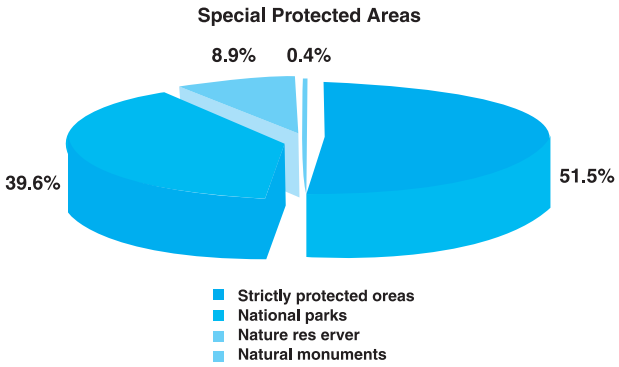

Figure 3.6. *Protected Areas of Mongolia*

Conservation of biodiversity has been given high priority by the Mongolian government. For instance, "Law on Special Protected Areas" (1994) and "Law on Buffer zones of Special Protected Areas (1997), were adopted. The Parliament approved " The National Program on Special Protected Areas" in 1998 and its Implementation Plan for 1998-2005 was adopted by the Government in 1999.

Today, special protected areas of Mongolia encompass 20.5 million ha of land covering 48 areas of 124 *sums* and districts of 19 aimags and the capital (roughly 13.1% of the whole country's territory). During the last 10 years the number of protected areas and their coverage has increased more than three times as seen in Figure 3.7 and figure 3.8 respectively. Some

of these protected areas are described in Table 3.2. the distribution of protcted areas in natural zones is show in Figure 3.9

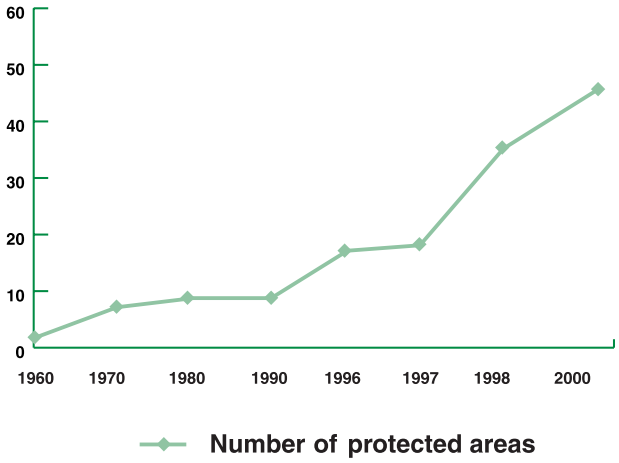

Figure 3.7 *Trends of the growth of protected areas in Mongolia*

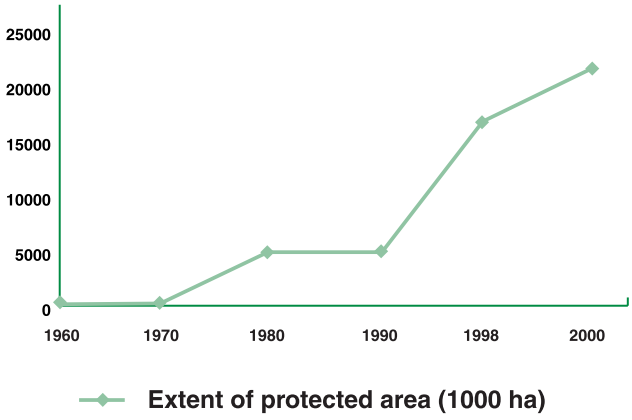

Figure 3.8 *Coverage of protected areas in Mongolia*

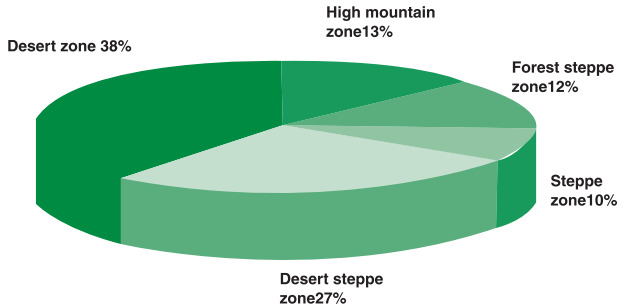

Figure 3.9 *Percentage of protected areas in natural zones*

According to the Mongolian Law on Special Protected Areas (1994), areas under protection are classified under four categories:

- Strictly Protected Areas
- National Conservation Parks
- Nature Reserves
- Monuments

Conventional management for protected areas in Mongolia is based on top-down approach. Figure 3.10 shows the organizational structure for management of protected areas. There are 11 protected area administrations in Mongolia. About 300 people work in protected administrations including rangers and specialists.

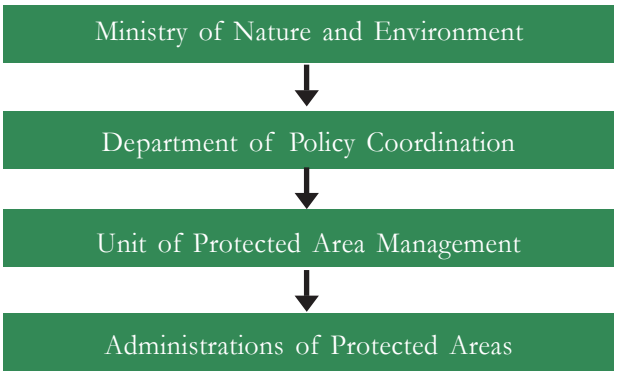

Figure 3.10 *Organizational structure for management of protected areas*

Photo 3.3 *Protected area- Lake Khovsgol National Park, Hovsgol Province*

Table 3.2: Important Protected areas

Protected Area Location	Natural zones	Area in ha	Established in year
Bogdkhan Mountain Strictly Protected Area, South Of Ulaanbaatar, Tov Province	Mountain Forest Steppe, Steppe	41,600 Hectar	1778 - Reestablished In 1978.
Khan Khentii Strictly Protected Area, Khentii, Tov And Selenge Provinces.	Taiga, High Mountain, Mountain Forest Steppe.	1.2 Million Hectares	1992
Great Gobi Strictly Protected Area, Bayanhongor, Gobi-Altai, And Khovd Provinces.	Desert, Desert Steppe.	5.3 Million Hectares	1975
Gobi Gurvansaikhan National Park, Omnogobi Province	Desert, Desert Steppe, Steppe.	2.0 Million	1994
Eastern Mongolia Strictly Protected Area, Sukhbaatar And Dornod Provinces.	Steppe Ecosystem	570,000 Hectares	1992
Uvs Lake Basin Strictly Protected Area, Uvs Lake, Turgen Mountains, The Altan Els "Golden Sands," And Tsagaan Shuvuut Mountain; Uvs Province	Desert, Desert Steppe, Steppe, Forest Steppe, High Mountain.	771,000 Hectares	1994
Lake Khovsgol National Park, Hovsgol Province	High Mountain, Forest, Steppe	838,000 Hectares	1992
Khoh Serkh Mountain Crest Of Altai Mountains, Khovd And Bayanolgii Provinces	Mountain	65,900 Hectares	1977
Khasagt Khairkhan Mountain Altai Mountains, Gobi-Altai province	Forest steppe landscape	27,400 hectares	1965
Otgon Tenger, central Mongolia, Zavkhan province	High mountain ecosystem	95,500 hectares	1992

Note: Apart from this there are several national parks established on mountains and historical places.

Legislation to protect biodiversity

The Government of Mongolia has promulgated many laws in order to protect the biodiversity of the country which are outlined in Box 3.1

Mongolia is seeking external assistance in addressing biodiversity issues in terms of-
- Conservation and cultivation of rare and very rare species of flora and fauna; and
- Improve management of special protected areas and develop eco-tourism

Box 3.1

Mangolian laws to protect bio-diversity

- The Mongolian law on Special Protected Areas, 1995, with respect to combat loss of biodiversity has following provisions:
  - Article 3: It classifies the Special Protected Areas as -
    - Strictly Prohibited Areas
    - National Conservation Parks
    - Nature Reserves
    - Monuments
    - Article 4: Peripheral Zones of Special Protected Areas
    - Article 12: Activities prohibited in Special Protected Areas
- The Mongolian Law on Environmental Protection, 1995 gives special emphasis on 'Natural Resource Reserve Assessments' and 'Environmental Impact Assessment' for the purposes of preserving the natural state of the environment. Moreover, it has following provisions for environment protection-
  - Article 32: Non- Governmental Organization participation in environmental protection
  - Article 34: Economic incentives for environmental protection
  - Article 36: Ecological training and education
  - Article 37: Compensation for damage caused to the environment
- The Mongolian Law on Hunting, 1995, regulates the protection and proper use of animals, which have significance for hunting.
- The Mongolian Law on Natural Plants, 1995, regulates the protection, proper use and restoration of natural plants, other than forest and cultivated plants.
- The Law on Water, 1995, deals with provisions for protection of water reserves, restoration and water quality.

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3.5 URBAN AIR POLLUTION

3.5.1 Introduction

Air quality is a significant environmental problem in urban areas of Mongolia, particularly in Ulaanbaatar. Primary sources of air pollution in Ulaanbaatar are three thermal power plants, about 200 small and medium sized heating boilers, about 60,000 traditional gers and wooden houses, and over 40,000 automobiles. Topography and meteorology exacerbated ambient air quality conditions in the country, and particularly in Ulaanbaatar. Mountains surround Ulaanbaatar up to 2,250 meters in height inhibited dispersion of pollutants. To compound the situation, a stable atmospheric inversion forms during the winter season. As a result, ambient pollutant concentrations often remained for days or weeks at a time to exceed Mongolian and other international ambient air quality standards. Burning of coal and woods in the households in urban cities has been identified as major sources of air pollution, which affects ambient air quality and human health.

3.5.2 Pressure

Air pollution problems in Ulaanbaatar can be attributed to power generation, growth of vehicles and industrial activities.

Energy: During the winter season, three large diesel power plants in Ulaanbaatar release 4.5 million cubic meters of gaseous pollutants, 4.14 tonnes of particulate matter, and 6.76 kilograms of carbon monoxide into the air every hour. The energy sector accounts for around 64 % of Mongolia's greenhouse gas emissions. More than 250 steam boilers burn over 400,000 tonnes of coal every year. Gers and wooden houses with manual heating (in which 48 % of the city population lives), use over 200,000 tons of coal and more than 160,000 cubic meters of fuel wood each year. For the cold seasons, the atmospheric content of carbon monoxide exceeds the permissible norm by 2-4 times.

Photo 3.4 *Emissions from thermal power plant in Ulaanbaatar*

Transportation: Transportation is a major source of air pollution in urban cities. The number of motor vehicles has increased vary rapidly in big cities and settlements in a short period of time. In 1995, it was estimated that over 60 % of the vehicles emitted pollutants exceeded the maximum allowable limits.

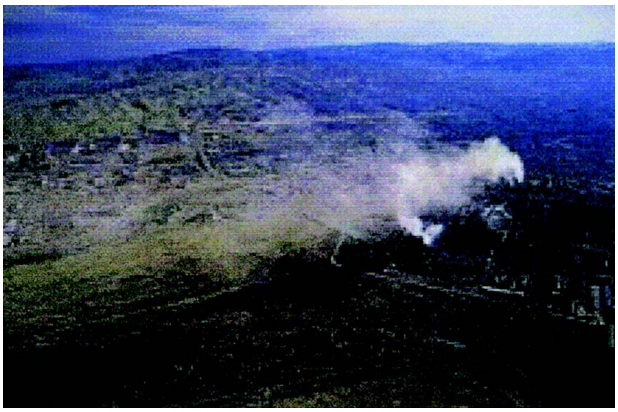

Photo 3.5 *Air Pollution in Ulaan baatar*

Industry: Industrial activities are also one of he major sources of air pollution in Mongolia. As estimated approximately one fourth of greenhouse gas emission is emitted from industrial activities.

3.5.3 State

Urban air quality is monitored to assess sulfur dioxide and nitrogen dioxide concentrations at 20 stations in 16 cities. Figure 3.11 shows concentrations of sulfur dioxide and nitrogen dioxide in different cities of Mongolia in 1999.

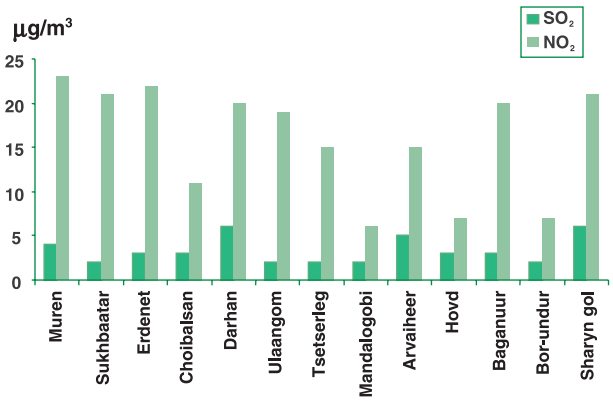

Figure 3.11 *Air pollution in selected cities*

In Ulaanbaatar, there are 4 air quality monitoring stations. The level of air pollution in Ulaanbaatar varies across the districts, depending on pollution sources, contents of emissions and meteorological conditions. During winter season, occurrence of temperature inversion increases air pollution level in the city. Figure 3.12 shows air pollution level in Ulaanbaatar.

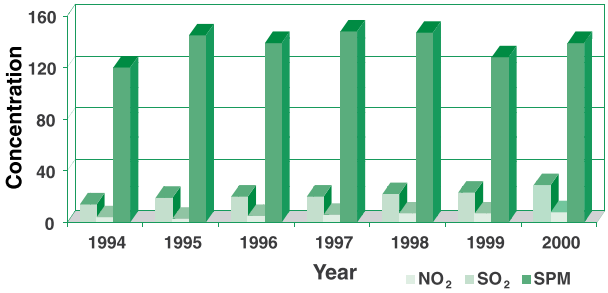

Figure 3.12 *Level of air pollution (in µg/ m ³) in Ulaanbaatar*

Corresponding to a rise in number of vehicles, concentration of nitrogen dioxide (NO_2) has been increasing over the years. Figure 3.13 shows the level of NO_2 as well as the increase in numbers of vehicles in Ulaanbaatar.

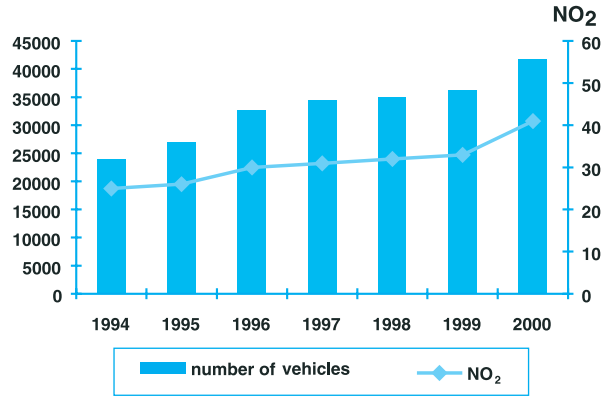

Figure 3.13 *NO_2 concentration (in μg/ m^3) and number of vehicles.*

Air pollution patterns repeat themselves every year, which are shown on SO_2 and NO_2 of 1998-2000 years. Monthly variations of SO_2 and NO_2 over the period of 1998- 2000 at different locations are shown in Figures 3.14 and 3.15.

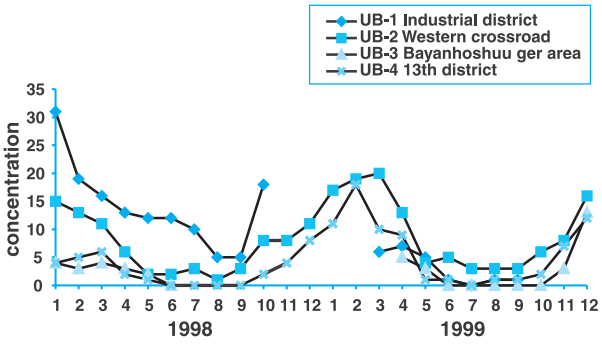

Figure 3.14 *Monthly pattern of SO_2 (in μg/ m^3) in Ulaanbaatar*

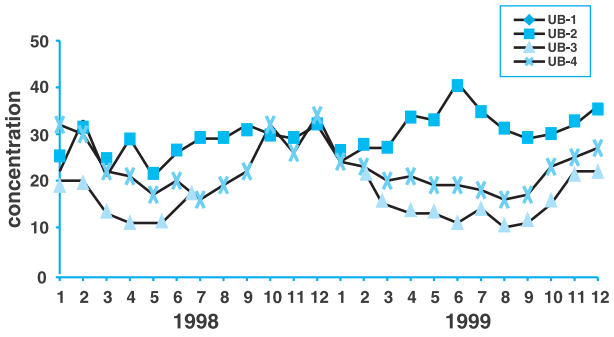

Figure 3.15 *Monthly pattern of NO_2 (μg/ m^3) in Ulaanbaatar*

SPM (Suspended Particulate Matter) concentration is reported to be higher in the month of April due to presence of strong winds. Figure 3.16 shows the changes in concentration of SPM in Ulaanbaatar in recent years.

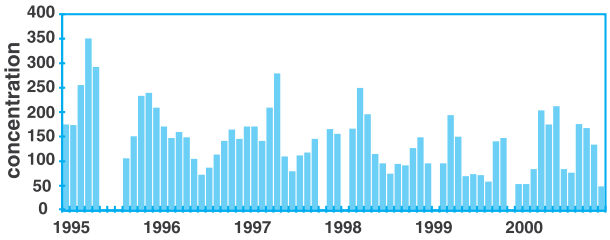

Figure 3.16 *Changes in SPM concentration (μg/ m^3) in Ulaanbaatar*

3.5.4 Impacts

It is reported that air pollution in Ulaanbaatar and other cities has affected human health. Acute respiratory diseases, tuberculosis and other lung diseases are reported to be higher during winter in Ulaanbaatar. For in stance, respirstory diseases of children under 5 years old is 2 - 3 times higher in Ulaanbaator then in rural areas.

3.5.5. Responses

Problems associated with air pollution have been recognized under the Air (Pollution) Act adopted in 1995. Under the Act, the government is mandated to regularly undertake air quality monitoring and provide information to concerned organizations and the public. The provisions in the Act include permit for air pollution discharge and hazardous impacts permit based on the volume of discharge, restrictions on air pollution discharge and hazardous impacts, and provisions for the actions to reduce Greenhouse Gas discharges and ozone layer protection.

The government has undertaken many measures to control air pollution that include:

- Substantial activities are being undertaken to replace old household stoves with advanced ones under the assistance of GEF/World Bank.
- Emissions from all vehicles were measured in 2000 and this activity would be continued over the years.

- The government has also planned to seek donor assistance for the reduction of air pollution in capital city and other towns through-
  - Local manufacturing and utilization of gas emission filters and catalyzing tools, establishment of special laboratory for control and analysis of transport emissions.
  - Manufacturing, promotion and distribution of cost efficient and low smoke stoves for household living in a ger.
  - Establish local set up for manufacturing pollution control devices
  - Setting up special laboratories for measurement and analysis of transport emission.

Part IV CONCLUSION AND RECOMMENDATIONS

PART IV CONCLUSIONS AND RECOMMENDATION

Mongolia is committed to Agenda 21 in order to pursue the sustainable development objectives in the 21st century. Development took place in the past decades has put pressure on country's natural resources and environment. Government policy on environment was developed in 1997 to protect the environment and natural recourses through legal mechanism as well as economic tools. Socio-economic policies are also being reformed to enhance the sustained economic growth through ecologically sound technology and production of high quality goods.

Natural resource base such as mining, forestry, animal husbandry and tourism provides a great opportunity for economic development in Mongolia. Exiting conditions of environment and landscape are in a reasonably good shape. Mongolia is also endowed with rich biodiversity. Existing market economy could have potential to adversely affect the present conditions unless integrated sound policies and strategies encompassing environmental, economic and social issues are developed and implemented.

This chapter includes the conclusions and recommendations for land, water, and forest resources, and air pollution. Various policies and strategies identified to protect and conserve these resources have been discussed.

LAND RESOURCES

Mongolia is the seventeenth largest country in the world. Land degradation in Mongolia, which occurs through human induced activities and natural causes has been identified as one of the priority concerns. Human activities resulted in land degradation include rapid development of farm land, mining industry, and overgrazing. Natural causes include droughts, natural drying, deficit in soil moisture, and strong wind and dust storms. A large portion (about 40%) of land in Mongolia is presently covered under desert area. The increasing rate of desertification is of great concern. The results of land degradation and desertification have affected pasture land and agricultural production, especially crop yield and animal production. Some of the strategies identified to reduce land degradation are as follows:

- A correct assessment of the nature and extent of the existing degraded land needs to be carried out using remote sensing techniques and GIS with scientifically sound criteria and indicators;
- A policy to promote improved and sustainable agricultural practices needs to be developed;
- A policy mechanism could be developed for mining companies to adopt reclamation and rehabilitation of land in an integrated exercise for all mining operations;
- In the urban areas, specific sites need to be designed for the safe disposal of solid waste in order to check the land degradation;
- Government's newly drafted 'Land Law' and 'Law of Land Fees' which aims to provide innovative land policies, which need to be implemented in a specific timeframe;
- The implementation of the National Plan of Action to Combat Desertification needs to be strengthened;
- Institutional mechanism and networking need to be strengthened for monitoring and control of land degradation and desertification;
- A strong partnership needs to be developed between government, business and civil society in order to address and combat the issue of land degradation and desertification; and
- Creating public awareness at the local level would help in getting public support and involvement towards sustainable management of land resources

WATER RESOURCES

Demands of water in Mongolia are mainly met from the ground water sources. But, in the recent years, cities and towns are experiencing shortage of water due to lowering down of ground water table and drying up of some springs and small streams. The increasing consumption of water due to population growth, industrial and agriculture activities has resulted in lowering of ground water tables. Surface water sources are getting contaminated due to untreated domestic sewage and industrial effluents. There is a need to develop strategies and action plans in order to protect the water resources and as well as human health. Some of the measures could be undertaken as follows:

- Technological intervention is required in order to enhance effective treatment of wastewater. Adoption of cleaner technology would help to safeguard surface water and increase viability of freshwater;
- Introduce market based pricing for demand management and efficient use of water;
- Monitoring mechanism needs tobe strengthening to assess the water quality in surface water, ground water, and wastewater discharge sources;
- Establish a realistic water budget through proper inventory of demand, supply, and availability of surface and ground water;
- Information on water consumption and wastewater discharges from industries and urban cities would help in developing strategies to optimize water allocation and uses;
- Development of institutional mechanism and trained manpower would help in enforcing existing laws, regulations and standards;
- Development of water zoning atlas would provide guidance for siting of industries and other economic activities; and
- Promoting integrated watershed management through policy intervention to enhance sustainable management of water resources.

FOREST RESOURCES AND BIO-DIVERSITY

Shrinking forest resources are one of the priority concerns in Mongolia. Increased human activities combined with forest fires and damaging insects has resulted in accelerating loss of forest cover. Loss of forests has aggravated erosion, increased desertification, negatively impacted the ground water table, and decreased agricultural productivity. The degradation of land and forests has also threatened biodiversity, especially the plant species. Many of the plants have medicinal value as currently over 200 species are being used for various treatments. Loss of forest resources could have serious implications on social and economic conditions in Mongolia. The situation demands urgent policy measures and action plans in order to reverse the negative trends in a specific timeframe. Some of the measures could be taken up as follows:

- More emphasize needs to be given on conservation aspects while developing policy measures and action plans;
- Action plan could be developed to conserve the rare and endengered species of flora and fauna;
- Institutional mechanism could be strengthened in order to develop and implement various policies and strategies;
- Continuous monitoing of biodiversity uses would help in reviewing the results of implementation of policies and programmes;
- Forest and biodiversity mapping using GIS and remote sensing techniques would facilitate the process of developing better strategies and action plans to manage forest and biodiversity resources, including identification of 'hot spots';
- Resources need to be raised for improvement and management of existing protected areas;
- Eco-tourism could be developed to harmonize the human and ecology interaction, which in turn would provide an economic opportunity for the local people; and
- A strong partnership needs to be developed between government, business and civil society in order to conserve and augment forest resources in Mongolia.

AIR POLLUTION

Air pollution in Mongolia can be attributed to coal and wood burning in households, forest fires, industrial emission and vehicular emission in urban areas. Rapid growth of vehicles has been the major sources of air pollution in urban cities. Urban population is reported to be increasingly suffering from air pollution problems, especially during winter months. Following measures could be undertaken to control air pollution in Mongolia:

- Control of industrial pollution could be made through promotion of cleaner technologies, strengthening emission standards, and enforcing the pollution control system;
- Air Pollution from power plants in ulaanbaatar could be improved through adopting efficient 'clean' coal technology, efficiency improvements in combined heat and poser plants, and improvement of efficiency in boilers, furnaces and coal stoves.
- Vehicular pollution control in cities could be done through augmentation of public transport system, setting strict emission norms, promotion on cleaner fuels like CNG, and traffic planning and management;
- A comprehensive air quality management strategy for major cities would help in controlling air pollution;

- Strengthening of monitoring network and institutional capabilities would facilitate an improvement on the enforcement mechanism;
- Well equipped laboratories and trained manpower would facilitate to improve monitoring networking and knowledge base on air pollution;
- Emphasize needs to be given on promotion of cost efficient and low smoke stoves for households;
- Use of renewable energy sources (Solar, Wind, Bio-gas) should be promoted with appropriate incentives; and
- Economic incentives need to be put in place to encourage industries to adopt cleaner technology and other conservation practices and discourage over utilization of natural resources.
- Emphasis should be given on public awareness and environmental education related to air pollution problems and concerns

While economic development is important to improve the quality of life of people, strong policies, planning and institutional mechanism would need to preserve environment and natural resources. A strong partnership amongst government, business and civil society would be required to bring about the desired positive changes. The Government of Mongolia is committed to achieve the goal of sustainable development, i.e. economic growth, social progress, and protection of environment and natural resources, which are mutually reinforcing.

Part V ANNEXS

I ACRONYMS AND ABBREVIATIONS

APEC	Asian-Pacific Economic Cooperation
BAP	The Biodiversity Conservation Action Plan
CML	Central Monitoring laboratory
Cu.m.	Cubic Meter
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPAP	Environmental Public Awareness Programme
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOM	Government of Mongolia
GTZ	German Technical Co-operation
ha	Hectare
JICA	Japan International Co-operation Agency
LG	Local Governance
MFAI	Ministry of Food and Agriculture
MAP -21	The Mongolian Action Programme for the 21-th Century
MAS	Mongolian Academy of Sciences
MER	Ministry of External Relations
MID	Ministry of Infrastructure and Development
MNE	Ministry of Nature and Environment
MH	Ministry of Health
MJ	Ministry of Justice
MLSW	Ministry of Labor and Social Welfare
ME	Ministry of Education
mm	Millimeter
MNT	Mongolian Tugrug
NAPCD	National Action Program to Combat Desertification
NAS	National Accounting system
NCSD	National Council for Sustainable Development
NEAP	National Environmental Action Plan
NGO	Non Governmental Organization
NSPE	National State Policy on Environment
NWPP	National Water Policy Programme
PAP	Public Awareness Programme
PPP	Polluter Pay Principle
RRC.AP	Regional Resource Centre for Asia and the Pacific
TACIS	Technical Assistance Common Wealth Independent States
TGS	Tugrugs
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational , Scientific and Cultural Organization
WB	World Bank
WHO	World Health Organization
WWF	World Wildlife Foundation

II COMPONENTS OF THE NATIONAL SoE

Part I EXECUTIVE SUMMARY

Part II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

Background

Natural Resources

- Land
- Water
- Forest
- Biodiversity

Environmental Conditions

- Atmosphere and Climate Change
- Forest and Steppe Fires
- Solid waste
- Natural Disasters

Social and Economic Driving Forces

- Energy
- Transport and communications
- Agriculture
- Mining
- Poverty
- Public Health

Part III KEY ENVIRONMENTAL ISSUES

- Land Degradation
- Desertification
- Deforestation
- Loss of Biodiversity
- Urban Air Pollution

Part IV CONCLUSIONS AND RECOMMENDATIONS

- Conclusions and Recommendations

Part V ANNEXES

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