PART II OVERVIEW OF MAJOR ENVIRONMENTAL DEVELOPMENTS AND TRENDS

2.1 GENERAL BACKGROUND

2.1.1 Socio- economic Development

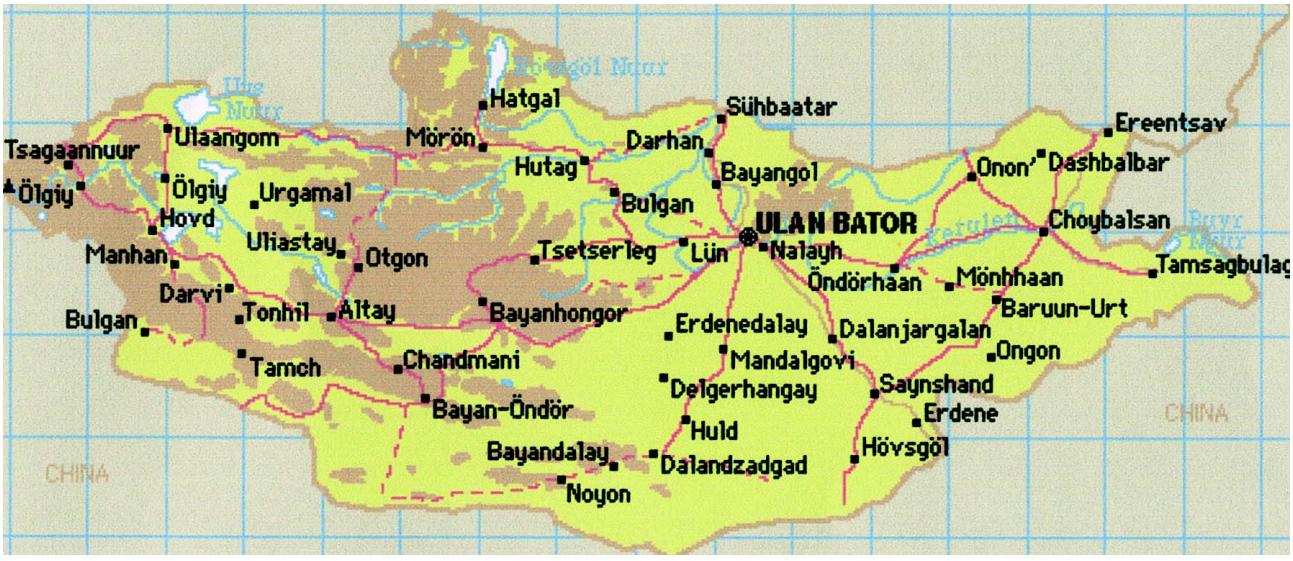
Population- Mongolia is a sparsely populated country, landlocked between the Russian Federation to the north and the People's Republic of China to the east, west and south. Mongolia has a population of about 2.4 million people spread over an area of 156.412 million ha. About 57 % of the population lives 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.

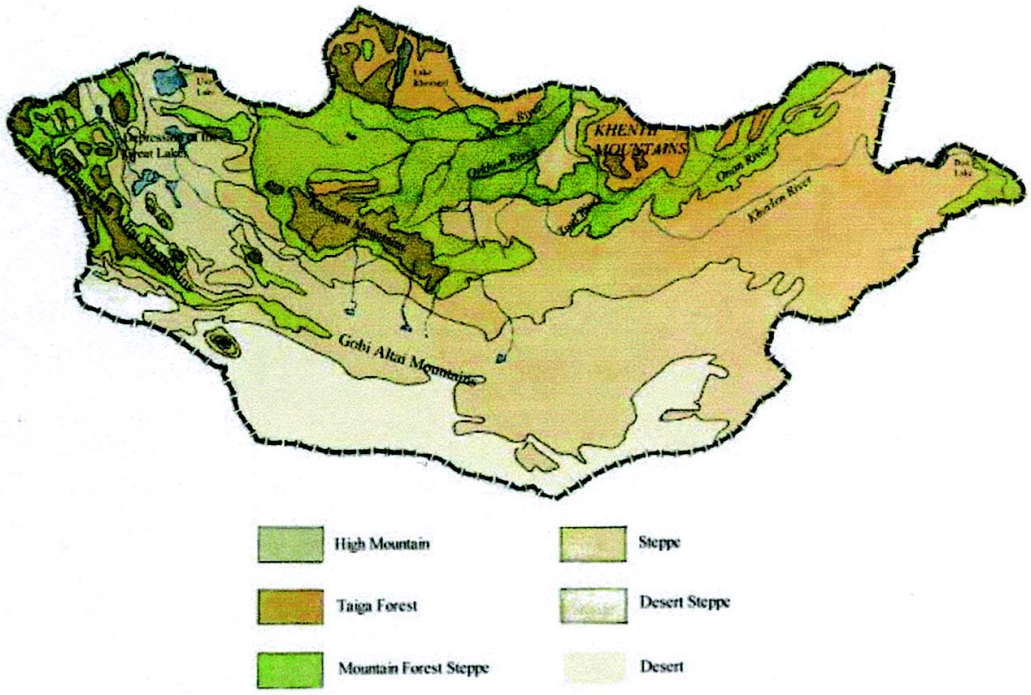
Topography- Although most of the country is flat, with rolling hills, there are several significant mountain ranges, notably the Altai, Khangai, Knentii and Khuvsgul. About half of the land is at an altitude of about 1,400 m or more above mean sea level. The altitudes range from 560 m (above sea level) 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*

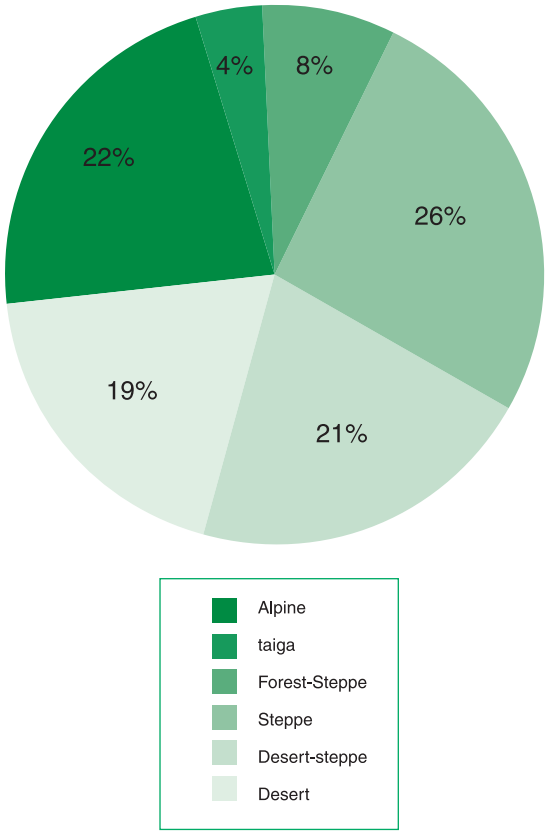


Figure 2.1 *Vegetation zones in Mongolia*

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

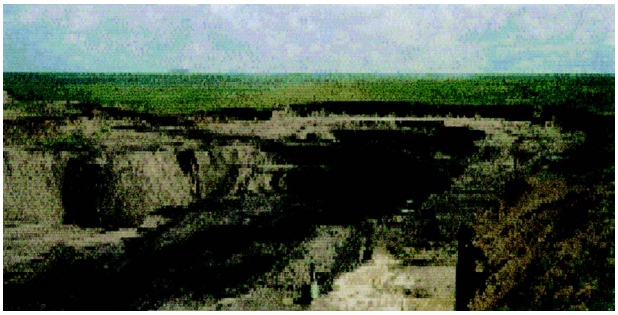


Photo 2.8 *Open mining*

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

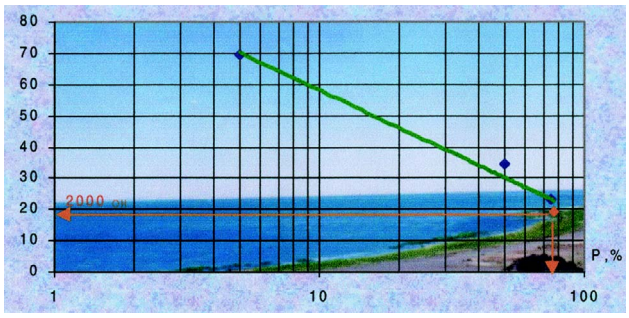


Figure 2.2 *Annual water resources with different probability, cubic km /year*

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.

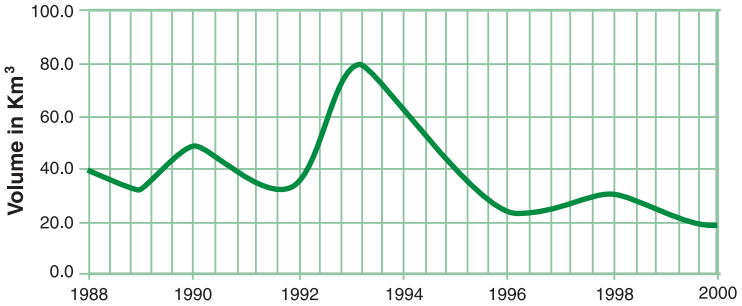
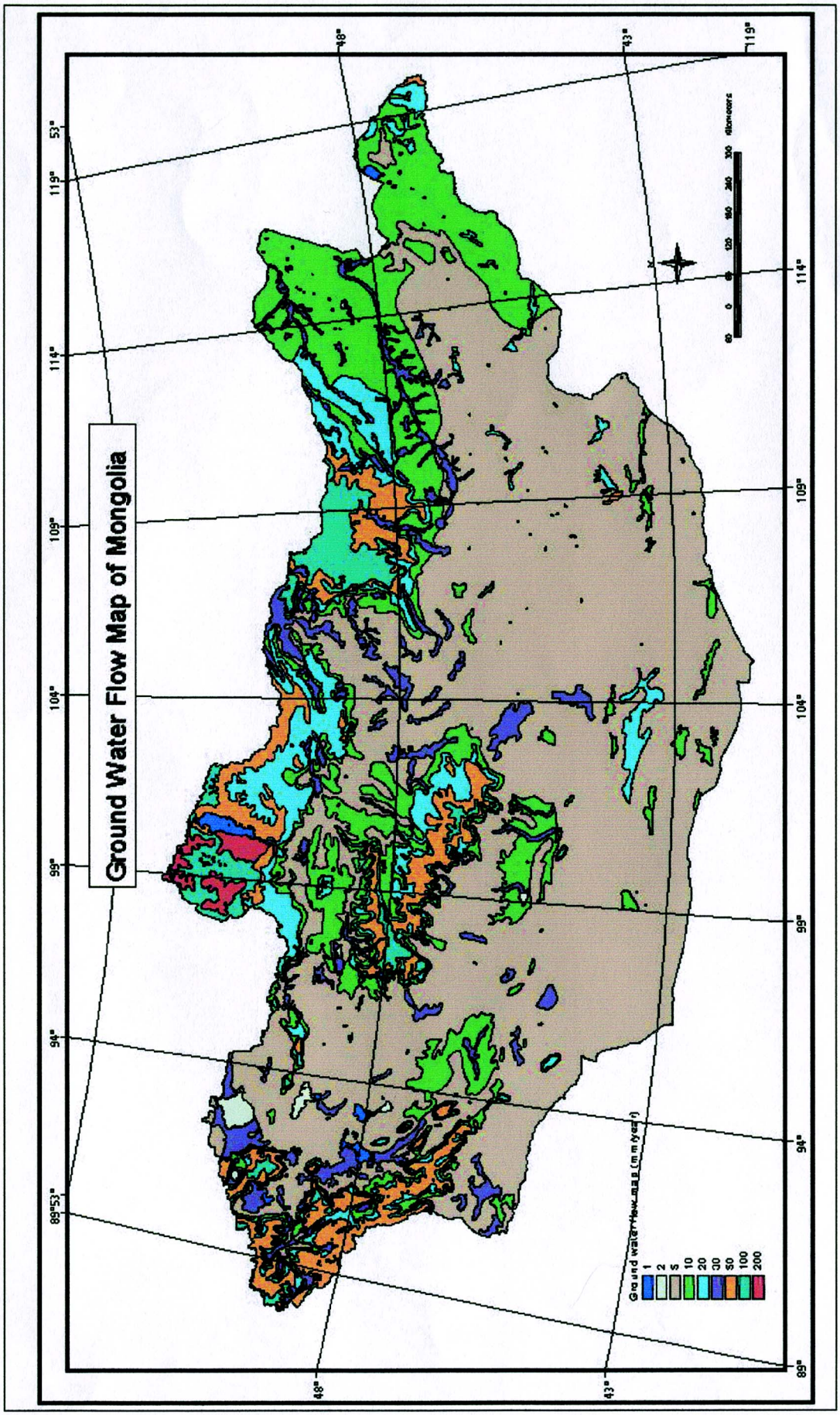
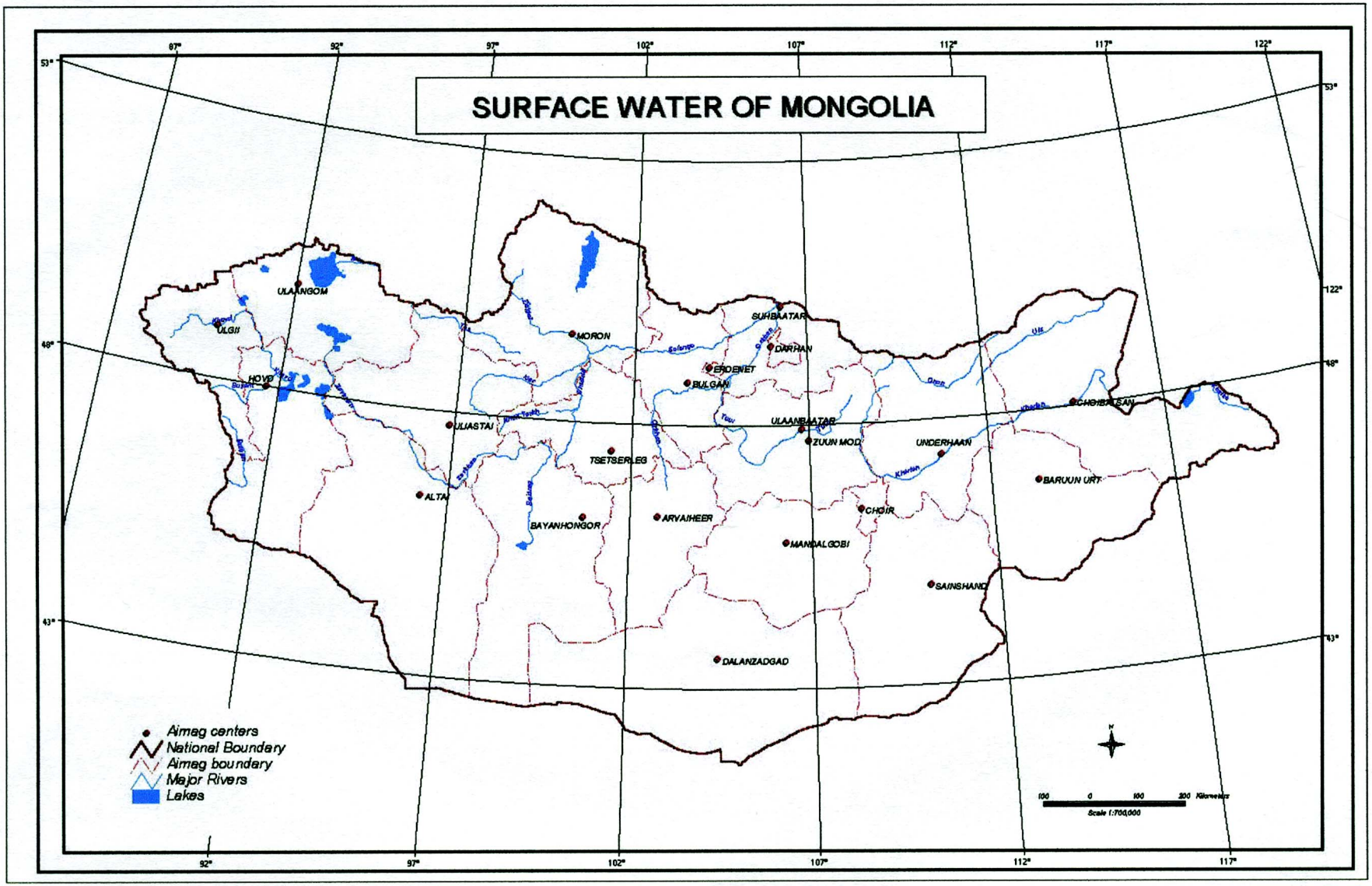


Figure 2.3 *Mongolia's annual surface run-off in cubic km/year*



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.

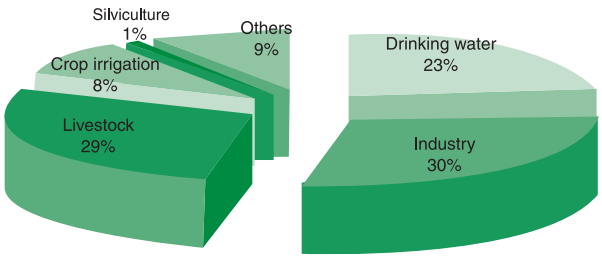


Figure 2.4 *Water uses distribution*
*(**Source:** MNE-2000)*

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.

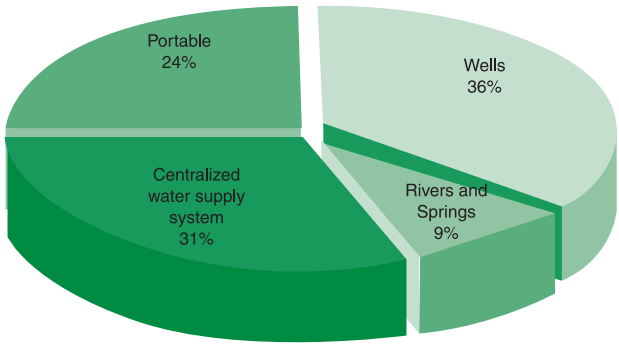


Figure 2.5 *Drinking water supply sources, in percentage*
*(**Source:** MNE 2000)*

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*

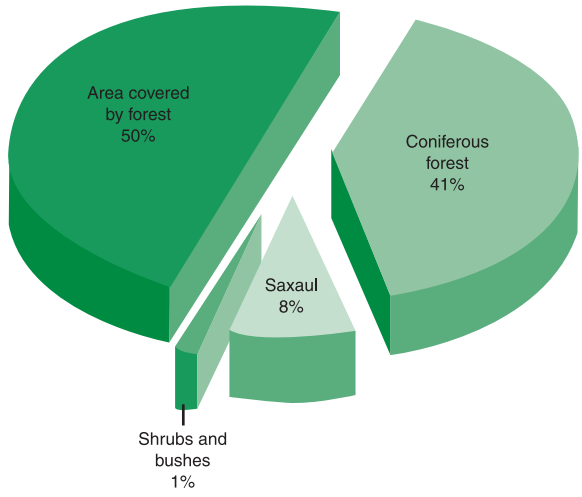


Figure 2.6 *Forest area*
*(**Source:** MNE 2000.)*

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*

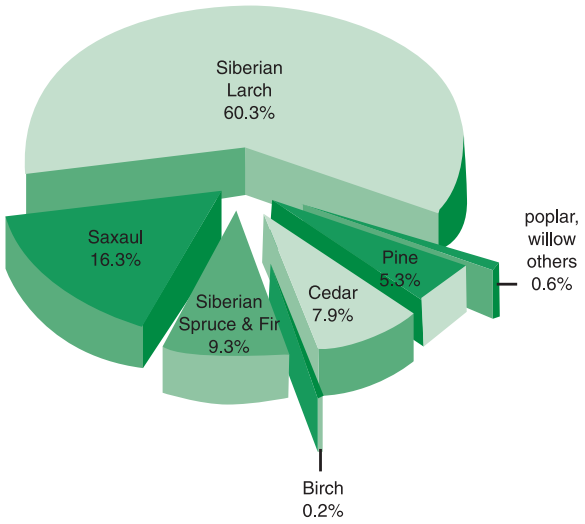


Figure 2.7 *Percentage of species in the total forest land in hectares.*
*(**Source:** MNE)*

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.

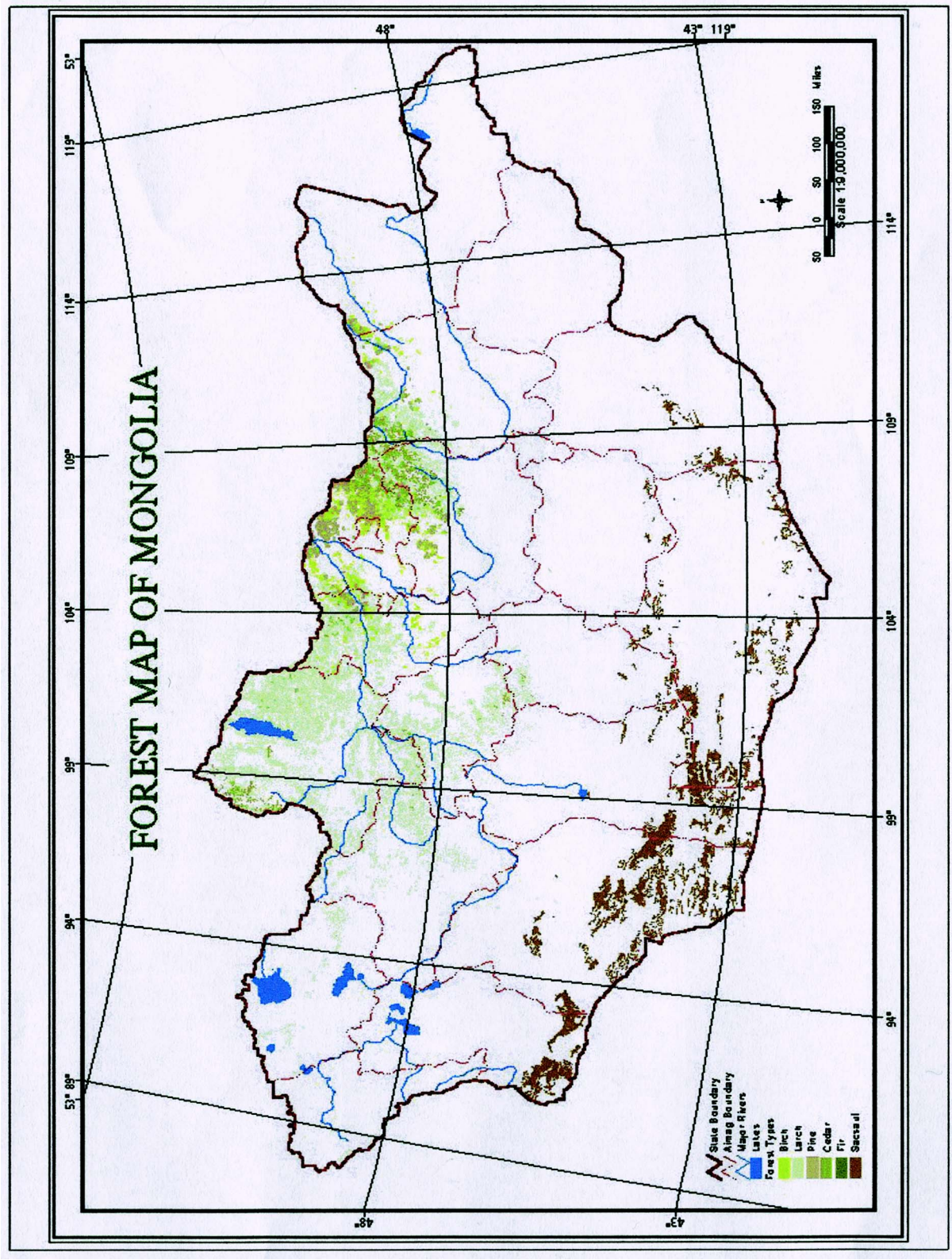
Photo 2.15 *Asiatic Ibex*

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

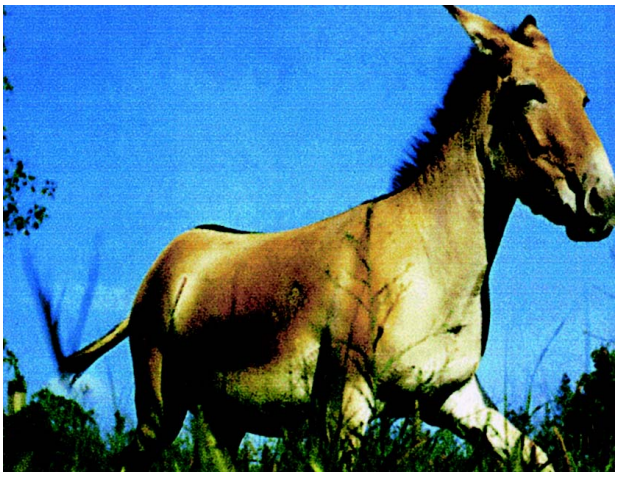


Photo 2.18 *Mongolian Ass*

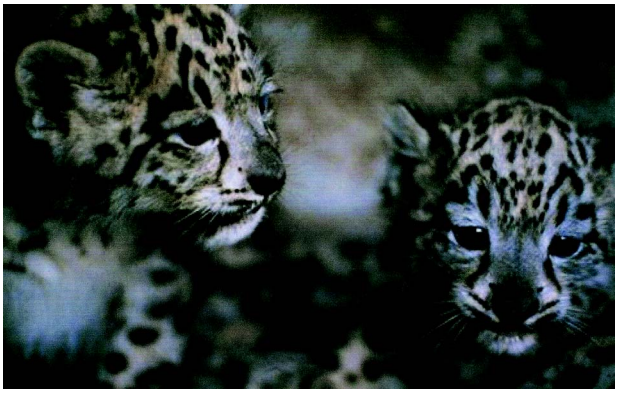


Photo 2.19 *Snow leopard Cubs*

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.

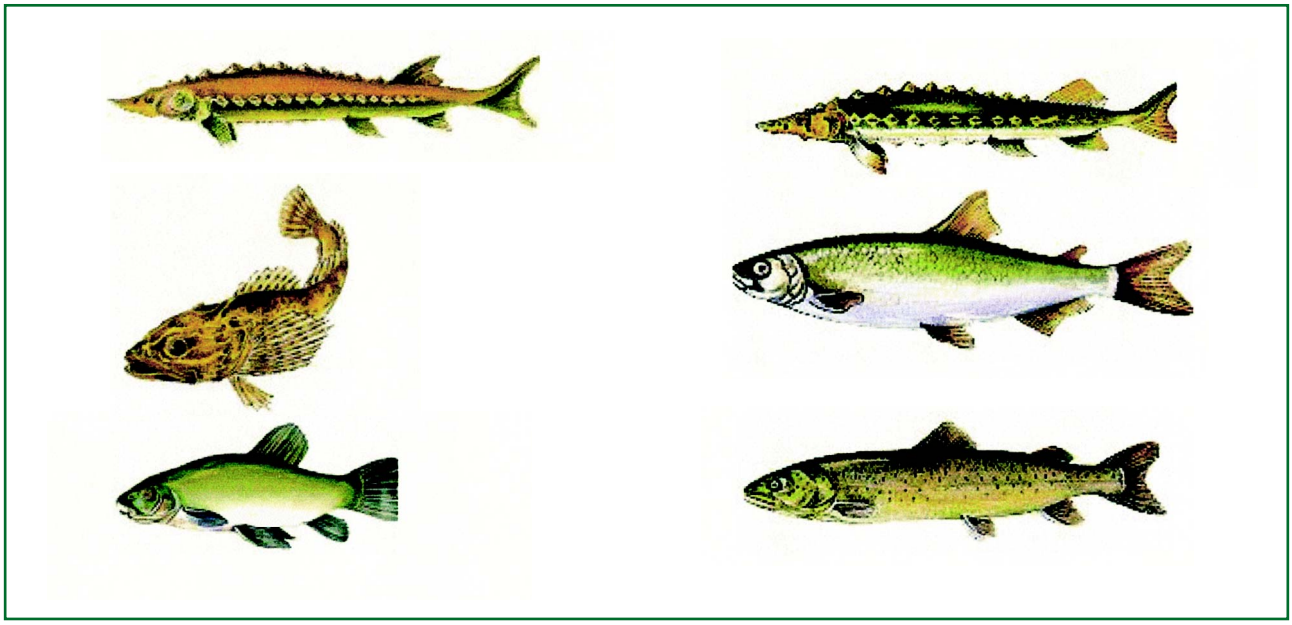


Photo 2.21 *Red Book listed sketches of Fish species of Mongolia*

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

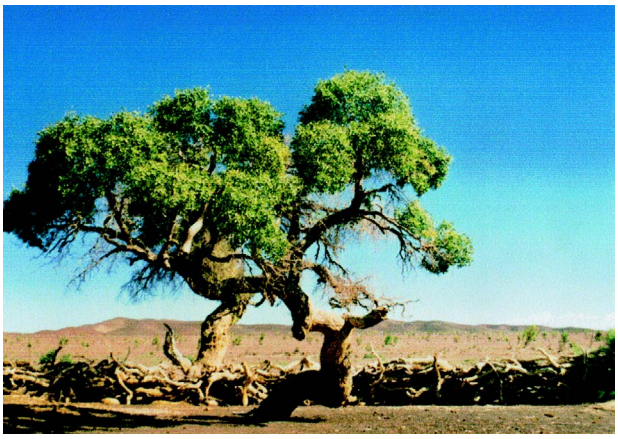


Photo 2.23 *Populus Diversfolia, a rare species tree with different leaves in one leaf*

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

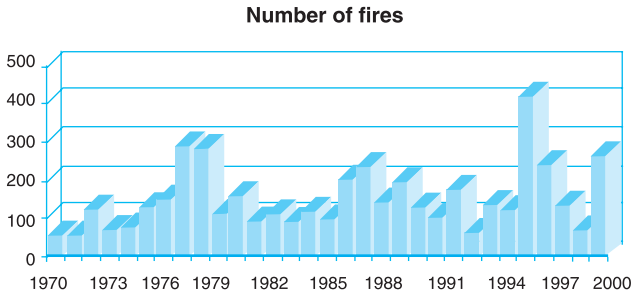


Figure 2.8 *Number of forest fires*

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.

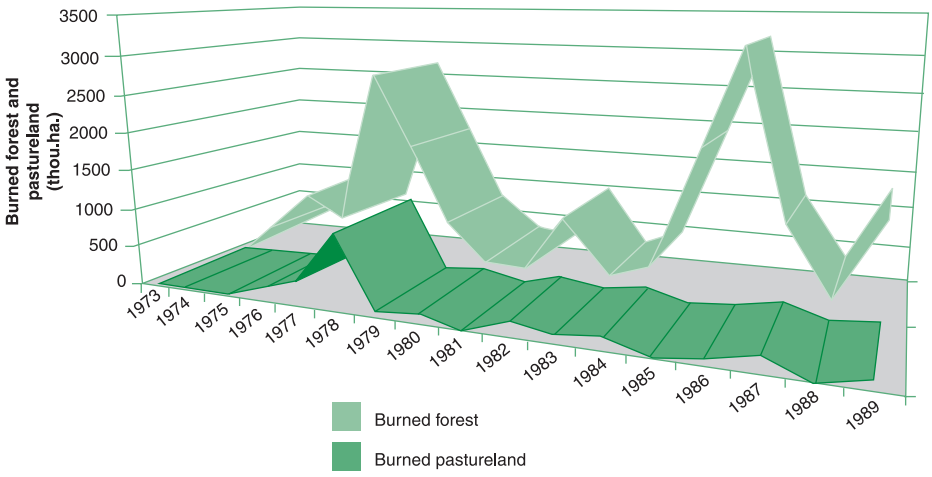


Figure 2.9 *Forests and pastures affected by wild fire*
*(**Source:** MNE 2000)*

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.

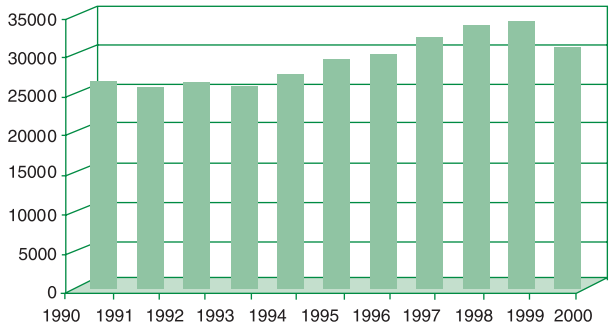


Figure 2.10 *Increase in livestock heads*

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.

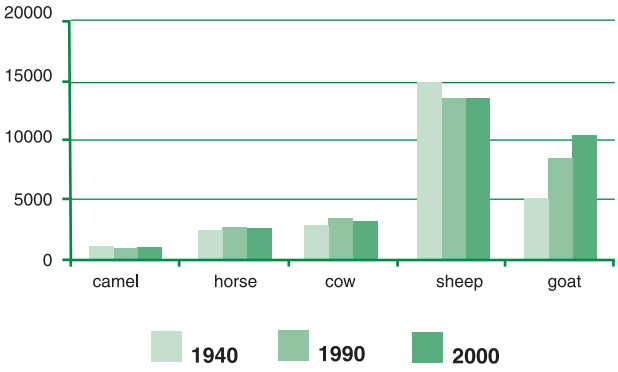


Figure 2.11 *Number of livestock*
*(**Source:** National Statsitical Office)*

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.

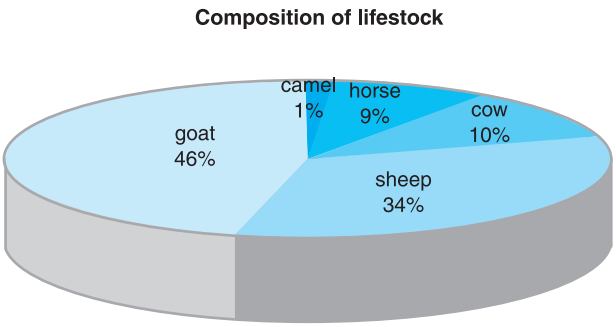


Figure 2.12 *Composition of livestock*

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.

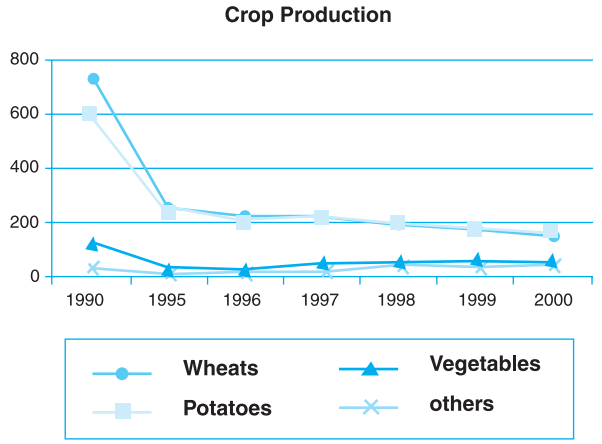


Figure 2.13 *Crop Production (in thousand tonnes)*

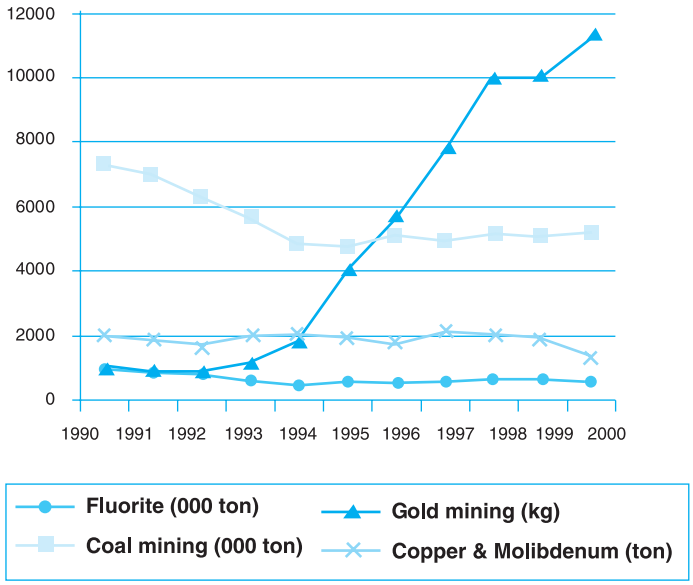


Figure 2.14 *Mining product outputs*

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.

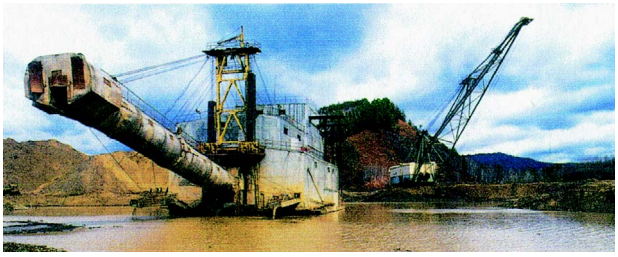


Photo 2.30 *Mining Operation uses heavy machinery*

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.

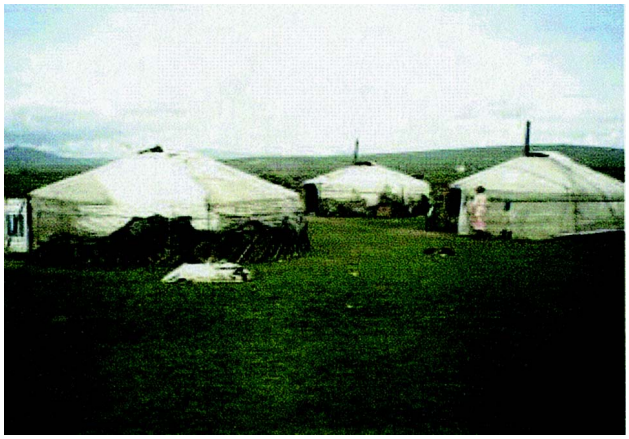


Photo 2.31 *Ger- typical settlement in the countryside of Mongolia*

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

References

1. ADB (1998). ALGAS report. Mongolia
2. Government of Mongolia and UNDP (1997). Human Development Reports
3. Government of Mongolia and UNDP (2000). Human Development Reports
4. Government of Mongolia and UNDP (1999). Mongolian Action Programme for the 21st Century
5. Ministry of Environment (1996). Nature and Environment in Mongolia (in Mongolian)
6. Ministry of Environment of Mongolia (1997). Biodiversity Conservation Action Plan for Mongolia
7. Ministry of Environment of Mongolia/UNDP (1998). Biological Diversity in Mongolia, National report
8. Ministry of Environment of Mongolia (1998). Proceedings of International Workshop on Wetlands Conservation in Mongolia and North-East Asia
9. Ministry of Environment of Mongolia (1999). State of Environment (in Mongolian)
10. Ministry of Environment of Mongolia (2000). State of Environment (in Mongolian)
11. Ministry of Environment, Mongolia (2000). National Action Programme on Climate Change
12. NSO and UNDP (1998). Living standards measurement Survey
13. Ramboll/UNOPS (1998). Solid Waste Management Study in Ulaanbaatar
14. Ts. Tserenchimed (2000). Economic and Social Development Studies (in Mongolian)
15. World Bank (1992). Mongolia towards a Market Economy