CHAPTER 2

OUTLINE OF STUDY AREA

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2.1 Natural Conditions

2.1.1 Topographical Features

(1) Topography

The topography of Mongolia is largely classified into the desert zone in the south, the central highland zone and the mountainous zone in the north and west. The Study Area is located in the transitional area where the mountainous zone around Lake Baykal in Russia changes to the Mongolian highlands and is part of the northern mountain range. Most of the area is situated between EL 800 m and EL 2,000 m and the highest point is Mt. Songol (EL 2,226 m) in the southeastern part while the lowest elevation is around 600 m along the northern border (see Fig. 2).

Mountains in the Study Area are distributed in the southeast and west. The Buteeliyn Mountains and Burengiyn Mountains in the west, both of which are approximately 1,800 m above sea level, run parallel to each other from northeast to southwest. Flat land is found along Orhon River, Selenge River and their tributaries. Other parts of Selenge Aimak are predominantly gentle hilly areas.

(2) River Systems

The Study Area is located in the catchment basin of Lake Baykal and the main watersheds in the area are those of Selenge River, Mongolia's longest river, Orhon River, Chikey River along the border and Dzilter River. Orhon River flows north-south in the middle of Selenge Aimak and its watershed lies to the east of the Burengiyn Mountains, in turn located in the western part of the Study Area. More than half of the Study Area is located in the watershed of Orhon River. Selenge River runs between the two mountain ranges in the northwestern part of the Study Area, meets Orhon River near the city of Sukhbaatar and flows into Lake Baykal across the Russian border. It eventually empties into the Kara Ocean via Angara River and Yenisey River. The watershed of Dzilter River is located between the Buteeliyn Mountains and the Russian border and Dzilter River joins Dzhida River across the border, which in turn then joins Selenge River. Rivers running in the northeastern part of the Study Area join Chikey River once they cross the Russian border and Chikey River in turn joins Selenge River.

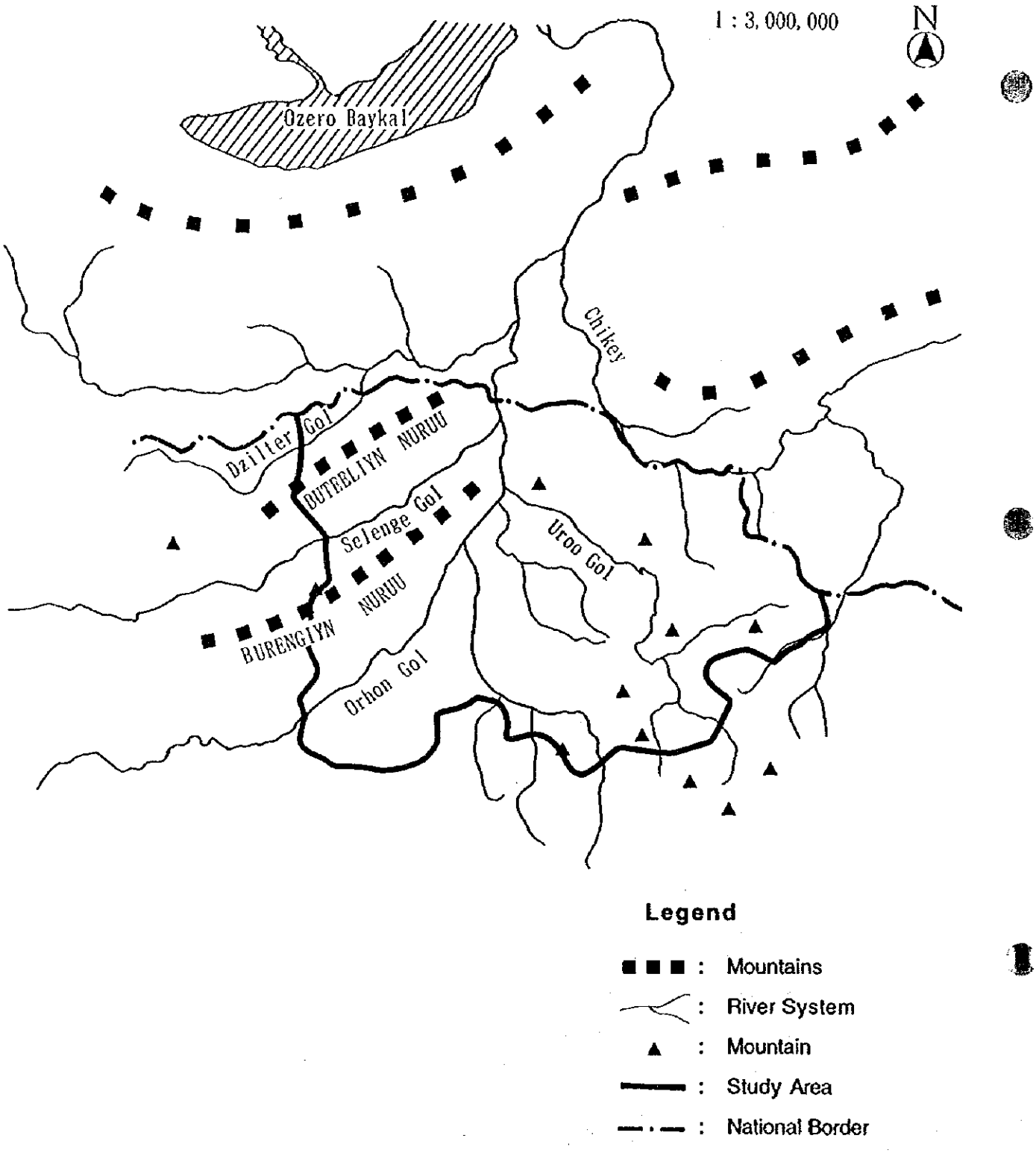


Fig. 2 Topographical Outline Map

2.1.2 Geology

The Study Area and its surroundings belong to an orogenic zone of the Late Precambrian and Early Cambrian Era and is situated between the Siberian Platform and Mongolian Geosyncline. During the orogenic process, wide areas were subject to metamorphism and, as a result, many granite intrusions are observed today.

2.1.3 Climate

According to the observation results of the Sukhbaatar Meteorological Observation Station for the period between 1984 and 1992, the mean annual temperature in the Study Area is 0.7°C while the mean monthly temperature ranges from -22.1°C in January to 19.0°C in July. The mean maximum monthly temperature is the highest in June at 36.4°C and the mean minimum monthly temperature is the lowest in January at -40.1°C. The mean annual rainfall is 276 mm and is concentrated between May and September. The overall picture of the Study Area is annual rainfall of less than 300 mm in the northern part at low altitudes and around 400 mm in the southern mountainous part. Based on the climatic zone categories of Koppen, Selenge Aimak is situated between the steppe zone and subpolar zone and shows a typical dry continental climate with large daily, as well as annual, temperature ranges.

2.1.4 Vegetation and Wild Plant Conservation

(1) Vegetation

The Study Area is one of Mongolia's richest in vegetation and the local vegetation can be classified based on the climatic zone and elevation (between 1,000 m and 2,000 m) as shown in Table 1.

Table 1 Vegetation Classification of Selenge Aimak Based on Climatic Zone and Elevation

Climatic Zone	Elevation (m)	Vegetation Category	Main Species
Boreal ↑	1,400 or more	• Mountainous Taiga Forest	Siberian larch, Siberian fir, Siberian spruce, Siberian pine
	upto 1,400	• Taiga Forest (forest with rich grass growth)	Iris, Cowberry, Rhododendron, Sedge, Siberian larch, Scotch pine
↓	upto 1,400	• Grassland (mountainous)	Birch, Feather-grass
Steppe	upto 1,200	• Grassland (dry land)	Cottonweed, Feather-grass
		• Riverside Vegetation	Willow, Sedge

In addition to above, in the mountainous and hilly areas of the Study Area, grassland and bushland tends to appear at south-facing slopes while forests tend to establish themselves on north-facing slopes. This distinctive difference between south-facing and north-facing slopes is quite common in neighbouring areas.

(2) Conservation of Natural Plants

The conservation of natural plants in Mongolia is prescribed by the Natural Plant Law (established in 1995) of Mongolia and Forest Law (1995) of Mongolia in order to achieve the following.

Natural Plant Law	:	of plants which grow in Mongolia, conservation, appropriate utilisation and regeneration of the wild plants other than plants in the forest and cultivated plants
Forest Law	:	conservation, appropriate utilization and regeneration of forests

The Natural Plant Law classifies wild plants into three categories: extremely rare, rare and common species, based on the number of individuals observed, their regeneration capability, distribution, and extinction hazard. The utilisation of plants falling into each category is controlled as shown in Table 2, 133 plant species of which are currently designated as extremely rare species.

Table 2 Basic Concept of Local Plant Classification and Control of Plant Use

Category and Basic Concept	Control of Plant Use
Extremely Rare: No capability of self-regeneration; extremely limited distribution and the size of the resources is too small for use; faces extinction hazard	May be used simply for research purpose
Rare: Limited capability of self-regeneration; limited distribution and a small number of individuals; faces possible extinction	May be used simply for family or research purpose
Common: Good capability of natural regeneration; wide distribution witha large number of individuals	May be used for family, research, and commercial purposes

Note: This table has been prepared based on the provisions of Mongolia's Wild Plant Law.

The Forest Law of Mongolia classifies Mongolia's forest resources into three categories: strict zone forest, protected zone forest and utilization zone forest, based on their ecological and economic importance with specific control of the forest conservation and utilization according to each category. The 1986 Red Data Book of Mongolian People's Republic lists 82 plant species consisting of 1) 17 endangered species, 2) 21 extinction facing species and 3) 44 rare species.

2.1.5 Protection of Wild Animals and Hunting

A total of 136 mammalian species, 426 bird species, 8 amphibian species, 22 reptilian species and 75 fish species have been identified in Mongolia. The Study Area is rich in large and medium size mammals and birds which are commonly hunted. Mongolia allows foreign hunters to hunt in the country and the provisions of the Hunting Law (established in 1995) of Mongolian relating to the protection and use of wild animals subject to hunting (mammals, birds and fish) are summarised below.

(1) Protection of Animals Subject to Hunting

The Hunting Law of Mongolia classifies wild animals subject to hunting into three categories extremely small number of individuals, small number of individuals and large number of individuals, based on the number of inhabiting wild animals, the reproduction capability of individuals and ecological importance. Hunting and capture and of animals in each category are controlled according to the categories, as shown in Table 3.

For extremely small number of individuals, 11 mammalian species, 6 bird species and 2 fish species are specified.

Table 3 Basic Concept of Local Wild Animal Classification and Control of Their Hunting and Capture

Category and Basic Concept	Control of Hunting or Capture
Extremely Small Number of Individuals: No capability of natural reproduction; limited distribution and the number of individuals is too small for use; faces a danger of extinction	May be captured simply for research purpose
Small Number of Individuals: Weak capability of natural reproduction; limited distribution and a small number of individuals; endangered	May be hunted and captured simply for special purposes
Large Number of Individuals: Good capability of natural reproduction; wide distribution with a large number of individuals	May be hunted and captured for family, commercial, and special purposes

Note: This table has been prepared based on the provisions of Mongolia's Hunting Law.

The 1986 Red Data Book of Mongolian lists 23 mammalian species, 19 bird species, 6 amphibian/reptilian species and 2 fish species.

(2) Hunting

The competent agency in Mongolia decides the ceiling for the number of wild animals to be hunted or captured annually based on the Game Law. To hunt or capture the wild animals, people must acquire a permit according to the category referred to in item (1) and the purposes of hunting or capture. (see Fig. 3) Each permit specifies the number of hunted and captured species and a capture period. Also a closed season for the hunting or capture for each species is specified as shown in Table 4. The hunting volume for the main species in the 4 year period from 1986 to 1989 is shown in Table 5.

A foreigner visiting Mongolia for hunting purposes may hunt only those species with a large number of individuals by obtaining a special permit from the competent central agency on payment of a special fee.

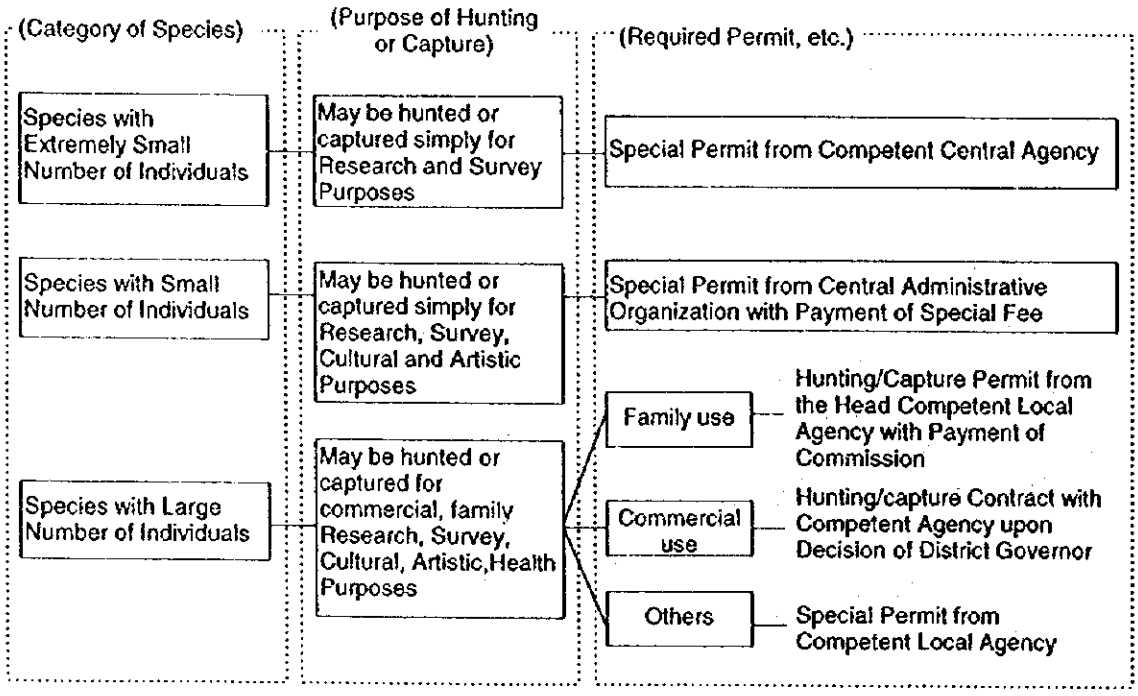


Fig. 3 Conditions for Hunting or Capture of Wild Animals

(Based on Mongolia's Hunting Law)

Table 4 Species Subject to Hunting Prohibition Period

Species	Period	English Name
Capreolus pygargus (capreolus)	1st December - 1st September	
Procapra gutturosa	"	Mongolian Gazelle
Sus scrofa	"	Wild Boar
Ursus arctos	16th November - 1st August	Brown Bear
Martes zibellina	16th February - 21st October	Sable
Martes foina	"	Stone Marten
Nyctereutes procyonoides	"	Racoon Dog
Lynx lynx	"	European Lynx
Gulo gulo	"	Wolverine
Vulpes vulpes	"	Red Fox
Vulpes carsac	"	Corsac Fox
Sciurus vulgaris	"	Red Squirrel
Mustela sibirica	"	Siberian Weasel
Lepus timidus	"	Arctic Hare
Lepus tolai	"	
Marmota sp.	16th October - 10th August	Marmot
Moschus moshiferus	1st January - 16th October	Siberian Musk Deer
Meles meles	1st November - 1st September	Eurasian Badger
Bonasia (Bonasa) bonasia	16th March - 1st September	Hazel Grouse
Lagopus lagopus, L. mutus	"	Willow Grouse, Rock Ptarmigan
Alectoris chukar	"	Chukar Partridge
Syrrhaptes paradoxus	"	Pallas' Sand Grouse
	"	
Anser spp.	1st May - 1st September	Wild Goose
Anas spp.	"	Duck

Source: Mongolia's Hunting Law

Table 5 Volume of Hunting (1986 - 1989)

Species	Volume	English Name
Lepus tolai	38,400	
Lepus timidus	3,300	Arctic Hare
Cytellus spp.	465,600	Ground Squirrel
Marmota spp.	1,109,300	Marmot
Tamias sibiricus	20,700	Asiatic Chipmunk
Sciurus vulgaris	18,000	Red Squirrel
Vulpes vulpes	5,000	Red Fox
Vulpes carsac	8,800	Corsac Fox
Meles meles	1,600	Eurasian Badger
Mustela eversmanni	7,230	Steppe Polecat
Canis lupus	4,200	Grey Wolf

Source: Mongolian Ministry of Nature and the Environment

2.2 Socioeconomic Conditions

2.2.1 Administrative Boundaries

Selenge Aimak has an area of 41,119 km^2 and is divided into 20 administrative districts with its administrative center located in Sukhbaatar (see Fig. 4). Darhanuul Aimak, an independent province with Darhan its capital, lies in the middle of the province. Darhanuul Aimak has become administratively independent since 1994 after integrating districts of Orhon, Hongol and Salkhit.

Fig. 4 Administrative Boundaries in Selenge Aimak
(Based on 1985 Atlas of Selenge Aimak)

The organization of the local government and the Forestry Office is shown in Fig. 5. Forestry Administration was placed under the jurisdiction of Natural Resources Policy Division and Scotch Pine Forest Protection and Administration Office merged with Forestry Office starting January 1997.

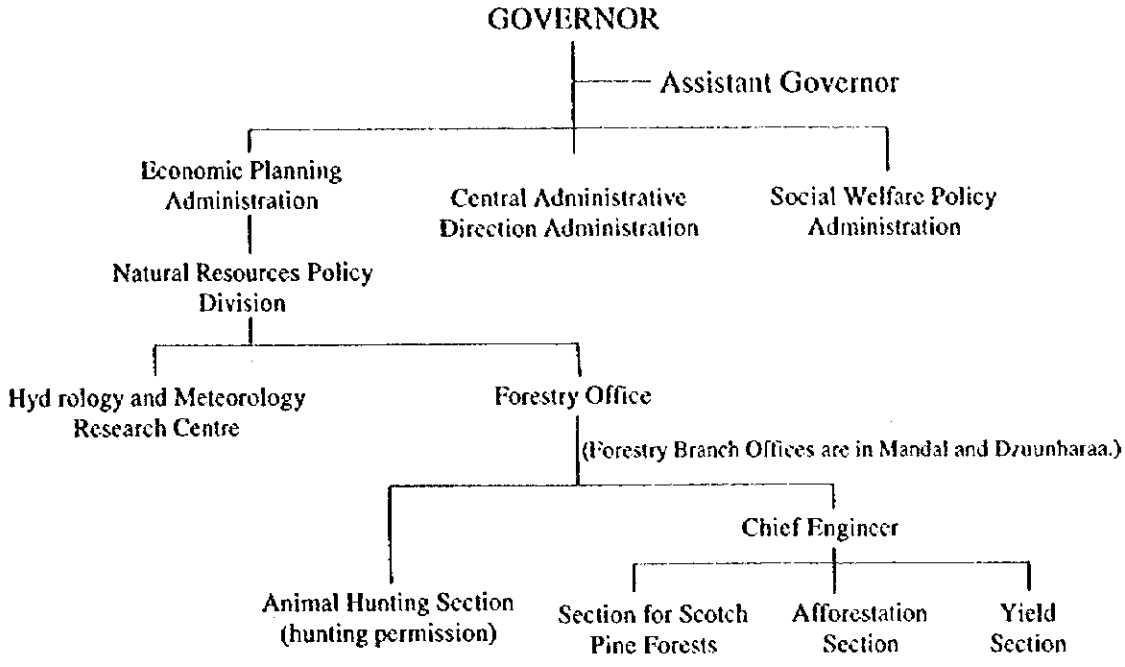


Fig. 5 Administrative Structure of Selenge Aimak

Each section of the Forestry Office is assigned the following work.

Afforestation Section : Management of provincial nurseries and afforestation

Yield Section : While the cutting volume is decided by the provincial government, the actual sites are decided by the Forestry Office

Animal Hunting Section: Processing of hunting applications made by foreigners

An example of organization of administrative division (Altanbulag District) is as shown in Figure 6. Nature protection officers are posted at each of these districts to engage in protection of natural resources (forest, river, soil, atmosphere) and is authorized to issue permit for cutting of trees of firewood and use of its byproducts. Allocation of nature protection officers is as shown in Table 6.

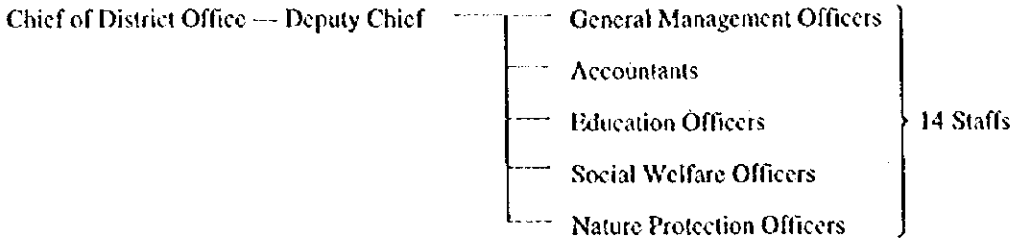


Fig. 6 Administrative Structure of Altanbulag District Office

Table 6 Number of Nature Protection Officer of Each District in Selenge Aimak

District	No. of Nature Protection Officers	Forest Area (ha)
Altanbulag	1	172,404
Uroo	2	645,259
Dzuunburen	2	17,760
Mandal	3	360,303
Orhon	1	2,738
Sant	2	35,349
Tsagaannuur	2	126,572
Bayangol	1	28,549
Orhontuul	2	7,242
Baruunburen	3	119,284
Tushig	2	185,911
Saihan	2	7,160
Javhlant	1	20,158
Shaamar	2	26,892
Huder	3	248,822
Hushaat	—	40,745
Sukhbaatar	4	—
Dzuunharaa	—	—
Dulaankhaan	1	—
Tunkhel	2	—
Total	36	2,045,148

Source: Selenge District Office (Data aquired in December 1994)

Note: Six nature protection officers are posted for management of green zones (Scotch pine forest in Tojiin) in the periphery of Sukhbaatar.

2.2.2 Infrastructure

(1) Roads

As of 1989, road transportation accounted for 72.7% of the cargo transportation and 45.5% of the passenger transportation in Mongolia, underlining the importance of the local road network. The total road length as of 1990 is 199,300 km, consisting of 49,300 km of trunk roads (either state or local roads) and 150,000 km of other roads. Paved sections extend 1,300 km, accounting for a mere 2.6% of the total trunk road length. Only three provinces, i.e. Selenge, Tov and Bulgan, have paved roads and the national ratio of paved roads is 0.8 km per 1,000 km^2. Sukhbaatar and Ulaanbaatar are linked by a state road having a length of some 340 km which can be travelled by car in approximately 5 hours. It is admitted that the Mongolia's current road network are the poor conditions of many roads, with most of the roads other than state roads being unpaved, and the lack of an appropriate road maintenance system despite the overall importance of roads in the national transport system.

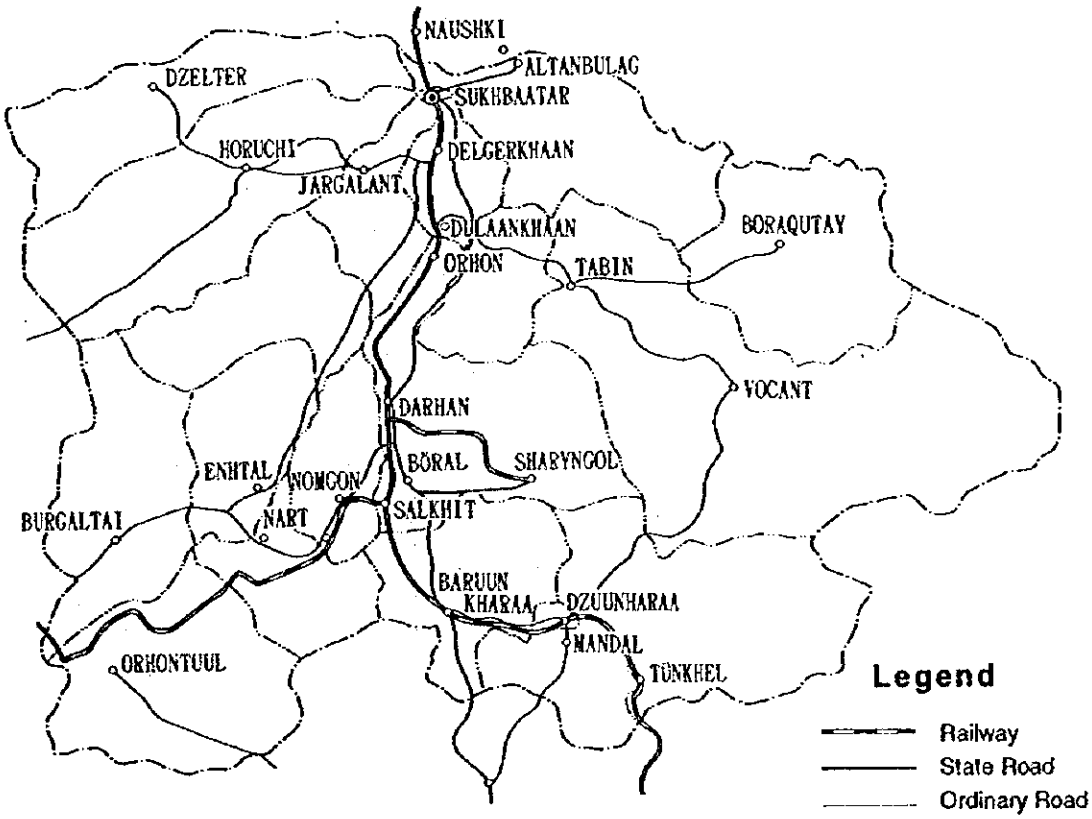


Fig. 7 Transport Network in Selenge Aimak

(Based on 1985 Atlas of Selenge Aimak)

(2) Railway

The first railway line in Mongolia was constructed in 1937 to transport coal from the Nalayh coalfield to Ulaanbaatar, the capital located 37 km away. In subsequent years, the importance of the railway as infrastructure for the mass transportation of cargo significantly increased, reaching a total service length of 1,748 km in 1985. The railway transportation volumes increased from 2.15 billion tons-km of cargo and 210 million persons-km in 1975 to 6.24 billion tons-km of cargo and 530 million persons-km in 1988. The most important route is that connecting Ulaanbaatar and Naushki on the Russian border via Sukhbaatar, linking with the Siberian Railway. The train travelling time between Ulaanbaatar and Sukhbaatar is 9 - 12 hours.

(3) Communication

Although the diffusion rate of telephone remains low in Mongolia, telephone communication is available between cities. However, means of communication is limited to radio outside city limits. Incidentally, it is possible to call Japan from Sukhbaatar.

2.2.3 General Conditions of Economy

(1) Land Use

The current land use conditions in Mongolia and Selenge Aimak are shown in Table 7.

Table 7 Land Use Conditions

(Unit: 1,000 ha)

Category	Mongolia		Selenge Aimak		Ratio in National Figure
	Area	%	Area	%	%
Forest	13,750	8.8	2,045	49.7	14.9
Grassland	125,000	79.8	1,751	42.6	1.4
Farmland	1,401	0.9	300	7.3	21.4
Others	16,499	10.5	16	0.4	0.1
Total	156,650	100.0	4,112	100.0	2.6

Source: FAO Yearbook, Production 1993 for Mongolia; RIFW's material on forest area in Selenge Aimak; Selenge Provincial Government for provincial data other than forests

The land area of Selenge Aimak accounts for only 2.6% of the total land area of Mongolia. Within Selenge Aimak, farmland accounts for 21.4% and forests account for 14.9%. These figures are relatively high vis-a-vis the corresponding figures for other provinces. In contrast, the grassland in the national land area accounts for only 1.4% which is much lower than in the case of many other provinces.

(2) Population

As of 1993, Mongolia's population stood at 2.25 million (population density 1.4 persons/km^2). The population of Selenge Aimak as of 1994 amounted to 90,220, corresponding to 4.0% of the national population and a population density of 2.2 persons/km^2. Its distribution is as shown in Figure 8. The two cities of Sukhbaatar City (population 20,810, 23%) and Dzuunharaa (population 16,925, 19%) accounted for 42% of the total provincial population.

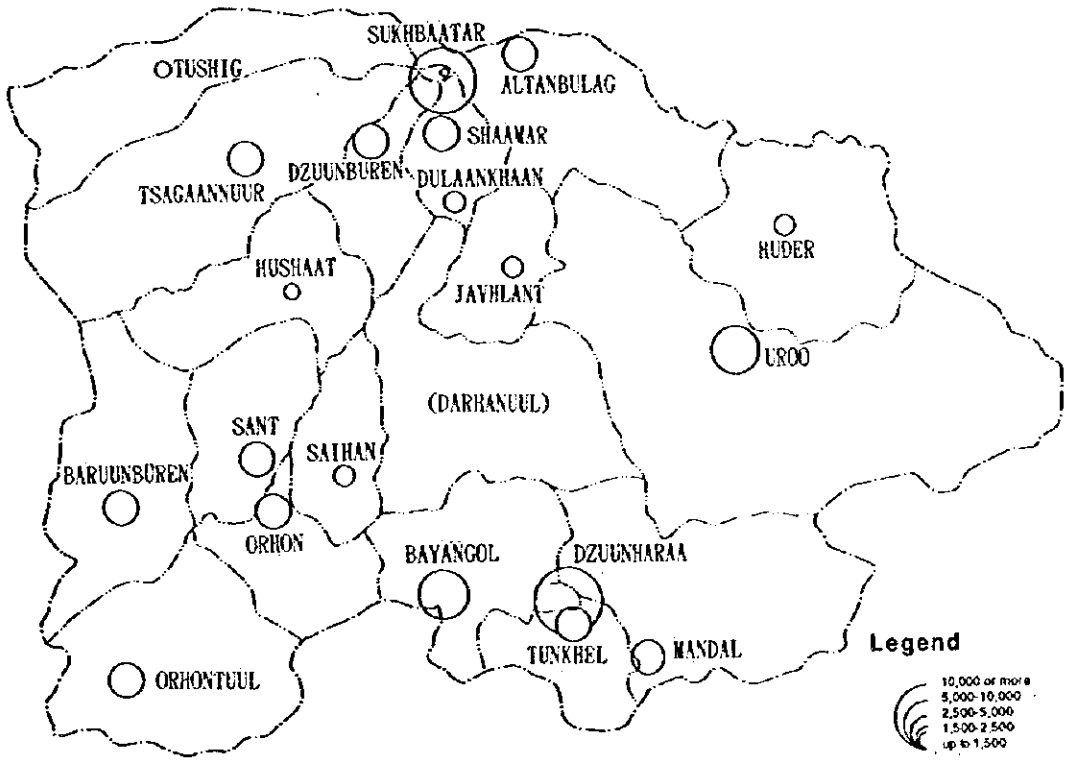


Fig. 8 Population Distribution in Selenge Aimak

(Source: Selenge Provincial Government)

(3) Agriculture

The total farmland area in Selenge Aimak is 299,523 ha, accounting for 21.4% of the whole farmland and farming is conducted by 72 farms and 2 fodder farms (as of 1994). The number of persons engaged in farming and agricultural production volumes are given in Table 8. The production of grain has been steadily declining since 1990 and the production of potatoes also shows a declining trend. All the farms face a problem of deteriorating tractors and other machinery.

Table 8 Agricultural Production in Selenge Aimak

Year	No. of persons engaged in farming	Agricultural Production (ton)		
		Grain	Potatoes	Vegetables
1990	2,547	187,713	29,834	6,536
1991	2,265	171,376	23,831	3,861
1992	2,194	154,313	16,469	2,381
1993	2,347	146,046	9,602	4,356
1994	2,341	123,413	10,385	6,768

Source: Selenge Provincial Government

Table 9 shows the statistics on the agricultural production volumes of Mongolia and Selenge Aimak. Selenge Aimak accounts for 29% of the total national production of grain, underlining its status as the base supplying vegetables and grain to the cities, such as Ulaanbaatar, Darhan, and Erdenet.

Table 9 Relative Importance of Agriculture in Selenge Aimak (Fiscal 1993)

Item	Mongolia (1,000 tons)	Selenge Aimak (1,000 tons)	Compared with domestic (%)
Grain	510	146	29
Root Vegetables/Tuberous Plants	74	9.6	13

Sources: FAO Yearbook, Production, 1993 for national figures; Selenge Provincial Government for local figures

(4) Stock Raising

The number of domestic animals raised in Selenge Aimak in 1994 stood at 496,391 as shown in Table 10. Stock raising data for Mongolia and Selenge Aimak for 1993 are given in Table 11. Selenge Aimak stands at 1.8% in total compared with the domestic stock. By species, the local ratio for cattle is the highest but still only stands at 3.0%.

Table 10 Stock Raising in Selenge Aimak

Year	Number of Domestic Animals					
	Camels	Horses	Cattle	Sheep	Goats	Total
1991	280	34,046	99,205	333,781	32,697	500,009
1992	292	34,925	96,603	312,257	37,806	481,883
1993	275	37,638	85,780	289,986	42,881	456,560
1994	270	38,620	92,964	305,049	59,488	496,391

Source: Selenge Provincial Government

Table 11 Relative Importance of Selenge Aimak in Stock Raising

Animal Type	Mongolia (1,000 heads)	Selenge Aimak (heads)	Compared with domestic (%)
Camels	415	275	0.1
Horses	2,200	37,638	1.7
Cattle	2,819	85,780	3.0
Sheep	14,657	289,986	2.0
Goats	5,603	42,881	0.8
Total	25,694	456,560	1.8

Sources: FAO Yearbook, Production, 1993 for national figures; Selenge Provincial Government for local figures

(5) Industries

The main industrial areas in Mongolia are found in Ulaanbaatar, Darhan and Erdenet in the north and Choybalsan in the east. Industrial activities also take place in Selenge Aimak. The main industrial activities and their geographical distribution in Selenge Aimak are shown in Table 12 and Fig. 9 respectively.

Table 12 Main Industrial Activities in Selenge Aimak

Area		Activities
Sukhbaatar		Weaving and sewing; wood processing; flour milling; fodder production; food processing; matches production
Dzuunharaa		Weaving and sewing; wood processing; metal processing; food processing
Vocant		Wood processing; metal processing
Dulaankhaan		Wood processing
Tunkhel		Wood processing
Reference	Darhan	Weaving and sewing; metal processing; leather processing; food processing
	Sharingol	Coal mining

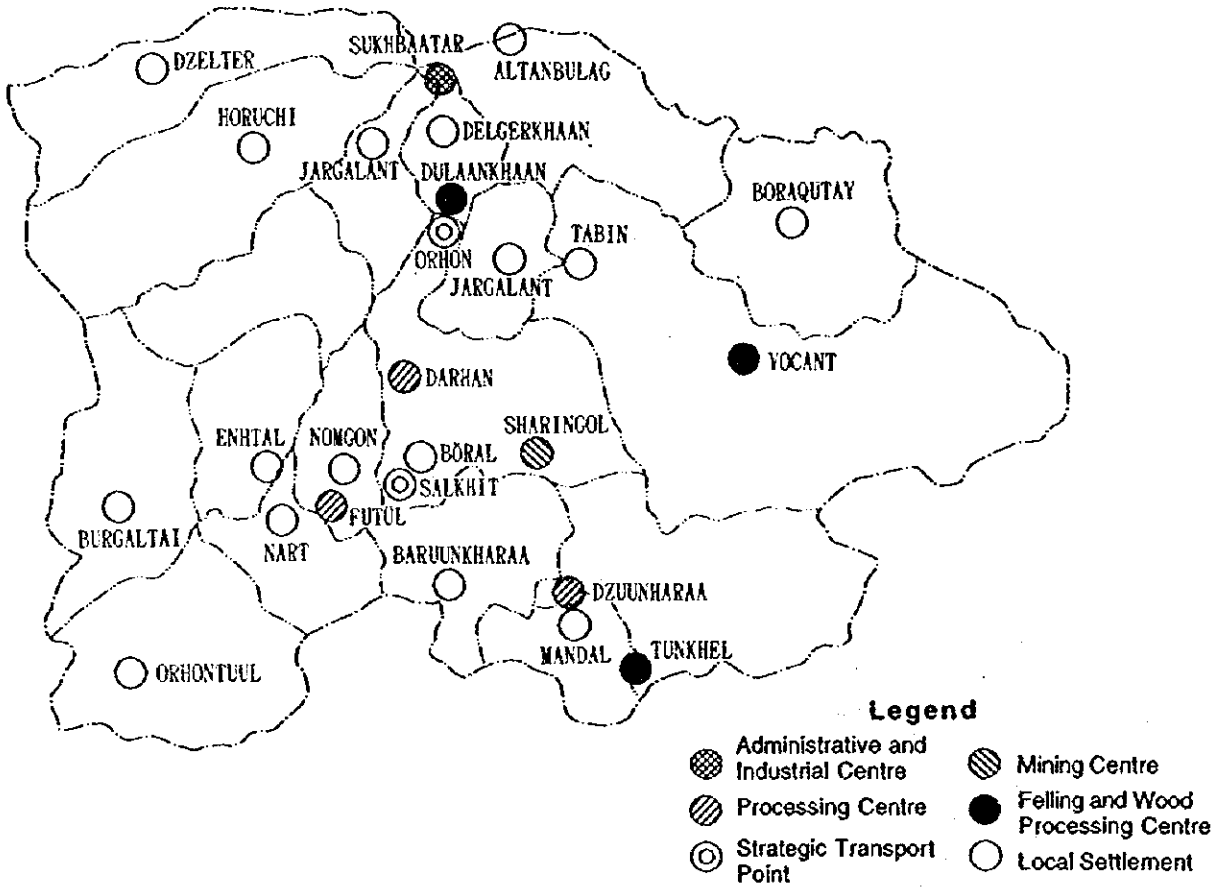


Fig. 9 Distribution of Main Industrial Activities in Selenge Aimak

2.2.4 Specialist Education on Forests and Forestry

The educational institutions in Mongolia comprise general education school (either 8 years of compulsory education or 10 years of compulsory education with additional 2 years), university (4 years) except medical colleges. While schools specialising in agriculture and forestry, etc. existed in the past and Selenge Aimak had a forestry college (abolished in 1994) at Altanbulag to train forestry technicians, to only the universities serve as the educational institutions providing specialist educational on forests and forestry. In addition to the State University of Mongolia, Universities have technical colleges specialising in such single subjects as engineering and agriculture/stock raising, etc. The following two higher educational institutions provide forestry-related education in Mongolia.

1) Faculty of Forest Research of State University of Mongolia (located in Ulaanbaatar)

   The teaching covers a wide range of forest and forestry subjects, including afforestation, forest protection, creation of urban parks, hunting and forest economy. Between 1980 and 1990, the Faculty produced 15 - 20 graduates each year. More recently, however, the annual number of the Faculty's graduates has declined to around 10.

2) Sawing and Machinery Course of Mongolian Institute of Technology

   The teaching subjects cover the industrial field including forestry machinery, sawing and forestry economy, etc. Between 1980 and 1990, the Course produced 10-15 graduates each year. However, the number of graduates in recent years has been around 15.

The graduates of the above two institutions are expected to make the best use of their specialist knowledge at the Ministry of Nature and Environment, RIFW, Forestry Office and sawmills, etc.

2.3 Landsat Data Analysis and Land Cover Map Preparation

2.3.1 Landsat Data Analysis

Landsat data analysis was conducted to clarify the conditions of land cover in the whole of Selenge Aimak.

(1) Acquisition of Landsat Data

The Landsat coverage map of the Study Area is as shown in Fig. 10. According to the map, the Study Area is covered by the 7 scenes. (see Table 13.)

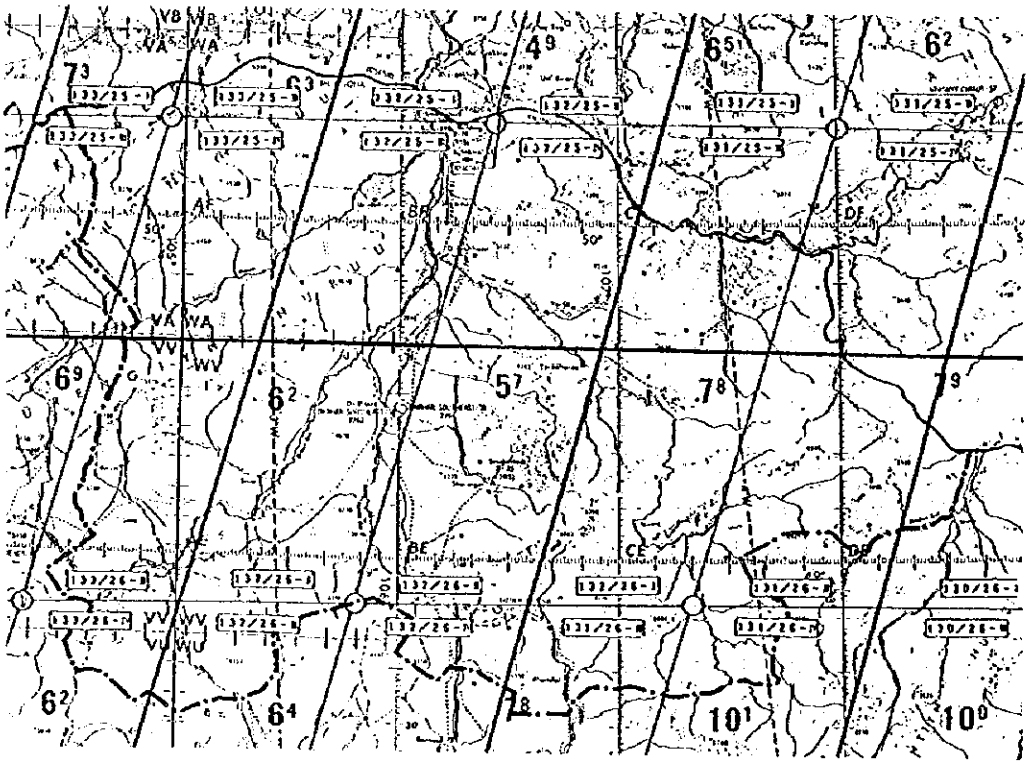


Fig. 10 Landsat Coverage Map

Considering the purposes of the Study, the conditions of the Study Area and characters of the Landsat images, the criteria for the Landsat data selection are summarised as follows.

- Data with no or few clouds

- Data collected in the summer (plant growing period) season
- Data collected recently

As a result of the data selection process, the 15 images listed in Table 13 were finally selected. These data were obtained from the EOSAT company in the US and a China receiving station in the form of positive films. The images were used to create a composite image with a scale of 1/250,000 for the subsequent analysis.

Table 13 Date of Data Collection

Path/Row	Date	From
130-26	24th September, 1989	EOSAT
	5th December, 1989	China Station
131-25	16th January, 1991	China Station
	17th October, 1992	China Station
131-26	7th September, 1989	China Station
	10th September, 1990	EOSAT
132-25	21st August, 1989	EOSAT
	12th May, 1990	China Station
	17th September, 1990	EOSAT

Path/Row	Date	From
132-26	18th June, 1989	EOSAT
	17th September, 1990	EOSAT
133-25	29th September, 1989	EOSAT
	19th May, 1990	China Station
133-26	19th May, 1990	China Station
	15th October, 1992	China Station
7 scenes in total		

(2) Pre-Interpretation and Field Survey

Existing data and maps on the natural conditions and vegetation of the Study Area were collected. Based on these data and information, the environmental characteristics of the Study Area, such as vegetation distribution, topography, soil, land use, seasonal changes of each forest type and present conditions of forest utilisation and protection, etc. were analysed.

Tentative land cover classification criteria were then determined based on the analysis results. For a better and more precise understanding of the Study Area's land cover, two perspectives were employed for these criteria, i.e. vegetation and the topography on which the vegetation grows. The tentative criteria were determined according to the following principles.

- Applicability to both the topography and vegetation in the Study Area and its vicinity

• Possibility of classification using the satellite images and existing data

The preliminary interpretation of both the vegetation and topography on the Landsat images was conducted based on these criteria. (See item (3) for details of the classification items and criteria.)

The field survey was then conducted for the purposes of confirming and correcting the results of the preliminary interpretation and finalising the classification criteria throughout nearly all area of the Study Area.

(3) Land Cover Classification Criteria

As a result of the preliminary Landsat image interpretation and field survey, classification criteria for the land cover (in terms of the vegetation and topography) in the Study Area were established. Each classification category and the relevant criteria are as described below.

1) Vegetation

The vegetation is classified into 9 categories listed in Table 14. The forest area is classified into 4 categories by the most dominant species although mixed forest patches exist in the Study Area. These categories are *Pinus sibirica* forests, *Larix sibirica* forests, *Pinus sylvestris* forests and broad-leaved forests. In addition to these categories, *Abies sibirica* and *Picea obovata* are also members of trees comprising the forest canopy. As they mainly occupy a small area forming mixed forests with *Pinus sibirica* and *Larix sibirica* in the Study Area, however, no independent category for these is introduced. The classification categories other than forests are grassland, farm land, settlements, open air mining and water bodies.

Table 14 Classification Items and Criteria of Vegetation

Category		Standard
Forest	*Pinus sibirica* forest	Forest dominated by *Pinus sibirica*. It includes small patches of *Abies sibirica* and *Picea obovata* forest.
	Larix sibirica forest	Forest dominated by *Larix sibirica*
	Pinus sylvestris forest	Forest dominated by *Pinus sylvestris*
	Broad leaved forest	Broad leaved forest dominated by *Betula platyphylla* and *Populus tremula*. It includes river side forest dominated by *Salix* sp.
Grassland		Area dominated by grass, herbs and shrub species.
Farm Land		Area used for cultivation
Settlement		City and village, excluding nomadic camps.
Open Air Mingin		Open air mining ground.
Water Body		River, lake and pond.

2) Topography

Topography was divided into 7 categories (Mountain/Hill, Water Surface) shown in Table 15 and Figure 11. A linear structure of gully was added to these categories. Standard for each category is as follows.

Table 15 Classification Items and Criteria of Topography

Category	Standard
Mountain, Hill	Topographic feature formed by erosion and having undulations. Generally mountain has high undulations than hill, but here both are put into one category. Inclination is higher than other topographic feature because of its undulations.
Low-relief surface of Summit	Wide and gentle ridgeline developed on top of mountain. This is classified as Low-relief surface of Summit.
Plateau, Terrace	Plateau is a feature which has a very little undulations as a result of erosion of mountain and hill. Terrace is a feature formed along a river, which has a flat terrace surface and a slanting terrace slope. Both of them are bordered by steep slopes and classified from colluvial slope by this characteristics.
Colluvial slope	Gentle slopes formed on foot of mountain and hill are named colluvial slope here. Pediment, colluvial slope and alluvial cone are included. Pediment is a huge gentle slope with little or no surface soil formed on foot of mountain and hill in dry area. It is thought to be formed by flood. Colluvial slope is also a gentle slope formed on foot of mountain and hill. It is formed by the accumulation of earth from back-slope caused by sheetfloods. It is much smaller than pediment. Alluvial cone is a small alluvial fan formed at a mouth of small gorge. It is thought to be formed by sudden debris flow. It is smaller and steeper than alluvial fan.
Alluvial Fan	Accumulation feature formed at the mouth of big gorge. It is formed by accumulation caused by decline in traction energy of stream at the mouth of gorge where stream joins main stream that inclination is more gentle.
Lowland at Valley Root	Low and flat land formed by an accumulation of earth carried by present river. Many rivers meander an old river floors remain in a form of crescent lake.
Water Surface	River, lake and pond (same standard as vegetation)
Gully	A narrow ditch-like topographical feature formed by erosion and separated from the adjoining slopes or other geomorphic surface by steep side walls.

Furthermore, the division of the Study Area by watershed was conducted to identify the distribution characteristics of the land cover categories. Firstly, the Study Area was divided into 7 zones, mainly according to the big rivers (see Fig. 12) and each zone was further divided according to the watersheds, giving the identification numbers A to G for the watersheds.

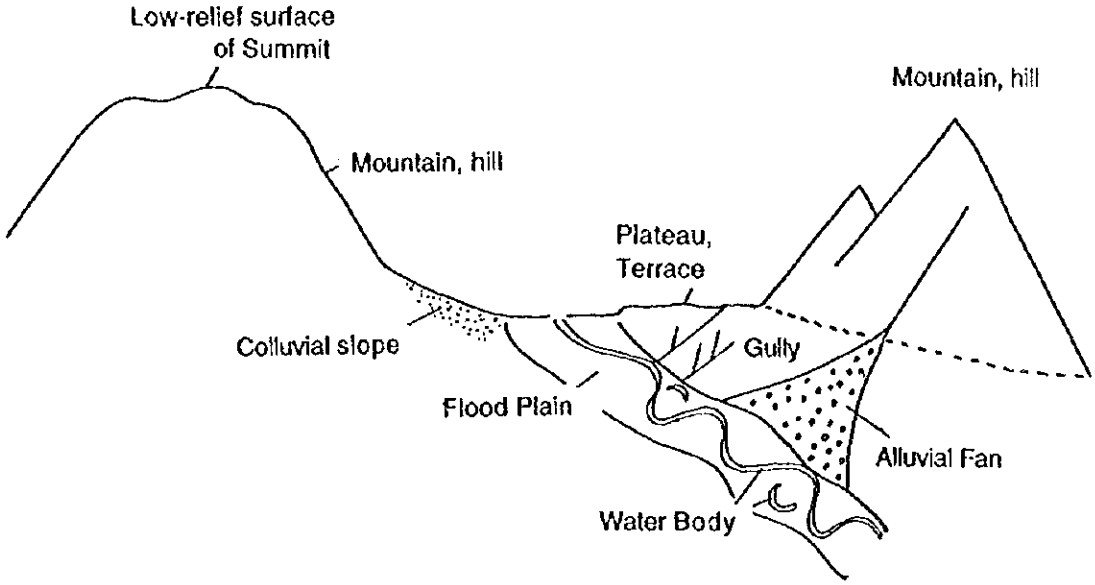


Fig. 11 Illustration of Topographical Categories

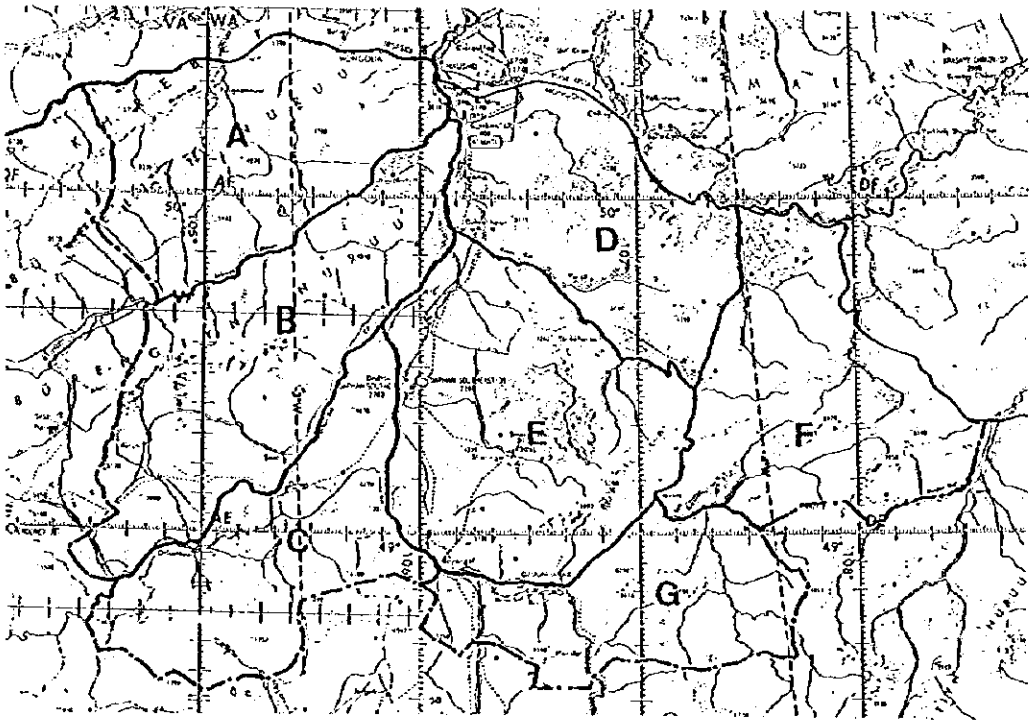


Fig. 12 Zoning of Study Area

Area composition for each category of vegetation and topography in the Study Area analyzed according to the foregoing division is as shown in Table 16. In terms of vegetation category, forest accounts for 40% of the entire study area (about 4.28 million ha) with *Pinus sibirica* forest, *Larix sibirica* forest, *Pinus sylvestris* forest and broad-leaved forest each accounting from 9 to 11%. Meanwhile, grassland and farmland account for 51% and 9% of the study area, respectively.

In terms of topography category, mountain/hill is by far the largest, accounting for 63% of the study area. This is followed by alluvial fan (12%), colluvial slope and plateau/terrace (both 10%). Area composition of forest, grassland and farmland by topographic category is as shown in Figure 13. While 83% of forest and 57% of grassland are located on mountains and hills, 41% of farmland is located on plateau and terrace and 33% on colluvial slope. In the mountain/hill category, forest and grassland account for 52% and 46% of the total area, respectively. The tendency of forests developing on north-facing slopes and grassland developing on south-facing slopes can be observed as a characteristic of area composition for vegetation cover of mountains and hills in the study area.

Area composition by vegetation category in the regional division is as shown in Figure 14. Approximate distribution of forest area and farm area was divided into zones according to these divisions and categories as shown in Figure 15. As can be seen in this figure, forest zones are concentrated around lumber processing centers such as Vocant, Dzuunharaa and Dulaankhaan.

Table 16 Cross-Tabulation of Land Area of Vegetation and Topographical Categories in Study Area

(Unit: ha)

Topography / Vegetation	Mountain, Hill	Low-Relief Surface of Summit	Plateau, Terrace	Colluvial Slope	Alluvial Fan	Flood Plain	Water Body	Total
Pinus sibirica forest	326,899	125,247	0	188	0	7,264	0	459,598
Larix sibirica forest	379,859	19,167	111	2,134	153	9,468	0	410,892
Pinus sylvestris forest	373,344	6,517	58,198	4,039	5	9,589	0	451,692
Broad-leaved forest	331,689	12,599	5,615	10,662	106	19,059	0	379,730
Forest Sub-Total	1,411,791	163,530	63,924	17,023	264	45,380	0	1,701,912
Grassland	1,230,027	13,660	201,778	290,860	18,954	418,164	0	2,173,443
Farmland	48,172	0	160,242	127,956	9,885	45,618	0	391,873
Settlement	172	0	2,793	855	433	1,990	0	6,243
Open-Air Mining	312	0	0	0	0	1,457	0	1,769
Water Body	0	0	0	0	0	0	4,760	4,760
Total	2,690,474	177,190	428,737	436,694	29,536	512,609	4,760	4,280,000

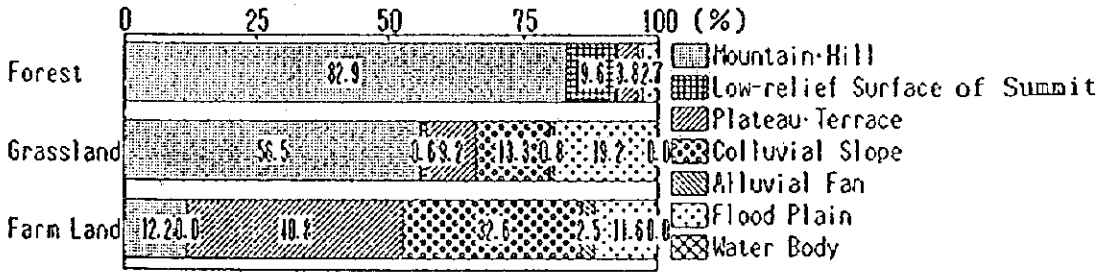


Fig. 13 Breakdown of Forest, Grassland and Farmland by Topographical Categories

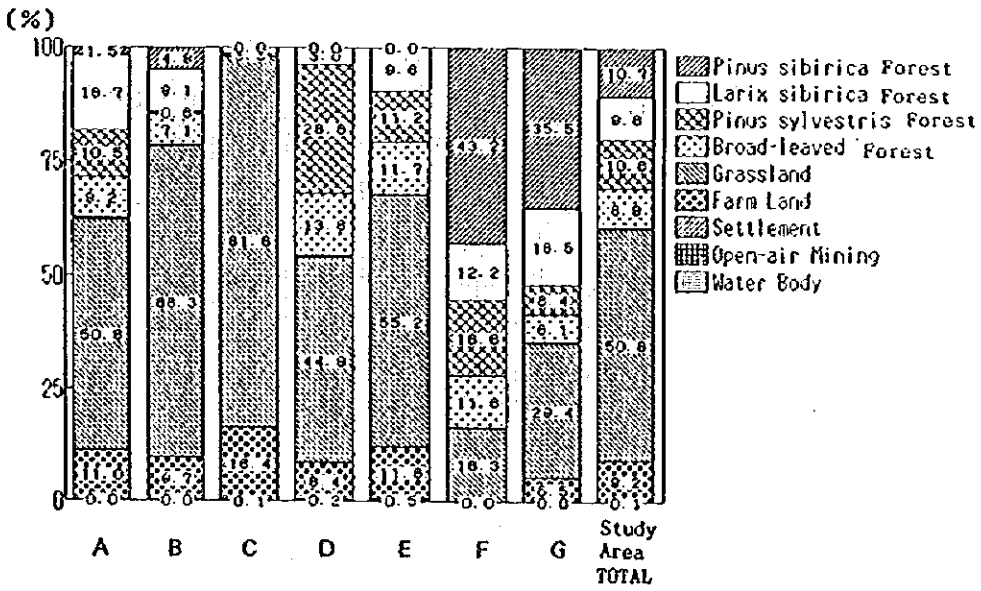


Fig. 14 Land Area by Vegetation Category in Each Zone

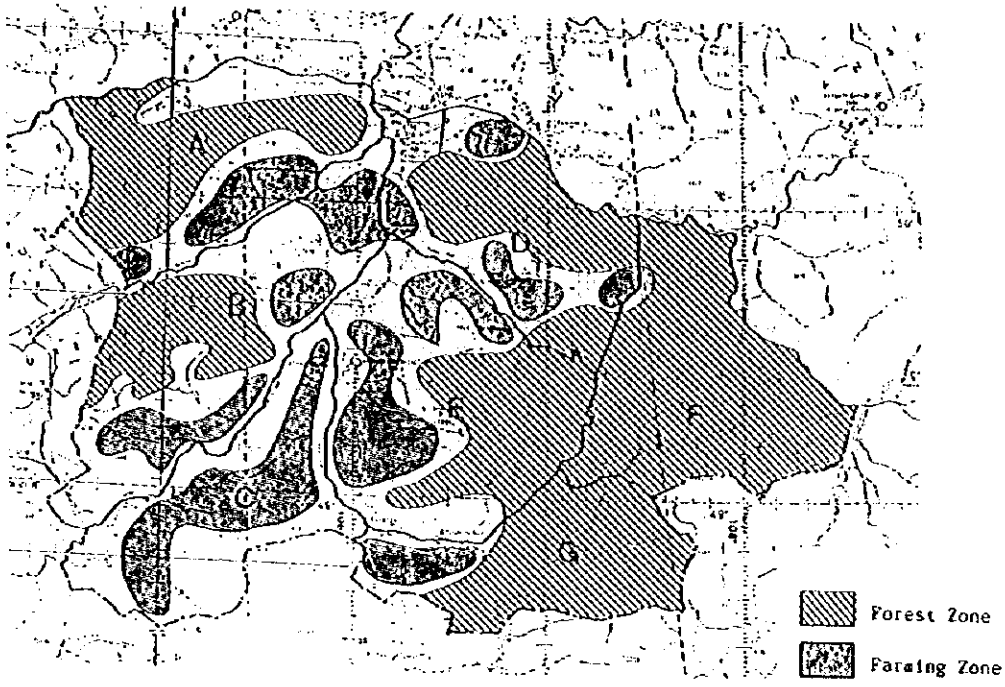
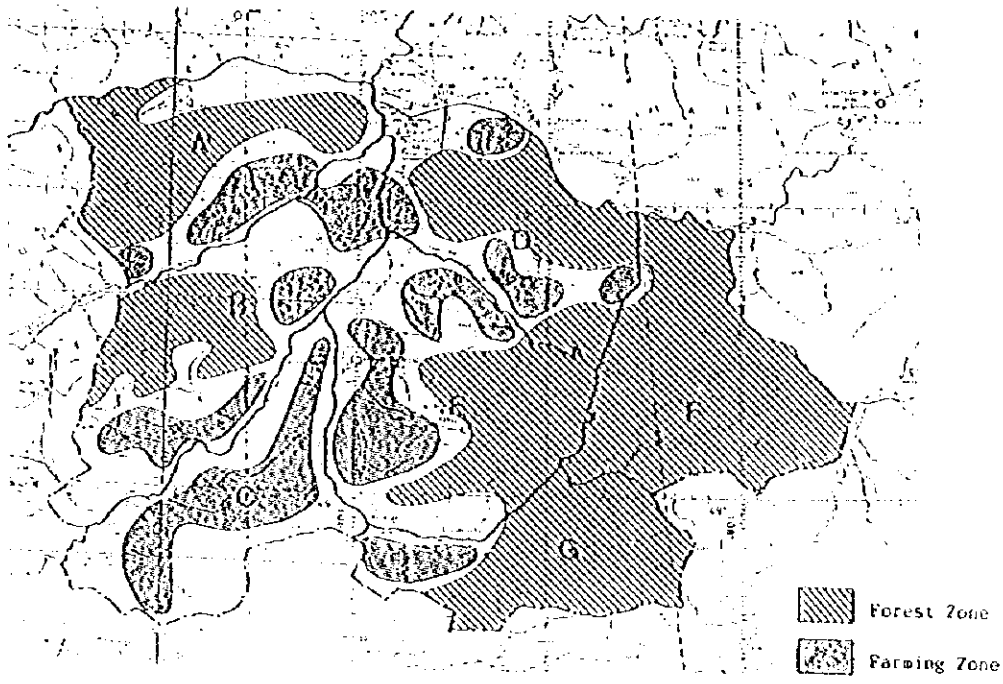


Fig. 15 Forest and Farmland Distribution in Study Area

2.3.2 Preparation of Land Cover Map

Preparation of the land cover map was made using the Landsat images, based on the classification criteria described in Table 14 and Fig. 15. The actual interpretation work used the colour tone, texture, shape and seasonal changes shown on the images as clues while referring to the field survey findings and existing data for collaboration where possible.

This land cover map, in fact, consists of two maps, i.e. a vegetation classification map and a topographic classification map. Each of these two maps is actually made up of 12 transparent overlay sheets to be placed over the corresponding satellite images of the 12 zones of the Study Area. These zones were created taking the Landsat scenes and extent of the Intensive Area into consideration (see Fig. 16). In short, each map is a composite product of these 12 sheets. In addition to the maps, the land cover analysis results for the Study Area were compiled into a technical report.



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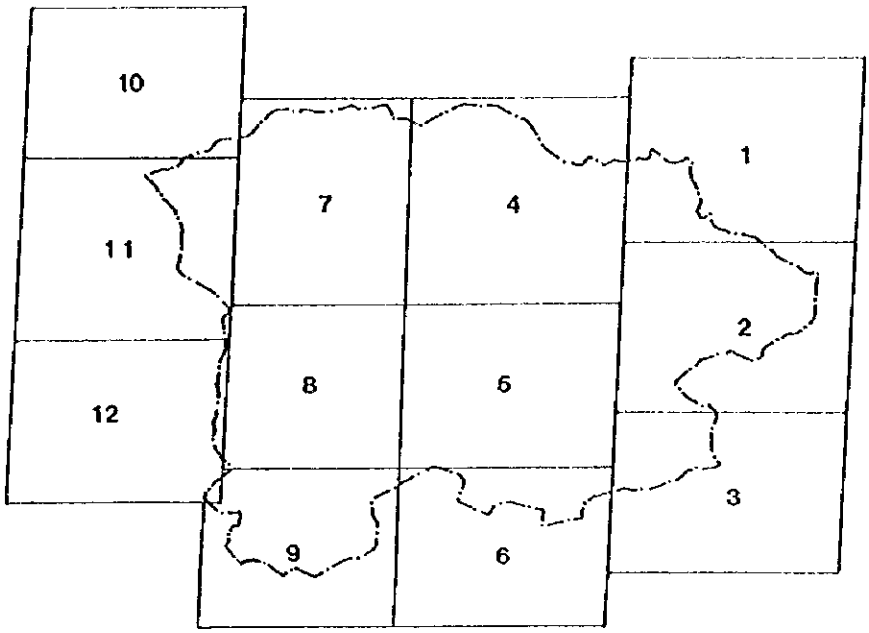

Fig. 16 Zoning for Land Cover Map

The outline of Study Area is summarized below through the preparation of the land cover map. The Study Area almost entirely belongs to the watersheds of Selenge River and its tributaries. Haraa River, a tributary of Orhon River, runs through the center of the Study Area from south to north. In addition, Uroo River merges with Orhon River and then merges with Selenge River at the northern end of Study Area before reaching the Russian border. The centre of the Study Area is occupied by extensive low and flat terrain consisting of alluvial lowland on both sides of these rivers. This lowland is encircled by sloping land, mainly mountains and hills, parts of which house the Intensive Area.

The local vegetation is largely classified into forest vegetation and non-forest vegetation, of which grassland is the predominant form. Several tracts of forest vegetation are found in the mountain/hill areas in the eastern and western parts of the Study Area. In the western part, forest vegetation is concentrated in two areas, i.e. in the Buteeliyn Mountains to the north of Selenge River and in the Burengiyn Mountains lying between Selenge River and Orhon River. In the eastern part, forest

vegetation covers a single, extensive tract of land, principly the watershed of Uroo River and the forests of the Intensive Area form part of the vast area of forest land in the northwestern corner. Non-forest vegetation, mainly grassland, extends from the low, flat land along the rivers to the lower slopes of the mountains and hills. In the border areas between forest land and grassland in the Study Area, the grassland tends to develop on the comparatively much drier south-facing slopes while forests tend to become established on north-facing slopes, creating a striped pattern in many areas.

As described earlier, the forest vegetation is broadly divided into 4 categories, the geographical distribution of which shows certain characteristics, mainly reflecting the elevation and human interference. *Pinus sibirica* forests are found at the higher part of mountains, the elevation of which is 1,500 m or more. Large *Pinus sibirica* forests are observed in the eastern part of the Study Area where the elevation is generally higher than in other parts. As the Intensive Area is hardly above EL 1,500 m, no large *Pinus sibirica* forests are found. *Larix sibirica* forests are mainly found from the middle to the upper slopes of mountains of which the elevation is 1,000 m or more. In terms of the vertical distribution, the Intensive Area is situated below *Pinus sibirica* forests. While *Pinus sylvestris* forests are generally located below *Larix sibirica* forests, many stands of *Pinus silvestris* are mixed with *Larix sibirica* in the border areas. The broad-leaved forests are dominated by *Betula platyphylla* and *Populus tremula*. These forests include pure stands or are mixed with needle-leaved species. Low willow (*Salix* spp.) forests are also included in this category and are found on riversides.

The main form of local non-forest vegetation is grassland which is used for grazing purposes in many places. Low density bushes can be observed on some steep slopes which are characterised by a thin top layer and plenty of gravel. Farmland is developed from grassland and wheat is the main crop cultivated. There are also meadows where fodder for passing winter is collected.

CHAPTER 3

AERIAL PHOTOGRAPHY AND PREPARATION OF TOPOGRAPHIC MAPS

CHAPTER 3 AERIAL PHOTOGRAPHY AND PREPARATION OF TOPOGRAPHIC MAPS

3.1 Aerial Photography and Field Investigation

(1) Aerial Photography

The aerial photography was conducted between June 11th and July 1st, 1994. The aerial photography specifications are as follows.

- Aircraft : AN-30
- Aerial Camera : RC-10 (focal length - 152 mm)
- Standard Photo Scale : 1/25,000 (approximate)
- Standard Flight Altitude : 4,700 m
- Reference Plane of Photography : 900 m
- Aerial Photo Coverage : 1,600 km^2
- Number of Strips : 13 strips
- Standard Overlaps : 60%
- Standard Sidelaps : 30%

The aircraft used was a twin-engine AN-30 which was chartered from Mongolian Airlines (MIAT). Ulaanbaatar Airport was used as the base for the aerial photography. The aerial photographs were taken by a Japanese photographer and the photo-processing, such as developing and printing, was entrusted to the State Administration of Geodesy and Cartography, Mongolia. Following photography, standardized prints were prepared and a decision as to the need for additional photography was made by checking the unclear portions of the photographs, reading disorder (e.g. clouds), picture plane tilt, overlap and sidelap. The flight course was set from north to south and photography records are as shown in Table 17.

Table 17 Aerial Photography Records

Strip	Flight Direction	Serial Photo No.	Arranged P. No.	Flight Date
C-1	W ← E	7391 - 7373	1 - 19	15th June
C-2	W → E	7353 - 7372	1 - 20	15th June
C-3	W ← E	7803 - 7784	1 - 20	1st July
C-4	W → E	7761 - 7783	1 - 23	1st July
C-5	W → E	7738 - 7760	1 - 23	1st July
C-6	W ← E	7650 - 7626	1 - 25	1st July
C-7	W → E	7599 - 7625	1 - 27	1st July
C-8	W → E	7320 - 7352	1 - 33	15th June
C-9	W → E	7662 - 7692	1 - 31	1st July
C-10	W → E	7246 - 7282	1 - 37	15th June
C-11	W ← E	7245 - 7211	1 - 35	15th June
C-12	W → E	7195 - 7210	1 - 16	15th June
C-13	W ← E	7194 - 7179	1 - 16	15th June

(2) Selection of Ground Control Points and Stone Marker

Nineteen new ground control points (GCP) were established in areas where the number of existing GCPs was insufficient as the orientation points for the aerial triangulation, and stone markers were buried. A private Mongolian company was subcontracted to conduct this work.

(3) Signalisation

Prior to the commencement of the aerial photography, 32 aerial signals were established at the new and existing GCPs and levelling points for their proper identification on the aerial photographs in order to ensure successful aerial triangulation.

(4) Ground Control Point Surveying

The ground control point surveying was conducted by closed traversing using the static positioning method of the Global Positioning System (GPS) to determine the coordinates of the newly established GCPs. Part of this ground control point surveying was entrusted to the State Administration of Geodesy and Cartography, Mongolia. In order to harmonise the coordinates of the newly established GCPs with Mongolia's geodetic system, link-up observation was conducted for the

existing 5 GCPs as well as 6 levelling points. The observation method used involved the installation of a GPS receiver at 4 points to simultaneously receive radio signals from 4 or more satellites. Each session lasted 2 hours and a total of 23 sessions were conducted. A total of 23 sessions were observed (see Appendix for closure errors of the vectors, discrepancy of vector of double side length and GPS observation network).

(5) Supplementary Field Survey

The supplementary field survey was conducted covering the two Model Areas (300 km^2). Data and information on the boundaries, local place names and that which could not be accurately identified on the aerial photographs were collected and positioned on the contact prints.

3.2 Preparation of Topographic Maps Using Aerial Photographs

(1) Computation for GPS Analysis

The adjustment computation to link up the newly established GCPs with the coordinates pursuant to Mongolia's existing geodetic system was made using the results of the GCP surveying and available data on the existing GCPs. The coordinates of the new computed GCPs are given in Table 19. The ellipsoid and coordinates system adopted by the State Administration of Geodesy and Cartography, Mongolia are Krassovsky's Ellipsoid (a = 6,378,245.000 m; b = 6,356,863.019 m) and Gauss-Kluegel's plane rectangular coordinate system (origin: BO = 0.00; LO = 105.00).

(2) Aerial Triangulation

Using the coordinates of the newly established GCPs as well as those of the existing GCPs and materials relating to the aerial signals, the aerial triangulation was conducted for 296 stereo models covering the entire Intensive Area (1,600 km^2). Block adjustment of the aerial triangulation was then conducted using the Independent Model software PAT-M43. The results of the block adjustment are as follows.

Discrepancy of tie points				
• Planimetry	S.D.	0.21 m	Max.	0.89 m
• Height	S.D.	0.27 m	Max.	1.04 m
Residual error of triangulation points				
• Planimetry	S.D.	0.49 m	Max.	1.24 m
• Height	S.D.	0.30 m	Max.	0.80 m

(3) Mechanical Mapping

Following selection of the Model Areas of 300 km^2 in the Intensive Area of 1,600 km^2, the topographical features were plotted based on the results of the aerial triangulation and field verification results using an analytical stereo plotter.

(4) Editing and Tracing

The plotted topographic sheets covering the Model Areas of 300 km^2 were edited and traced using ink. The two topographic maps with a scale of 1/25,000 were prepared, one for Model Area 1 and other for Model Area 2.

3.3 Preparation of Topographic Maps Using SPOT Data

(1) Contour Lines

The ground coordinates of random three-dimensional data were computed by the image correlation method using the corresponding points of the left and right stereo SPOT data images. This random three-dimensional data was then rearranged to create a quadrate digital elevation model (DEM). Finally, contour lines were automatically created from the quadrate DEM using computer software and plotted on the map by an auto-plotter.

(2) Orthophotos

Based on the computed ground coordinates described in (1), orthophoto data were produced by rearrangement of the images. These orthophoto data were used to produce orthophotos using a laser printer.

(3) Preparation of Topographic Maps

Topographic maps of the Intensive Area with a scale of 1/50,000 were produced by superimposing the contour maps and orthophotos. Four sheets of topographic map were prepared.

CHAPTER 4

SURVEYS IN INTENSIVE AREA

CHAPTER 4 SURVEYS IN INTENSIVE AREA

4.1 Natural Conditions Survey

4.1.1 Climate

The Intensive Area is situated around Lat. 50°N and on the climatic boundary of the steppe zone and boreal zone. Meteorological observation data of the Sukhbaatar Aimak Meteorological Research Center (Lat. 50°14'10"N, Long. 106°11'50"E, altitude 620m) which is the nearest station to the Intensive Area for the last 9 years is as given in Figure 17 and Table 18.

The mean annual temperature is 0.7°C. The mean maximum monthly temperature ranges from -22.1 °C in January to 19.0°C in July. Highest temperature is 36.4°C in June and lowest temperature is -40.1°C in January.

The annual rainfall is 276 mm, most of which is recorded in summer between May and September, and between July and August a thunderstorm falls, sometimes hailing. On the other hand, hardly any rainfall is recorded in winter. Because of small amount of snow in winter, soil freezing is deeply developed. The relative humidity is approximately 60 - 70% in summer with relatively high rainfall, approximately 60 - 70% in winter when the mean temperature is below 0°C and lower than 50% in April and May. The mean wind velocity is 1 - 3 m/sec and a gentle breeze is observed throughout the year. For the maximum wind velocity, a high wind blows in April and May. From the spring period to the fall period, the frequency of north wind is increased and then north-west wind is increased.

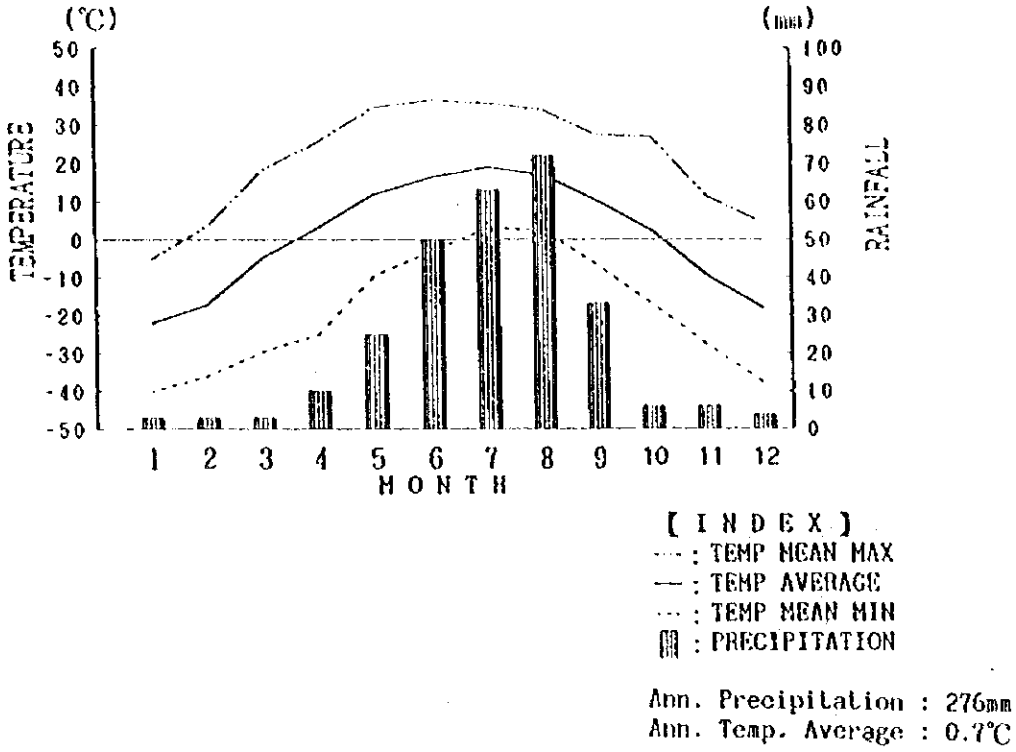

Fig. 17 Climatic Diagramme of Sukhbaatar

Table 18 Meteorological Data Observed at Sukhbaatar

Month	Temperature			Rainfall (mm)	Relative Humidity (%)	Wind Velocity		Wind Direction (%)
	Mean (°C)	Maximum (°C)	Minimum (°C)			Mean (m/sec)	Maximum (m/sec)	
1	-22.1 -28.6 ~ -18.6	-5.3	-40.1	3 0 ~ 8	77 66 ~ 84	1	6 ~ 14	SE = 87.5 S = 12.5
2	-17.3 -19.9 ~ -12.5	3.4	-36.0	2 0 ~ 9	73 63 ~ 80	2	8 ~ 14	SE = 50.0 N = 37.5 S = 12.5
3	-4.9 -9.2 ~ 5.6	18.4	-29.4	2 0 ~ 5	61 57 ~ 66	2	9 ~ 20	S = 37.5 NW = 37.5 N = 25.0
4	3.0 0.5 ~ 5.2	25.6	-25.1	10 2 ~ 30	49 44 ~ 57	3	14 ~ 28	N = 62.5 NW = 25.0 S = 12.5
5	12.1 10.2 ~ 14.3	34.5	-9.4	25 5 ~ 63	49 54 ~ 64	3	14 ~ 26	N = 100.0
6	16.5 15.0 ~ 17.8	36.4	-3.0	50 13 ~ 65	58 54 ~ 64	2	10 ~ 21	N = 87.5 NW = 12.5
7	19.0 17.5 ~ 20.0	35.6	3.1	63 24 ~ 134	66 56 ~ 75	2	9 ~ 20	N = 75.0 S = 25.0
8	17.1 15.8 ~ 18.4	33.9	2.4	72 35 ~ 134	69 63 ~ 78	2	6 ~ 18	N = 87.5 NW = 12.5
9	10.2 8.3 ~ 11.8	27.5	-6.9	33 4 ~ 55	66 56 ~ 69	2	10 ~ 18	N = 100.0
10	2.3 5.8 ~ -0.2	27.0	-17.1	6 0 ~ 16	61 45 ~ 67	2	9 ~ 16	N = 50.0 NW = 25.0 S = 25.0
11	-9.6 -12.7 ~ -6.4	11.3	-28.0	6 1 ~ 16	70 64 ~ 75	2	10 ~ 18	S = 50.0 N = 37.5 SE = 12.5
12	-18.2 -22.2 ~ -11.6	4.5	-37.8	4 0 ~ 6	74 68 ~ 89	2	8 ~ 14	SE = 62.5 S = 25.0 N = 12.5
Mean	0.7	21.1	-18.9	276	—	—	—	—

Note
The table is compiled based on observation data from 1984 to 1992. (Data for 1985 and 1986 are missing.)

Mean Temperature : upper row = overall mean temperature
lower row = fluctuation range of mean temperature

Rainfall : upper row = overall mean rainfall
lower row = fluctuation range of mean rainfall

Relative Humidity : upper row = overall mean relative humidity
lower row = fluctuation range of mean rainfall

Wind Velocity : maximum wind velocity is shown as the monthly maximum wind velocity range

Wind Direction : monthly prevailing wind direction and the percentage of its frequency through the observed duration

The number of rainy days and the amount of rainfall by classification for the period from April to July were aggregated to grasp the rainfall situation in spring and summer. The results are as shown in Table 19. The number of rainy days with daily rainfall of less than 4 mm in May through July is 15 to 16 days/month and most rainy days fall into this grade. The relatively high rainfall in June and July is explained by the increased number of rainy days with daily rainfall of 4 mm or more compared to other months.

Table 19 Number of Rainy Days and Rainfall by Classification from April through July

(Units: days, mm)

Month / Daily Rainfall (mm)	April		May		June		July	
	Rainy Days	Rainfall	Rainy Days	Rainfall	Rainy Days	Rainfall	Rainy Days	Rainfall
Less than 1.0	6.9	2.9	8.5	3.3	8.9	4.1	6.0	3.1
1.0 - 3.9	3.3	5.6	6.3	13.0	7.4	15.1	10.0	23.6
4.0 - 6.9	0.7	3.2	0.6	3.1	3.1	17.2	4.6	25.3
7.0 - 9.9	-	-	0.3	2.1	1.5	12.5	2.0	17.3
10 or more	-	-	0.1	1.8	1.5	20.9	2.3	39.3
Total	10.9	11.7	15.8	23.3	22.4	69.8	24.9	108.6

Source: Sukhbaatar Meteorological Research Center; average figures for 1987 through 1994

Fig. 18 indicates that the annual rainfall figure above EL 800 m in the Intensive Area is 300 - 350 mm which is slightly higher than the annual rainfall at Sukhbaatar. At the same higher elevation areas, the mean winter temperature in January is slightly higher than that at Sukhbaatar while the mean summer temperature in July is slightly lower. These tendencies become increasingly prominent in accordance with the higher elevation.

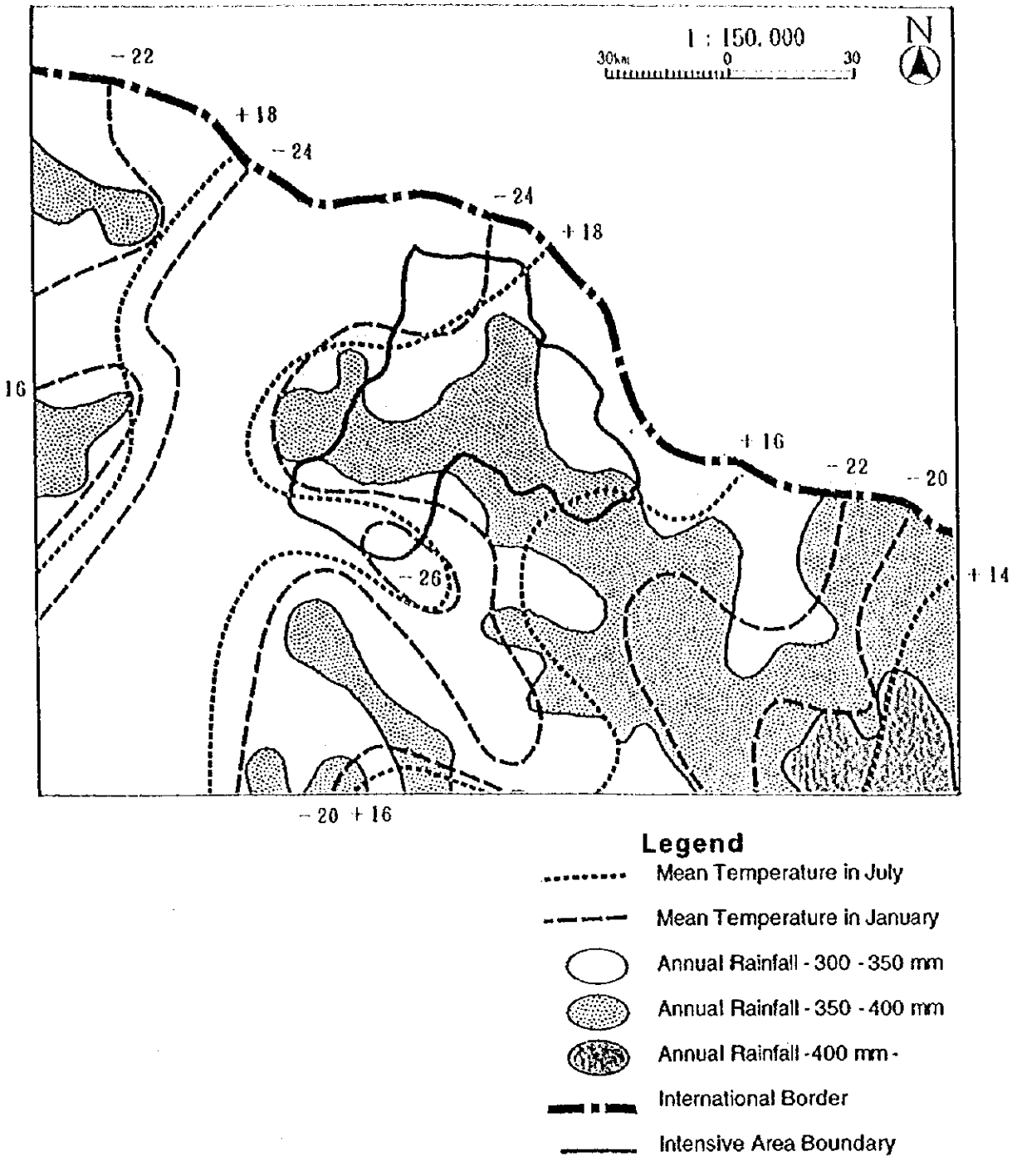

Fig. 18 Climatic Zone Map

4.1.2 Topography and Geology

Most parts of the Intensive Area are in the altitude range of between 650 m and 1,500 m with Mt. Delgilhaan, located at its western boundary, being the highest point at 1,553 m. In the Intensive Area, 1,300 class mountains run eastwards from Mt. Delgilhaan while 1,000 m class mountains, with Mt. Hatotto, Mt. Hangai and Mt. Shuluut comprising the major peaks, run north - south. Gentle slopes lie at the summit of these mountains. Terraces and alluvial lowland spread extensively in areas below approximately altitude 850 m. Geologically, the mountains contain andesite, schist, tuff, rhyolite, porphyry (all of which are formed in the Triassic Period), granite, granodiorite and gabbro, etc. (see Fig. 19). In general, south-facing mountainsides are steep and have many outcrops of various rocks while north-facing ones are not so steep and often have pediments. As this tendency appears to be common irrespective of the base rock type, strike and dip of stratum, it is reasonably believed to be the result of erosional process reflecting the different climatic conditions governing north-facing and south-facing slopes.

Along the tributaries of Chikey River and Uroo River are terraces consisting of sediments of sand, gravel and mud, the surface layer covered with a thick sand layer. Many of the terrace surfaces show a rolling pattern due to erosion. A series of high terrace scarps are observed along rivers with deepening. A series of valley bottom lowlands is also observed along major streams while many well developed alluvial cones are observed from the piedmonts to the lowland.

4.1.3 River Systems

The river systems in the Intensive Area originate from those mountains running east-west or north-south in the central area. Three watersheds, i.e. Herane River watershed in the central area, Chikey River watershed in the east which extends into Russian territory and Uroo River watershed in the southwest, cover most of the Intensive Area. Herane River originates from Mt. Delgilhaan, crosses the central part of the Intensive Area from the south-west, meets a number of tributaries originating from the Hangai mountain range and joins Chikey River across the Russian border. On entering the flat land across the Russian border from the mountainous Intensive Area, Chikey River flows into a swamp into which the tributary in the Chikey River also flows. Uroo River greatly meanders from east to west through the flat land near the Intensive Area and eventually joins Orhon River (see Fig. 20).

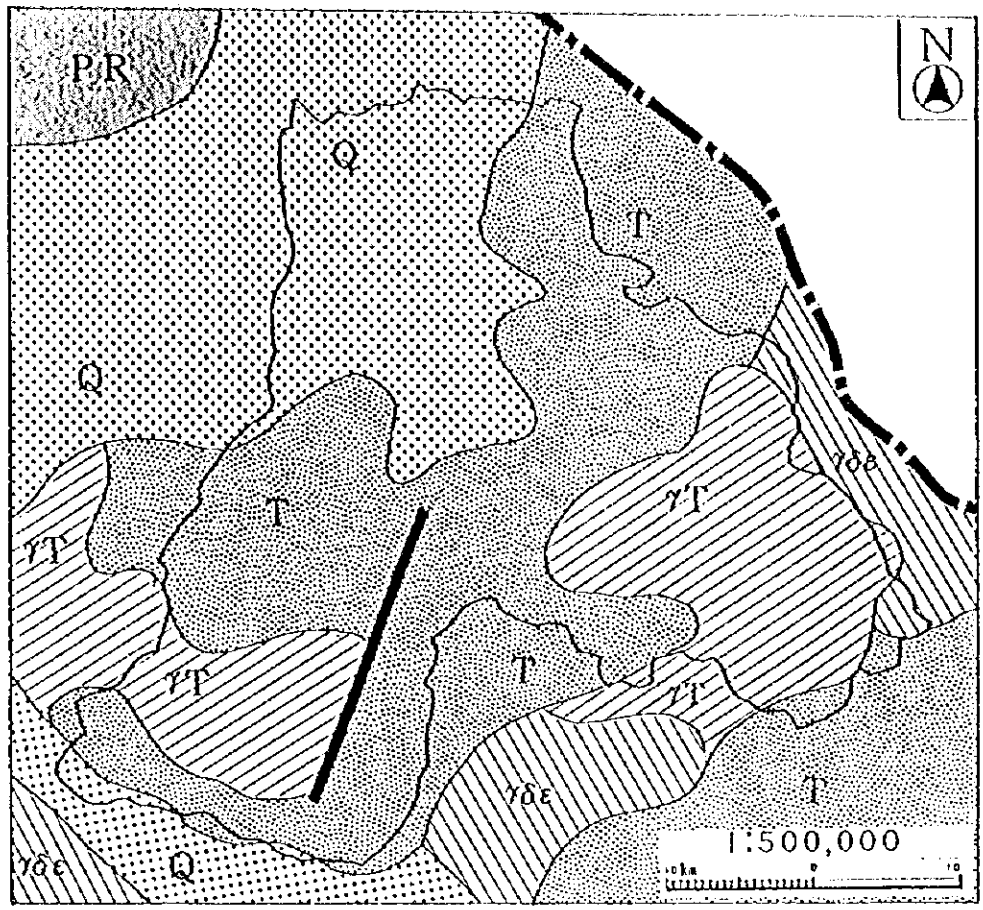

Fig. 19 Geological Map

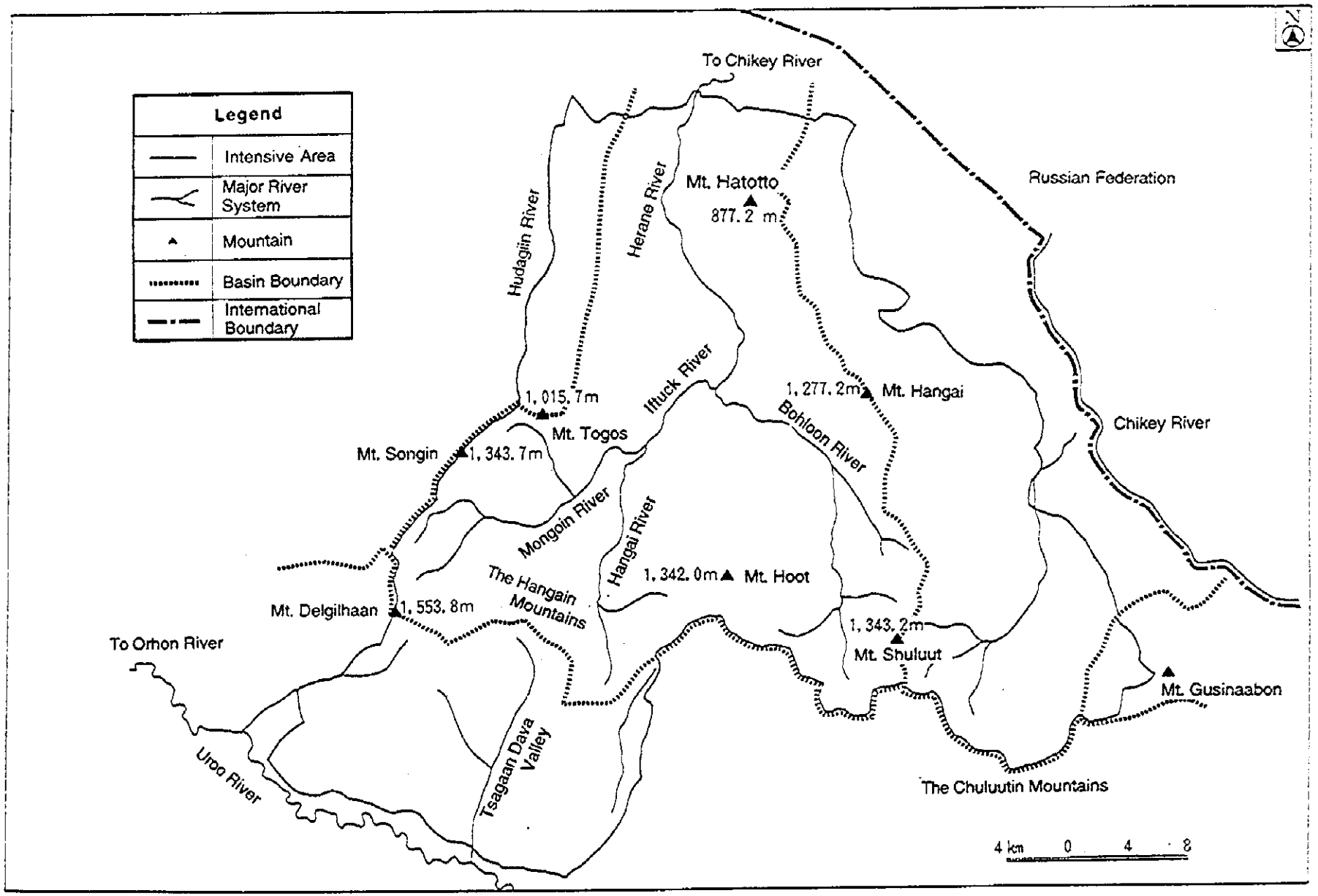

Fig. 20 Topographical Outline Map

4.1.4 Soils

The soils in the Intensive Area are largely classified into Cambisols and Leptosols which are mainly distributed at steep mountains, Kastanozems at pediments, Arenosols at terraces and Fluvisols at valley bottom lowlands. The Soil Map of the World (Vol. VIII, 1978) of the FAO-UNESCO also indicates the distribution of Podzolvisols, Greyzems and Chernozem. These soils were not confirmed at the field but their existence is highly Plausible. The existence of Podzols and Chernozems is also indicated by a Mongolian publication (Atlas of Selenge Aimak, 1985) which classifies Cambisols and Fluvisols in the categories of Brown Forest Soils and Meadow Soils respectively.

4.1.5 Vegetation

(1) Distribution

The vegetation in the Intensive Area and its neighborhood consists of forest communities commonly called taiga which are a kind of coniferous forest, having developed as zonal vegetation under the subpolar climate. The species growing in these taiga must be capable of withstanding extremely low temperatures of below -30°C in winter and consist of coniferous trees belonging to the *Abies*, *Picea*, *Larix* and *Pinus* genera and broad-leaved trees belonging to the *Betula* and *Populus* genera.

Within the Siberian taiga, the Intensive Area is located in the southern part of the Lake Baykal catchment carea. The main species in the Intensive Area are *Pinus sylvestris* and *Larix sibirica*. Broad-leaved trees of the *Betula* and *Populus* genera are also observed. While *Pinus sylvestris* is seen throughout the Intensive Area, *Larix sibirica* only begins to appear around EL 800 m with large stands being distributed in areas of more than EL 1,000 m. The Intensive Area and its neighbourhood is an area where climax forests are found in the form of pure *Pinus sylvestris* forests, *Larix sibirica* forests or coniferous mixed forests of these two species.

The stratification of these forest communities consists of a tree layer, shrub layer, herb layer and moss layer. In many cases, however, the tree layer and moss layer are the only visible layers as the species and coverage of the shrub layer and herb layer are not extensive. One characteristic of these forest communities is that broad-leaved trees belonging to the *Betula* and *Populus* genera invade areas which have become bare due to forest fires or cutting, creating uniform broad-

leaved forests or mixed forests of coniferous and broad-leaved trees. Compared to coniferous forests, the shrub layer and herb layer of these new forest communities have more species and coverage. There are observed many traces of forest fire sites and cut-over sites in the Intensive Area and its surroundings and, therefore, only a small number of virgin coniferous forests are observed.

The soil moisture at the south-facing slopes of mountains is much lower than at north-facing slopes due to the drying effect of direct sun, etc. and is covered with grass and plants in place of tall trees. *Ulmus pumila* and rosaceous shrubs as *Malus pallasiana* grow on grassland in places.

The plains, such lowland at valley root, erosion plateaus, and terraces are dominated by pasture. The forests in the plains are mainly pure *Pinus sylvestris* forests although pure *Betula platyphylla* forests and mixed forests of coniferous and broad-leaved trees can be seen at sites which were once laid bare by forest fire or cutting, etc. Stands of the *Populus* genus are observed in band form along rivers. A total of 250 species of 50 families are observed in the Study Area, the predominant tree species of which are listed in Table 20.

Table 20 List of Main Tree Species

Family	Species
Pinaceae	*Larix sibirica*
"	*Pinus sylvestris*
Betulaceae	*Betula platyphylla*
"	*Alnus fruticosa*
Salicaceae	*Populus suaveolens*
"	*Populus tremula*
"	*Salix pentandra*
"	*Salix pseudopentandra*
"	*Salix triandra*
Ulmaceae	*Ulmus pumila*
Rosaceae	*Padus asiatica*
"	*Malus pallasiana*
"	*Rosa acicularis*
"	*Spiraea media*
"	*Spiraea salicifolia*
"	*Cotoneaster melanocarpa*
"	*Amygdalus pedunculata*
"	*Armeniaca sibirica*
"	*Rubus sachalinensis*
Saxifragaceae	*Ribes rubrum*
Berberidaceae	*Berberis sibirica*
Ericaceae	*Rhododendron dahuricum*
Caprifoliaceae	*Sambucus sibirica*
Leguminosae	*Caragana pigmaea*

Note: Arranged from RIFW data.

(2) Plant Species to Require Special Attention

Of the main species observed in the Intensive Area, the 3 species to require special attention, as listed in Table 21, were abstracted from 133 extremely rare species stipulated by the Natural Plant Law of Mongolia and 82 pieces included in the Mongolian Red Data Book of 1986.

Table 21 Plant Species to Require Special Attention in Intensive Area

Species	Classification A	Classification B
Juniperus sabina	○	—
Lilium dahuricum	○	○
Rhododendron dahuricum	○	—

Classification A : category of extremely rare species of the Natural Plant Law of Mongolia
Classification B : listed in the Mongolian Red Data Book of 1986

4.1.6 The Fauna

(1) Distribution

Due to the rich vegetation by Mongolian standards, ranging from forests to grassland, marsh, and swamps, rich fauna are also observed in the Intensive Area. The main wild mammals and birds which likely inhabit the Intensive Area and its surrounding areas are 32 mammalian species of 14 families of 6 orders and 45 bird species of 25 families of 11 orders (see Appendix 6).

Based on traces of the fauna, the most common local large mammals are believed to be *Capreolus pygargus* and *Cervus elaphus*, both of which belong to the Cervidae family and the habitat of which extends from forests to grassland. They are also frequently sighted near gels and farming fields. *Alces alces* mainly live in forests but traces are also observed in open grassland in forests and at swamps. Traces of *Sus scrofa* are observed in forests and in forest border areas.

In regard to *Canis lupus* which prey on Cervidae and the raised domestic animals, their traces suggest that the number of individuals is small and that the habitat overlaps with that of Cervidae.

While the main habitat of *Ursus arctos* is believed to be forests, they appear near gels when nuts, which comprise their main diet, are poorly grown. Therefore, the area in which they are found extends outside forests depending on the availability of food in each season or year. In a year with a poor harvest of nuts, the damage caused to domestic animals is said to be much worse than in a year with a good harvest.

(2) Wild Animals to Require Special Attention

Of those species that are presumed to inhabit the Intensive Area and its surroundings, there are 2 mammals and 2 aves that require special attention as shown in Table 22. This is based on the fact that they are either included in the category of extremely rare by the Hunting Law of Mongolia (11 mammals and 6 aves) or listed in the Mongolian Red Data Book of 1986 (23 mammals and 19 aves).

Table 22 Mammalian and Bird Species to Require Special Attention in Intensive Area and Surrounding Areas

Species	Classification A	Classification B
Mammals		
- *Alces alces*	○	○
- *Moschus moschiferus*	○	○
Aves		
- *Pandion haliaetus*	○	—
- *Otis tarda*	○	—

Classification A : listed in the Mongolian Red Data Book of 1986
Classification B : category of species with extremely small number of individuals of the Game Law of Mongolia

4.2 Socioeconomic Conditions Survey

4.2.1 Location of Intensive Area

In terms of the administrative background, the Intensive Area mainly belongs to the Altanbulag District (parts of the southwestern area belong to Shaamar District, Javhlant District or Uroo District). The Intesive Area extends to Lat. 49°47'47" - 50°16'40" and Long. 106°18'20"-107°8'20" E. Altanbulag where the office of the Altanbulag District is located is linked to Sukhbaatar by a state road of some 24 km in length. Beyond Altanbulag, the road is unpaved and the northwestern edge of the Intensive Area is about 10 km away (see Fig. 21).

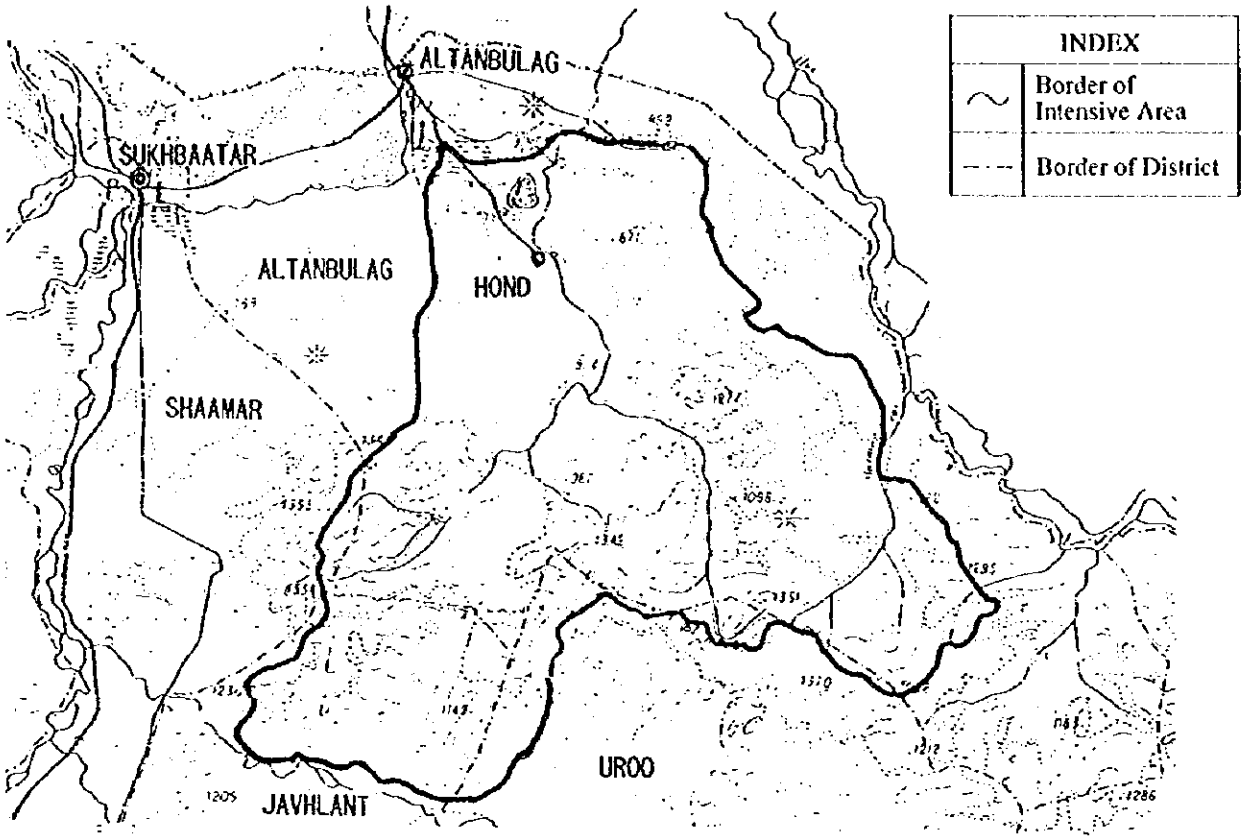

Fig. 21 Location of Intensive Area

4.2.2 Population

The total population of the Altanbulag District was some 3,283 and its population density was 1.2 persons/km^2 as of December, 1994, the details of which are given in Table 23.

Table 23 Population of Altanbulag District (1994)

Age	Total	Population		
		%	Male	Female
1 - 6	580	17.7	301	279
7 - 8	1,178	35.9	544	634
19 - 59	1,421	43.3	686	735
60 -	104	3.2	64	40
Total	3,283	100	1,595	1,688

Source: Altanbulag District Office (1994)

There are a total of 805 households and the average number of people per household is approximately 4. Some 80% of the entire population live in Altanbulag, the district's main town, and its vicinity which provide such places of employment as a hospital, school, administrative office, post office and shops, etc. There are 6 large enterprises in the Altanbulag District which are engaged in farming and stock raising activities.

Some 200 people are engaged in farming, some of which live in or near Altanbulag and which only move to a house near their farmland, with or without their families, during the farming season while others permanently live near their farmland. A total of 392 people are engaged in stock raising. Thirty-five people are unemployed. While 215 people (90 men and 125 women) are engaged in private work, some can be classified as potentially unemployed as sufficient work is unavailable.

The Intensive Area has farms of 3 farming enterprises and 3 tourist facilities run by the state government, provincial government and a private enterprise respectively. Gels belonging to nomads are observed at grassland. Forty households with 160 people live in Hond, the largest settlement in the Intensive Area.

4.2.3 Industry

(1) Farming

The farming area in Altanbulag District is some 12,128 ha, accounting for 4.6% of the total land area of 264,357 ha of the district which is lower than 7.3% for Selenge Aimak. The method of cultivation is crop rotation of cultivating one year and fallow the following year.

The farming outputs of the Altanbulag District are shown in Table 24.

Table 24 Farming Outputs of Altanbulag District (1994)

F.Y.	Number of Farmers	Output (tons)		
		Grain	Potatoes	Vegetables
1994	200	2,860	1,081	1,200

Source: Altanbulag District Office

The share of Altanbulag District in the farming output of the entire province is 2.3% for grain, 10.4% for potatoes and 17.7% for vegetables, indicating a high percentage of potatoes. Vegetable crop has become popular in the recent years with 400 households growing tomatoes, cucumber, cabbage, onion, radish and carrot. The outline of the 3 farming enterprises in the Intensive Area is as shown in Table 25.

Table 25 Farming Enterprises Operating in Intensive Area

Enterprise	Year of Establishment	Business Size	Machinery Owned	Number of Employees	Working Period	Remarks
A	1960: Reorganized as a limited company in 1990	Wheat: 1,000 ha 800 tons/year Potatoes: 150 ha 1,000 tons/year Land area owned: 1,500 ha	Tractors: 12 Combines: 11 Trucks: 1 Jeeps: 1 Others: 1	40	End of March to end of October	Also owns domestic animals, the fostering of which is entrusted to stock raising people
B	1968: Reorganized as a limited company in 1992	Wheat: 1,200 ha 1,500 tons/year	Tractors: 8 Combines: 7 Trucks: 2 Jeeps: 1	30	Permanent settlement	As above
C	1975: Operates as a limited company at present	Cabbages output: 500 tons/year Potatoes and others	Tractors: 5 Trucks: 2 Jeeps: 2	20	February to October	

All of these enterprises were formerly cooperatives during the age of the People's Republic but were reorganized as limited companies following the country's shift to a free economy. All the machinery was inherited from the time of the cooperatives and is rather deteriorated. However, the funds for replacement are unavailable. As the business prospects of these enterprises are rather bleak, there is currently talk regarding a merger in view of their survival.

(2) Stock Raising

The current conditions of stock raising in the Altanbulag District are shown in Table 26.

Table 26 Number of Domestic Animals in Altanbulag District (1994)

F.Y.	Number of people owing domestic animals	Number of domestic animals					
		Camels	Horses	Cattle	Sheep	Goats	Total
392	392	6	1,724	4,010	7,800	1,293	14,833

As stated earlier, a couple of farming enterprises also have some domestic animals, the fostering of which is entrusted to stock raising people. This means that some stock raising people raise domestic animals of their own while others raise animals entrusted to them as well as their own animals. Table 27 shows typical examples of these two types of stock raising people.

Table 27 Family Composition of Nomads and Number of Raising Domestic Animals

Family Composition	Domestic Animals (heads)						Frequency of Shifting (times/year)
	Division	Horses	Cattle	Sheep	Goats	Total	
Family A: 13 members with 4 gels (couple, 8 children, mother and grandparents)	Ownership	30	20	150	10	210	5 - 7
Family B: 7 members with one gel (couple, 5 children)	Ownership due to commission	16	13	10	16	55	3 - 4
			60	200		260	
	Total	16	73	210	16	315	

In Mongolia there are no legal restrictions on grazing in forests if found necessary, excepting at plantations.

As far as the Intensive Area is concerned, nomads change their grazing sites several times each year. As there appears to be no shortage of grazing land, pasturing people appear to have freedom of movement. In winter, they stay in one place for the entire season.

(3) Tourism and Recreational Facilities

The Intensive Area has a state-run camping site for children, a recreational facility run by the provincial government and a privately-run tourist hotel as outlined in Table 28.

Table 28 Tourism and Recreational Facilities

Ownership	Location	Facility Details	Number of Employees	Open Period	Remarks
National Children's Centre	Gun Nuur Area	Camping site for 240 children; 1,000 children stayed in 1994	20 (5-6 in winter)	End of June to end of August	Many stay for around 10 days
Province-run Hond Recreation Centre	Hond	Accommodation capacity for 50 guests; hall and canteen; 3,500 people stayed in 1994	15	As above	Many guests stay for the weekend
Private Enterprise	Gun Nuur Area	Accommodation capacity for 30 guests with one building and 2 gels; 600 Mongolian and 100 foreign guests stayed in 1994	6 (one in winter)	As above	

4.2.4 Infrastructure

(1) Roads

No asphalt paved road and gravel paved road exist in the Intensive Area, all of which are dirt roads. Of these roads, the most important natural roads are one stretching from Altanbulag to Hond and another stretching from Altanbulag to Uroo. The roads crossing grassland are, in fact, naturally formed paths due to the frequent passage of vehicles and the roads in the forests are also similar, while in addition to these roads, some roads are constructed for the hauling of logs. Fig. 22 shows the network of the main roads in the Intensive Area.

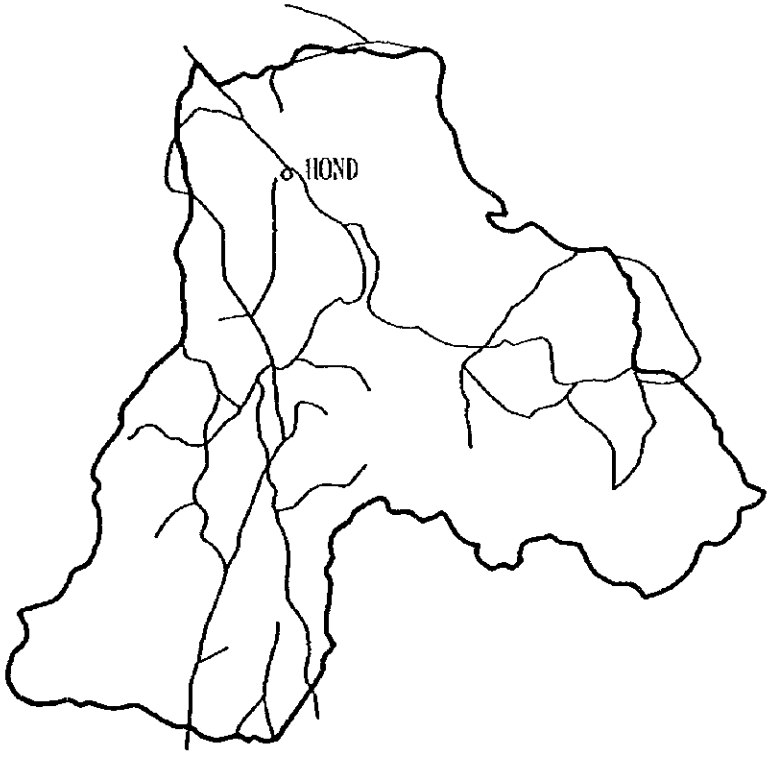

Fig. 22 Network of Main Roads in Intensive Area

These roads have the following characteristics.

1) As the road network was not constructed according to any plan, road distribution is uneven. In addition, roads are blocked in some areas as bridges are nothing more than a row of logs. For this reason, access to certain parts of the Intensive Area by vehicle for forest inventory purposes is difficult as it requires many hours before reaching the destination. (In Mongolia, horses are used as the means of transport for forest inventory purposes.)

2) As the roads are not paved, vehicle speed is significantly reduced on rainy days due to tire slippage. In particular, owing to lack of drainage facility, there are areas where the water from the rain accumulates as well as areas where road surface is eroded or collapsed by flowing water from the rainfall.

(2) No telephone exists in the Intensive Area, so that people cannot interconnect with persons other than this area, except for installation of radio equipment.

4.3 Forest and Forestry Survey

4.3.1 Forest and Forestry Related Laws

(1) Forest Law of Mongolia

The basic law regarding forest and forestry in Mongolia is the Forest Law which was enacted in 1974. Following the shift towards democracy, however, a new Forest Law went into force in June 1995. At the same time, such related laws as the Mongolian Land Law, the Mongolian Environmental Protection Law, the Mongolian Special Protected Area Law and the Hunting Law were revised. The new Forest Law stipulates that all forests continue to belong to the state but that the authority for forest management and utilization is substantially decentralized to local administrative bodies. In addition, clear cutting has been prohibited and more than 70% of the income from forest use must be allocated for protection and restoration of the forest.

Forest resources are divided into strict zone forests, protected zone forests and utilization zone forests.

1) Strict zone forests

Strict zone forests are comprised of subalpine forests, strictly protected areas, pristine zones/conservation zones, national conservation parks and special zones and are area in which natural features of the forest and its environmental balance is maintained. All activities except for forest fire prevention and blight prevention are prohibited in these forests. (A total of 28 nature reserves, totaling 10.1 million ha and including Mt. Bogd, Mt. Balkan and Mt. Kholgol have been designated as strictly protected forest by the central government by 1993.)

2) Protected zone forests

Protected zone forests are comprised of green zones[1], prohibited strips[2], *Haloxylon ammodendron* forests, small forests with an area under 100 ha, brushes and small woods on slope facing south and woods on steep slope with an inclination of 30° or more. All activities except for salvage cutting and removal of damaged trees to protect and foster the forest and to increase its natural growth and rejuvenating capacity, harvesting of firewood for household use and use of byproducts. Green zones (except for the capital) are designated by the council of representatives from the provinces on the recommendation of the State Central Administrative Organization.

3) Utilization zone forests

Utilization zone forests include all forests that are not located in strict zone forests and protected zone forests. Individuals, enterprises and organizations are permitted to harvest firewood for commercial purposes in return for payment of forest utilization fee. However, cutting of and damage to young trees and special trees[3], cutting of stand in clear cutting method, unauthorized hay making and grazing are prohibited in utilization zone forests.

(2) The Mongolian Law on Special Protected Areas

The Mongolian Law on Special Protected Areas, which went into effect in 1994, was enacted for the purpose of protecting unique vegetation, rare animals and plants, historical and cultural monuments and natural landscapes in the natural zones of Mongolia. With regard to "Special Protection Zones," the law stipulates on research and study activities as well as activities such as utilization and acquisition of Special Protection Zones and preservation and conservation of pristine condition. As shown in Table 29, Special Protection Zones are divided into 4 groups and into further subgroups.

1) A green zone is created around a city (not including the capital) or village to maintain environmental balance and offer fresh environment to the people and is created within 30 km of the perimeter of the residential area of a city or village.
2) Prohibited strips are comprised of the following forests and play an important role in preventing soil erosion and in maintaining the balance of surface water and ground water.
   a. Forests within 5 km periphery of the headwater area of a river or a lake
   b. Forests within 3 km periphery of a river bank, mineral water and spring
   c. Forests within 1 km of both side of state road or railway roadbed
3) Cutting or damaging of fruit-bearing species and shrub such as *Abies sibirica*, *Rhamnus* spp, *Populus diversifolia*, *Elaeagnus* spp, *Cornus* spp., *Tamarix* spp., *Sambucus* spp., *Sorbus* spp. and *Hippophae* spp.
   Cutting of *Pinus sibirica*, *Picea obovata* and *Ulmus* spp., etc. without the official permission.

① "Strictly protected areas" are areas where consideration is given for special protection in view of the characteristics, scientific importance and ecological balance of the pristine environment. In addition, activities that will alter or destroy the environmental elements in the said zones will be prohibited as a rule.

② "National conservation parks" are areas in which the pristine environment is relatively well-preserved and have importance in terms of history, culture, science, education and ecology. Restrictions for use is slightly lenient compared to Strictly protected areas.

③ "Nature reserves" are areas in which protection, conservation and restoration of natural environment is performed. While traditional livelihood activities may be performed as long as they do not violate the content of regulations set forth in Table 29, commercial activities that alter the pristine environment such as mining, construction and forestry are prohibited.

④ "Monuments" are areas for protecting natural legacies that are unique from historical and cultural point of view. Protection applies only in the domain of the monument and activities that will diminish the landscape are prohibited within 0.1 to 3 km periphery of the domain.

Table 29 Structure of Special Protection Zones

Division of Special Protection Zones	Subdivision	Main Restrictions
① Strictly protected area	① Pristine zone	Only the research and study activities that preserve the natural original condition and do not accompany destruction can be performed.
	② Conservation zone	In addition to the above, activities with no environmental problems that promote increase in animals and plants as well as natural disaster recovery activities can be performed.
	③ Limited use zone	In addition to the above, environmental conservation activities and collection of resources to the extent necessary for local residents can be performed.
② National conservation parks	① Special zone	Environmental conservation activities and natural disaster recovery activities can be performed in addition to protection activities.
	② Travel and tourism zone	Fishery activities can be performed in permitted zones in addition to restrictions that apply to limited use zone of strictly protected areas and special zone of national conservation parks.
	③ Limited use zone	In addition to the above activities, traditional livestock husbandry activities and, subject to ecological assessment, tourist activities can be performed.
③ Nature reserves	① Ecological reserve	Protection activities for ecosystem can be performed.
	② Biological reserve	Rare and endangered animals and plants are protected and their reproductive activities can be performed.
	③ Paleontoligical reserve	Remains of ancient animals are protected in their natural state.
	④ Geological reserve	The land's unique formations, signs and structures are protected.
④ Monuments	① Natural monuments	Comprised of waterfalls, cliffs, caves, different kinds of rock formations, small groups of trees, oases, mineral waters, springs, sand dunes, meteorite craters, lava beds, and calderas.
	② Historical and cultural monuments	Comprised of ancient human dwellings and ruins of ancient cities and settlements as well as subjects of traditional activities of culture and religion.

Among Special Protection Zones, surrounding areas of strictly protected areas and national conservation parks are designated as "near-border territories" and are used for conservation of Special Protection Zones and improvement of the lives of residents in the vicinity.

Boundaries of near-border territories are determined by the State Central Administrative Organization comprised of the Citizen Representative Khurals and the State Administrative Central Organization.

(3) Forest and Grassland Fire Prevention Law

Promulgated in May 1996 as a law concerning prevention, fire fighting, damage assessment and restoration of forest and grassland fires to supplement the provisions of the Forest Law to prevent fires that are frequently occurring in Mongolia, and was enforced in the same day. Comprised of 3 sections and 14 articles, the law recognizes the authority of the central government, the State Central Administrative Organization, the heads of local administrative bodies and Citizen Representative Khural as well as the responsibility of the people and enterprises while offering provisions for identification of the cause of fire, assessment of damage and compensation for those who have incurred damage from the fire.

(4) Forest Plan

The RIFW conducts a forest resources survey in accordance with the Regulation Regarding Formulation of Forest Plans (established in 1957 and revised in 1992 and 1996) to complete a forest inventory book, forest type map and explanatory notes and to prepare a forest plan (valid for 15 years) for each province.

1) Forest Categories and Forest Compartments

Based on the Regulation Regarding Formulation of Forest Plans, land is largely classified as forest land and non-forest land. The former is further classified as stocked land (stand density ratio of 0.3 or more) and unstocked land (stand density ratio of less than 0.3). Forests and non-forests are also classified into the following categories based on the forest management type for the former and the current land use for the latter.

a) Forest Land

Stocked Land : ① natural forests, ② man-made forests, ③ scrub

Unstocked Land : ④ land with scattered trees, ⑤ land damaged by forest fire, ⑥ cut-over land, ⑦ forest land under regeneration

b) Non-Forest Land : ① grassland, ② farmland, ③ lakes and rivers, ④ roads, ⑤ nurseries, ⑥ firebreaks, ⑦ swamps, ⑧ sandy areas, ⑨ mining sites, ⑩ 'Tsegaanengil', ⑪ rocky areas, ⑫ landslide sites, ⑬ power transmission routes

The forest compartmentation consists of compartments and sub-compartments. Compartments are bordered by such natural topographical features as ridges, valleys and/or rivers, etc. and are serially numbered from north to south. The main meeting points of compartments are marked by compartment boundary signs. Sub-compartments are determined based on the current land use conditions. The forest management type, stand type and forest physiognomy are also used to establish sub-compartments. Other factors to determine sub-compartments include the age class, stand quality, stand density, type of vegetation and degree of inclination, etc. The minimum land size of a sub-compartment is 1.0 ha (protected zone forest) and 3.0 ha (utilization zone forest) for stocked land and 0.1 ha for unstocked land. In the case of a young forest, the area is either 0.3 ha (protected zone forest) and 0.5 ha (utilization zone forest).

2) Method of Cutting, Cutting Age and Cutting Cycle

According to the Regulations Regarding Cutting of Timber and Firewood (established in 1985, revised in 1995), shelterwood cutting and selective cutting are used as the method of cutting concerning regeneration cutting since clear cutting has been banned by the Forest Law. Cutting age is 121 years or more for needle-leaved trees and (formerly 101 years or more for *Pinus sylvestris*) and 61 years or more for broad-leaved trees. Initial selective cutting of needle-leaved forests is performed for stands with stand density of 0.5 or more up to cutting rate of 25%. Cutting cycle ranges 20-30 years and the cutting rate is within 40%. The following cutting will be conducted after the range of 6 to 12 years. Initial shelterwood cutting and selective cutting of broad-leaved forests are performed for stands with stand density of 0.5 or more up to cutting rate of 25-40%. The following cutting is conducted after the range of 6 to 8 years. The limit of cutting area is 50 ha and the length of cutting area shall not exceed 500 m.

3) Forest Inventory Book and Forest Physiognomy Map

A forest resources survey uses aerial photographs and also involves field work, mainly for visual measurement purposes. The survey findings are mechanically computed to produce a forest inventory book for each district. This forest inventory book describes the following subjects for each compartment and for each sub-compartment.

① land size, ② forest description (species and mixture ratio, name of shrubs found, number of trees per ha, tree height, age, soil type and its description, inclination), ③ type of forest, ④ age class and stand age, ⑤ average tree height and average DBH, ⑥ stand quality class, ⑦ stand density ratio, ⑧ stand volume per ha, gross volume and volume per species, ⑨ volume of scattered trees, ⑩ volume of dead and/or fallen trees, ⑪ management method (forest management work to be conducted in the plan period). Laws specified, continuous years' growth rate, etc. are not included.

No entry is made regarding the legal requirements/instructions and the rate of growth. A forest physiognomy map is created by entering the compartment boundaries and compartment size, sub-compartment boundaries and sub-compartment size, age class, stand quality class and tree quality on a blank map (scale: 1/50,000). The 4 age classes used are distinguished by 4 different colours. While topographical maps with a scale of 1/100,000 are available in Mongolia, there exists no map with scales larger than this scale and with contour lines.

4) Forest Plan

A forest plan is prepared for each province which compiles the details of the forests surveyed on a district basis. The entries of the accompanying explanatory notes include the current conditions of forest resources and changes since the previous survey (such as land area, volume and mean growth by forest type), planned cutting and utilisation in the plan period (feasible land area for cutting, volume, cutting rate and cutting cycle by species), restoration (collection of seeds, nursing, afforestation and tending, etc.), forest protection and by-products, etc.

The priority for harvesting is given to over-mature forests with a high density which are located in convenient sites for hauling. For harvesting, the cutting rate and cutting volume per sub-compartment and per species are designated in the form of a maximum cutting volume and the regeneration method is instructed.

A forest survey was completed for Selenge Aimak at the end of 1994 and explanatory notes were prepared (the previous plan was prepared in 1983).

4.3.2 Timber Production and Use

(1) Forest Resources

Forest land in Mongolia occupies some 15,219,000 ha (9.7% of the total land area of the country), of which some 13,924,000 ha are classified as stocked land, accounting for 8.9% of the country's total land area. The shares of the main species in terms of stocked land show a majority of *Larix sibirica* with 50.8%, followed by *Haloxylon ammodendron* (27.7%), *Pinus sibirica* (7.6%), *Betula* spp. (6.8%) and *Pinus sylvestris* (5.1%). All other species together account for a few percentage of the national forest land.

Within Selenge Aimak, *Pinus sylvestris* occupies the largest forest area (31.8%), followed by *Larix sibirica* (27.2%), *Betula* spp. (24.2%) and *Pinus sibirica* (15.7%). These top four species account for 99% of the forest land area of Selenge Aimak, particularly *Pinus sylvestris* accounting for 50.5% of the whole country. In terms of volume, *Pinus sylvestris* is again top with 33.7%, followed by *Larix sibirica* (31.5%), *Pinus sibirica* (20.4%) and *Betula* spp. (13.7%). In all, Selenge Aimak can be described as a province with rich forest resources (see Tables 30).

Table 30 Land Area by Species in Selenge Aimak

Subject Area	Division	Total number	Species											
			Larix sibirica	*Pinus sylvestris*	*Picea obovata*	*Abies sibirica*	*Pinus sibirica*	*Betula* spp.	*Populus tremula*	*Populus* spp.	*Hippophae* spp.	*Salix* spp.	Shrub-land	*Haloxylon ammo-dendron*
Selenge Aimak	Stocked land area (ha)	1,131,856	307,555	359,685	3,555	1,855	177,718	274,467	2,711	—	792	131	3,387	—
		(100.0)	(27.2)	(31.8)	(0.3)	(0.2)	(15.7)	(24.2)	(0.2)	—	(0.1)	(0.1)	(0.3)	—
		((8.1))	((4.4))	((50.5))	((14.8))	((100))	((16.8))	((29.1))	((29.3))		((5.4))	((0.7))	((1.6))	
	Volume ($1,000m^3$)	158,990.6	50,139.2	53,599.8	546.1	345.6	32,429.3	21,700.5	255.1	—	*	5.0	*	—
		[140.5]	[163.0]	[149.0]	[153.6]	[186.3]	[182.5]	[79.1]	[83.0]			[38.2]		
		(100.0)	(31.5)	(33.7)	(0.4)	(0.2)	(20.4)	(13.7)	(0.1)			(0.0)		
Mongolia Total	Stocked land area (ha)	13,923,511	7,069,545	711,919	23,986	1,855	1,054,625	944,666	9,254	1,412	14,726	19,074	211,749	3,860,700
		(100.0)	(50.8)	(5.1)	(0.2)	(0.0)	(7.6)	(6.8)	(0.1)	(0.0)	(0.1)	(0.1)	(1.5)	(27.7)
		((100))	((100))	((100))	((100))	((100))	((100))	((100))	((100))		((100))	((100))	((100))	((100))

Source: RIFW, Ministry of Nature and the Environment

Notes: 1. Figures in parentheses are percentage figures of total number. Figures in brackets represent volume (m^3) per ha. * indicates no total number and the double parentheses represent percentage of Selenge Aimak for the whole country.

2. Comparing these values with the ones of Table 6, 7 and 16, the differences are presumably caused due to the investigated time or the land categorisation.

(2) Cutting

1) Procedures of cutting, etc.

The procedures of cutting, etc. and the flow of the relevant approval or permission under the new Forest Law is outlined in Figs. 23-26.

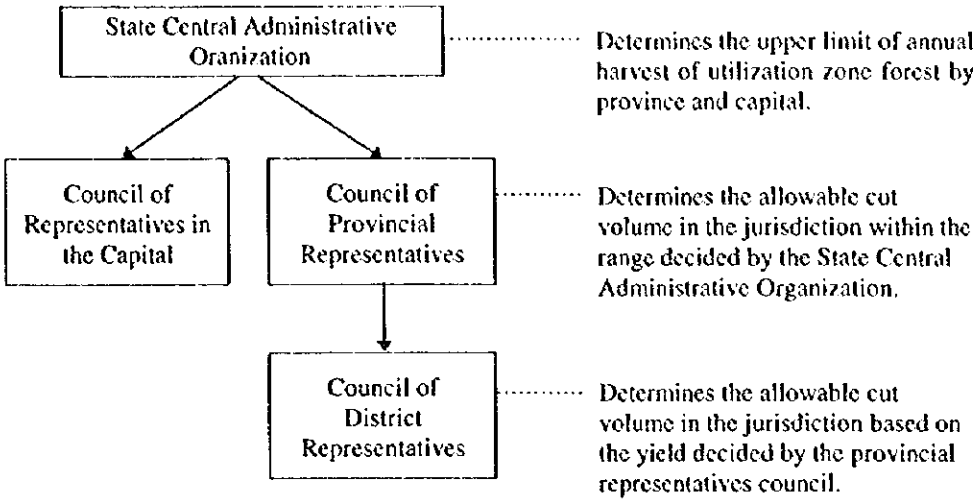

Fig. 23 Harvest Amount Decision

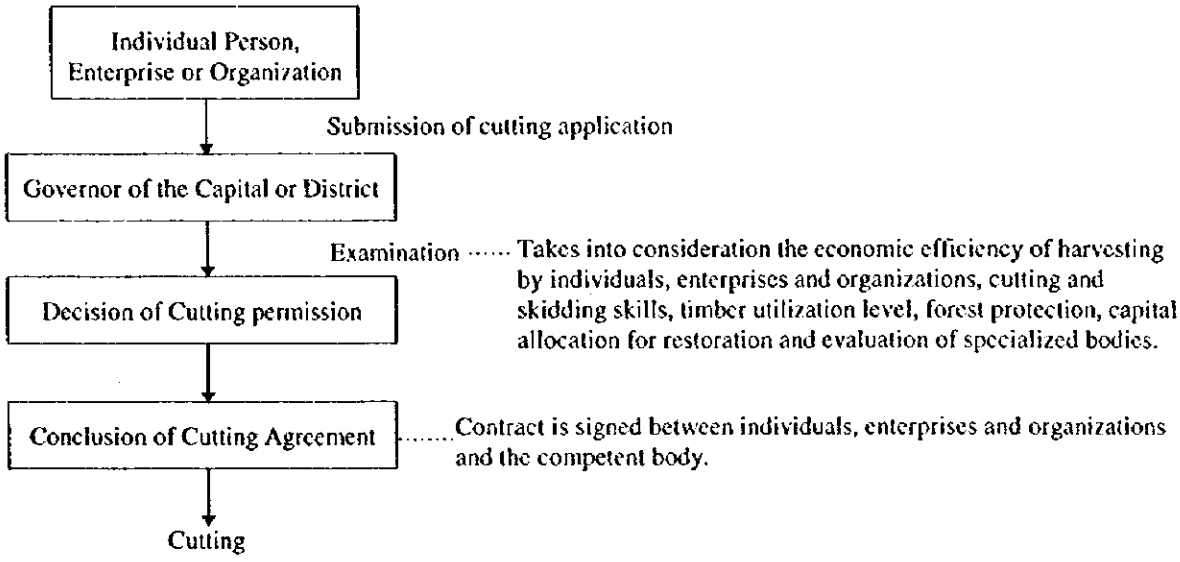

Fig. 24 Commercial Wood Cutting Permission

The following are specified in the cutting agreement.

① Legal basis of cutting

② Purpose of harvesting, species, volume and period

③ Explanation of forest management and boundary between the cutting area and forest

④ Diagram of harvesting mechanism, tree selection plan and period required for the work

⑤ Stumpage value and delivery term

⑥ Fire and blight prevention plan, forest restoration and cost of execution

⑦ Conditions for returning the cutting site

⑧ Responsibilities, obligations and rights of parties to a contract

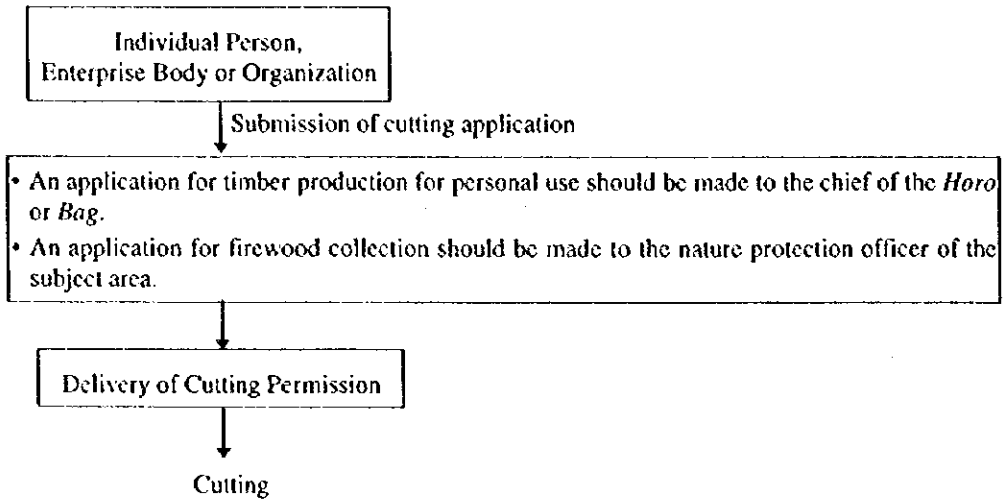

Fig. 25 Home Use Wood and Firewood Cutting Permission

A cutting permission should specify the following items.

① Name and address of persons owing cutting permission
② Subject species and cut volume
③ Period of hauling
④ Location of cutting site

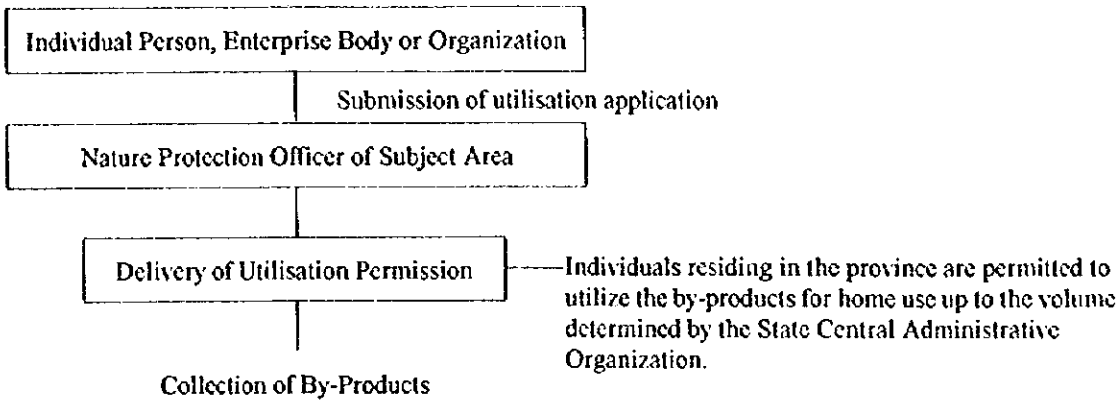

Fig. 26 By-Product Utilisation Permission

A utilisation permission should specify the following items.

① Name and address of persons owing utilisation permission
② Types and quantities of by-products
③ Period of collection
④ Location of collection site

2) Permitted Cutting Volume in Altanbulag District

In the new Forest Law, the authority concerning the permission for cutting of standing trees was transferred from provincial governors to district heads. The number of permits for cutting of standing trees granted in 1995, their area and their volume are as shown in Table 31.

Table 31 Permitted Cutting Volume in Altanbulag District

Classification		Number of Permits	Area Permitted (ha)	Volume Permitted (m^3)		
				Coniferous Trees	Broad-leaved trees	Total
General timber		12	1,700	43,000	15,000	58,000
Home use	Timber	75	1,000	22,000		22,000
	Firewood	1,680	570	12,500		12,500
Total		1,767	3,270	77,500	15,000	92,500

Source: Selenge Provincial Goverment

3) Cutting, skidding and transportation of timber

As for cutting, cutting can be performed after determining volume for tree species, firewood/timber, and class of the designated cutting area through sample plot survey and paying the forest utilization fee based on the Regulations Regarding Selection of Cutting Sites (established in 1985, revised in 1995). The main factors in the selection of subject forests for cutting are stand age, tree density and ground inclination. Firewood/timber classification of the standing trees include timber (one or more squared timber of 6.5 m or more can be collected), small timber (one squared timber of less than 6.5 m can be collected) and firewood (lumber length of 2.0 m or less).

The cutting process usually consists of ① cutting by chainsaw, ② trimming by axe, ③ yarding (mainly tree length logs) by crawler-type tractor and ④ transportation of the logs to a sawmill by truck or trailer. The transportation of tree length logs by trailer appears to be fairly common. Bucking is conducted in multiples of 2 m and 6 m appears to be the most common length. A cutting team usually consists of 6 workers and one team equipped with one chainsaw cut and trim some 30 m^3 of wood per day.

Cutting and hauling generally take place from October to April as the roads can support log-loaded trucks as heavy as some 23 tons due to the snow cover (40 - 60 cm in mountainous areas and 20 cm in lowland areas) and frozen road surface. In contrast, during the period from May to September, the sandy to clayey soil tends to result in a muddy road surface due to rainfall and the passage of heavy vehicles because of natural roads without from rainwater flow facilities. As a result, cutting and hauling are not usually conducted at this time except for the removal of trees damaged by forest fire. (If such trees

were left standing, there is a likelihood of an outbreak of harmful insects which could result in deterioration of the quality of an entire stand.) In recent years, however, the cutting, hauling and transportation of trees other than those damaged by forest fire are sometimes conducted during the above period in hill forests, making the hauling and transportation passageways extremely muddy.

(3) Timber Supply and Demand

1) Materials Production Volume

The 10 year statistics (Table 32) cited from the FAO Forest Products 1993 show that the annual log production volume for timber and veneer in Mongolia upto 1988 was 1,040,000 m^3 (990,000 m^3 from coniferous trees and 50,000 m^3 from broad-leaved trees). Since 1991, however, the production volume from coniferous trees has gradually declined while there has been no production from broad-leaved trees.

While the combined production volume of firewood from coniferous and broad-leaved trees was once steady at 1,350,000 m^3/year, equivalent to approximately 0.6 m^3/year per capita, the production volume from coniferous trees began to decline in 1988, reaching as low as 37% of the peak production level. No firewood has been produced from broad-leaved trees since 1991.

Most of the logs for timber production are delivered to sawmills in the form of tree length logs. Sections with a small end diameter of 18 cm (accounting for 80% of the tree length log volume) are cut for timber production and the remaining smaller diameter sections are cut as firewood at wood yards. Trees damaged by forest fire and the limbs and tops, etc. are also used as firewood.

2) Production Volumes of Timber and Other Products

By 1988, the production volume of timber from coniferous trees was constant at 470,000 m^3/year and increased at one time from 1989 to 1990, followed by a period of a significant decline from 1991 onward. In 1993, the timber production volume from coniferous trees was equivalent to 23% of the 1989 level. Sawmills are facing hardship, partly because of the relatively low sawing yield of some 40% and the declining log production volume and partly because of the ageing of the sawing machinery. In

addition to timber, sawmills also produce panelboards, plywood and particle boards, the production volumes of which have remained at practically the same level.

3) Import and Export of Wood Products

In 1987, 18,000 m^3 of timber was exported for China. Timber has since been exported intermittently with the volume totalling 91,000 m^3 in 1993. Imported wood products include panels, plywood, paper, cardboard and newsprint paper. However, the import volume for the 4 years (1986 - 1989) was less than 1,000 m^3/year (1,000 tons) respectively.

4) Wood industry in Selenge Aimak

Some 70 to 80% of all timber-related businesses in Mongolia are concentrated in Selenge Aimak. There are 4 large-scale sawmills around Sukhbaatar and Dulaankhaan which have a timber production capacity of 40,000 to 50,000 m^3/year. The main species are *Pinus sylvestris* and *Larix sibirica*, although *Pinus sylvestris* is predominant. As shown in Table 33, the products are plank wood, pillars, floorbeds and sleepers while associated factories manufacture furniture and gel components. (*Betula* spp. had been used by nomads for bowls but has been discontinued because of poor yield percentage.) In Altanbulag District, there are 4 small-scale mills. There is also the only match factory in Mongolia that uses poplar (with diameters of 20 cm or more) from the upper reaches of Uroo River outside the Intensive Area. Plywood factory and particle board factory have not operated since 1994 owing to difficulty in procuring adhesives. There are paper processing factories but there are no pulp paper mills.

Table 32 Domestic Production and Import/Export Volumes of Materials and Wood Products

			Unit	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Log Production		Coniferous: Timber and Veneer	1,000 m³	990	990	990	990	990	780	780	690	475	420
		Coniferous: Firewood	1,000 m³	1,215	1,215	1,215	1,215	1,215	1,010	635	650	510	445
		Sub-Total	1,000 m³	2,205	2,205	2,205	2,205	2,205	1,700	1,415	1,340	985	865
		Broad-Leaved: Timber and Veneer	1,000 m³	50	50	50	50	50	50	50			
		Broad-Leaved: Firewood	1,000 m³	135	135	135	135	135	135	135			
		Sub-Total	1,000 m³	185	185	185	185	185	185	185			
		Total	1,000 m³	2,390	2,390	2,390	2,390	2,390	1,975	1,600	1,340	985	865
Wood Products		Coniferous: Timber	1,000 m³	470	470	470	470	470	553	509	270	125	125
		Panels	1,000 m³	4	4	4	4	4	5	4	4	3	3
		Plywood Board	1,000 m³	3	3	3	3	3	5	3	2	1	1
		Particle Board	1,000 m³	1	1	1	1	1	1	1	2	2	2
Imports of Wood Products	Exports	Timber (Coniferous)	1,000 m³				18		23			26	91
	Imports	Panels	1,000 m³	1	1							4	
		Plywood Board	1,000 m³	1	1								
		Paper/Paperboard	1,000 tons	13	13					1	1	2	
		Newspaper Rolls	1,000 tons	4	4								1
		Printing and Thin Paper	1,000 tons	3	3					1	1		
		Other Paper and Paperboard	1,000 tons	6	6							1	

Note: Figures includes estimates of the FAO.
Source: FAO Forest Products, 1993

A total of 87 former-Soviet-made sawing machines and one Chinese-made bandsaw are in operation in the area under the jurisdiction of the Selenge Forestry Office. The Soviet-made sawing machines of frame gang saw are

capable of producing more than one timber in one operation with more than one saw being attached and have a significantly irregular sawing property. They can handle log of 65 cm (75 cm × 75 cm based on the specifications) and 55 cm (65 cm × 65 cm based on the specifications). Since larger logs cannot but be sawn using the Chinese-made band saw, trees of over 70 cm diameter change to ones with weakness, such as decay, leaving in the forests. On the other hand, the small end log diameter for sawing to obtain timber is 18 cm.

The Selenge Forestry Office has a sawmill provided with one former-Soviet-made sawing machine (28 KW) which is capable of producing 35 m^3 of timber/day with 16 hours of operation (2 shifts). The sawing yield appears to be around 40%.

Table 33 Production Volumes of Wood Products in Selenge Aimak

Product	Unit	1990	1991	1992	1993	1994
Timber	m^3	93,981	81,962	45,215	35,172	25,365
Plywood	m^3	3,422	1,916	1,054	227	-
Railway Sleepers	m^3	16,999	12,950	7,260	10,210	9,930
Particle Boards	m^3	4,343	1,157	880	256	-
Window Frames	m^3	45,300	22,636	5,166	-	-
Floorboards	m^3	24,150	92,026	32,514	20,534	19,454
Gel Components	m^3	-	-	3,159	2,348	1,000
Furniture	1,000 Tg	8,474	9,116	10,327	3,460	10,207
Others	1,000 Tg	-	-	1,156	4,242	8,650
Firewood	m^3	190,000	203,000	205,000	210,000	216,000

Note: Tg designates the currency of Mongolia, about 350 Tg exchanged for 1 $ as of 1994.

4.3.3 Afforestation

(1) Current Conditions

Afforestation efforts commenced in Mongolia in 1968 and *Pinus sylvestris*, *Larix sibirica*, *Populus suaveolens* and *Haloxylon ammodendron*, etc. have been systematically planted since 1972. The total afforestation area was some 51,990 ha for 20 years from 1975 to 1994. In Selenge Aimak, 4,200 ha of land (some 8% of the national figure) was planted during the above period, mainly by the Selenge Forestry Office, Dzuunharaa Branch Office, logging enterprises.

Logging enterprises without afforestation department let Forestry Office to substitute for afforestation by providing funds. The main species planted are *Pinus sylvestris* and *Larix sibirica* in cut-overland and forest fire damaged land, and *Populus suaveolens* and *Ulmus pumila* are planted for reclamation of wind prevention forests.

Areas recently afforested by Forestry Office of Selenge Aimak and the afforestation areas of the Intensive Area and Model Area based on the aerial photograph interpretation are given in Table 35. Data involve *Pinus sylvestris*.

Table 34 Afforested Area in Mongolia

unit: ha

Year	Afforested area	Year	Afforested area	Year	Afforested area	Year	Afforested area
1975	258	1980	967	1985	3,203	1990	4,402
1976	228	1981	876	1986	3,575	1991	4,992
1977	324	1982	1,688	1987	3,819	1992	4,488
1978	361	1983	2,610	1988	3,229	1993	4,586
1979	450	1984	2,941	1989	4,039	1994	4,954

Source: Ministry of Nature and the Environment (1996)

Table 35 Afforestation Areas in Forestry Office of Selenge Aimak

(Unit: ha)

Year	Jurisdiction of the Forestry Office	Intensive Area	Model Area
1990	380		
1991	415		
1992	300		
1993	185		
1994	220	837	97
Total	1,500	837	97

Sources
1) Selenge Forestry Office.
2) The total figures for the Intensive Area and Model Area (only Model Area 1 has afforestation sites) are based on the aerial photograph interpretation results.

Stipulations of the new Forest Law concerning afforestation are as outlined below.

- Afforestation shall be performed at forests and cut-over area that have been damaged by fire and blight for restoration of forest, preservation of species and mitigation of climatic impact by using the local government budget and budget formed under the initiative of individuals, enterprises and organizations.

- An individual, enterprise or organization intending to cut trees for commercial purposes shall conduct afforestation work at the cut-over sites and obtain positive evaluation results by the specialized forestry organization. He shall hand over the planted trees to the district governor two years after planting the trees. He shall plant 3 to 5 seedlings for each stand harvested at his own expense. (Note: In practical terms, 1 ha of afforestation is required for every 100 m^3 of cut volume.)

- The central government organization shall prepare afforestation projects for unstocked spots in forests, grassland, Gobi Desert and headwater, spring and river areas and for the creation of forest belts designed to prevent the deterioration and erosion of soil at farmland, and shall finance such projects with the central government budget and other funds.

- The governor of a province or the capital shall decide on the date of tree planting every fiscal year for the afforestation project for the areas under his jurisdiction.

- The governor/head of a district, sub-district, Bag, Horo shall be responsible for supply of seedlings, selection of afforestation sites, land preparation and organization of forestry activities related to irrigation and nursing of the planted trees with the cooperation of specialized organizations and participation of local residents.

- An individual, enterprise or organization shall be entitled to own the forest and standing trees that have been planted at his own expense at a site under his possession or usage after paying the proper usage fee based on a contract.

(2) Method

1) Land Preparation

Land preparation for afforestation purposes uses a plough-mounted tractor which digs inverse triangular-shaped grooves of 70 cm in width and 30 - 40 cm in depth at 3 - 5 m intervals (See Fig. 27). The dug soil is then replaced in the grooves to achieve a groove depth of 15 - 25 cm. The grooves are, in principle, dug parallel to the contour lines.

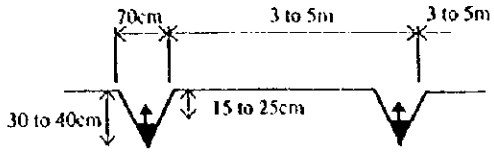

Fig. 27 Basic Land Preparation by Machine

2) Planting

Seedlings are carried from the nursery to the planned planting site and planted temporarily (create a ridge, line the seedlings, cover with soil and water). Planting is performed by inserting a planting spatula into ridges to dig holes, planting the seedlings. Planting is completed after earthing and trampling. Six hundred seedlings are planted by one person in one day.

When planting *Larix sibirica* in a mountain area, 15 to 20 cm diameter holes are dug with a scoop, seedlings are planted into these holes and trampled. Planting season is from late April to mid May, planting 3,000 to 3,500 trees/ha (3 to 6 seeds/hole when sowing the seeds directly). Planting interval is 0.9 m with 3 to 5 m distance between rows.

Survival rate requiring repeated afforestation and supplementary planting are treated as follows.

- The afforestation work is repeated if the survival rate is less than 40%
- Supplementary planting is conducted if the survival rate is between 40% and 80%
- An afforestation site with a survival rate of 80% or higher is considered successful.

A seedling is allegedly planted 15 to 25 cm from the surface to collect moisture and secure a shade. However, this planting method, including the land preparation process, must be reviewed because of its poor survival rate attributable to removal of the surface soil that deteriorates the moisture environment, poor quality of seedlings and deep planting. Incidentally, the Forestry Bureau had been dispatching afforestation supervisors to afforestation sites to provide guidance on afforestation and study the survival rate prior to democratization but is discontinued at present.

As for other planting methods, Vocant Lumber Company. (located in Vocant located midstream of Uroo River) uses a hoe which is inserted in 90 degree angle from two directions without land preparation, lifting the soil with one hoe, planting the seedlings between the two followed by trampling. This method is said to have achieved a good survival rate.

In the direct sowing method, holes with 5 to 8 cm diameter are dug next to stumps in cut-over areas and areas damaged by fire as well as thick roots until they reach the ground. The 5 to 10 seeds of *Pinus sylvestris* are sown in each of these holes in late March trough late April. While the purpose of this method appears to lie in preventing drying and securing moisture, the work rate of 15 to 50 holes/day/worker raises questions about the efficiency of this operation. Incidentally, scraping a square meter of ground surface before sowing the *Larix sibirica* seeds directly is said to have attained some success in Arhangai Aimak.

3) Nursing

Intrusion of vegetation is slow because top soil is removed during land preparation, making nursing work such as cutting of undergrowth unnecessary. Meanwhile, guards are posted if necessary to prevent damage from livestock.

(3) Present State of Nursing

The number of nurseries and seedling production in Selenge Aimak is as shown in Table 36. *Pinus sylvestris* seedlings are grown at nursery gardens of the Selenge Forestry Office (located in of the Intensive Area and was opened in 1981) and Vocant Lumber Company, while *Larix sibirica* seedlings are grown at the nursery of Dzuunharaa Branch. While nursery facilities are mainly comprised of 1) Vinyl house, 2) plowing tractor and 3) irrigation facility, and

other vehicles has not been renewed since 1981 (root cutter is unusable) and it has become difficult to procure vinyl for greenhouses in the recent years.

Table 36 Seedling Production in Selenge Aimak

Year	Number of Nurseries	Seedling Culture Area (ha)	Number of Seedlings Prepared (thousand seedlings)		
			Pinus sylvestris	*Larix sibirica*	Total
1990	3	1.8	1,600.0	800.0	2,400.0
1991	3	2.0	1,600.0	800.0	2,400.0
1992	3	2.0	2,000.0	900.0	2,900.0
1993	3	2.0	2,000.0	900.0	2,900.0
1994	3	2.0	2,000.0	900.0	2,900.0

Source: Selenge Provincial Government

(4) Nursing Methods

Principle methods of nursing *Pinus sylvestris* are as follows:

1) Seed

The yield fluctuation cycle of seeds is shown below.

- *Pinus sylvestris* (Scotch pine) : 4 - 5 years (poor harvest unnoticed)
- *Larix sibirica* (Larch) : 5 - 7 years
- *Pinus sibirica* (Siberian pine) : 5 years

Collection of the cones of *Pinus sylvestris* is conducted from October to March, resulting in about 50 kg/day/person and the seeds undergo the following process from collection of the cones to actual seeding.

Collection of cones from natural forests → drying of cones → collection of seeds → cleaning and selection → storage → germination test → germination treatment → seeding

The germination promotion treatment of *Pinus sylvestris* seeds is conducted by exposuring them under cold atmospheric environment from March to April.

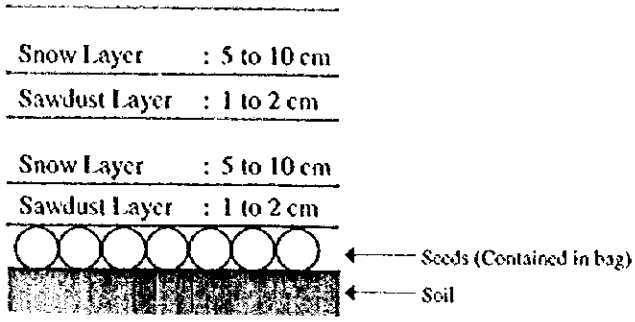

Fig. 28 Germination Promotion Treatment

2) Nursing

○ Nursing in Vinyl House

① Scatter seeds at 10 to 20 cm widths in line at nursery beds in vinyl house in April.

② The amount of seeds sown is 1.5 to 2 g/m^2 (3.5 g/m^2 for *Larix sibirica*)

③ Nurse for 2 years in the vinyl house.

④ Vinyl cover of the vinyl house is removed in May of the third year and the seedlings are nursed for additional year by means of open culture.

⑤ No transplanting of seedlings is performed. Seedlings are dug out in the spring for planting.

○ Open culture

① Seeding is conducted from late April to early May (in consideration of the extent of temperature rise).

② In the case of open culture, concave or flat ground is used as nursery bed. A wooden board with openings is used to create shade in summer (see Fig. 29).

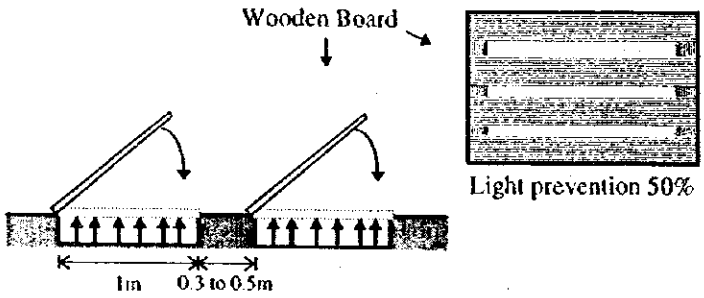

Fig. 29 Bed-Making and Shading

③ No transplanting of seedlings is performed. Seedlings are planted after being nursed for 3 to 4 years.

④ Irrigation is performed when necessary by using a sprinkler.

⑤ Root cutting is performed 1 year prior to actual planting.

⑥ Weeding is conducted from late May to late Augast as appropriate. However, herbicide is not used.

⑦ Chemical fertilizers and manure (from sheep, horses and cows) are used for fertilization. Chemical fertilizers are added from mid June to early July according to the condition of growth.

⑧ Chemical spraying is performed in June and July according to disease symptoms.

⑨ Preparation for winter is made by covering the seedlings with sawdust in the fall of the first year. This sawdust is removed next spring.

○ Dimensions of planting stock

While the dimensions of planting stock are a height of 9 cm and a base diameter of 3 mm, the general height of the stock shipped from the nursery for planting is 15 to 20 cm.

○ Miscellaneous

Naturally renewed *Pinus sylvestris* is not utilized as planting stock. Vocant Lumber Company attempted to nurse the seedlings using pots (5 cm in diameter and 15 to 20 cm in depth) until 1983 but decided to discontinue owing to lack of vinyl pots and high labor requirement.

Open culture has increased in the recent years owing to unavailability of vinyl for vinyl house, resulting in planting of smaller seedlings. One of reasons for the poor survival rate in afforestation areas appears to lie in insufficient growth of seedling roots caused by lack of root cutting and thinning. Soil building at nursery gardens and root building of seedlings must be considered.

4.3.4 Forest Roads

The Intensive Area (including the Model Areas) spreads east, west and south from a point some 34 km distance by road from Sukhbaatar and is reached by firstly heading east from Sukhbaatar to Altanbulag on an asphalt paved road and then turning south on a path created by the repeated use of trucks and farm tractors. While there are some recreational facilities and large farms in the Intensive Area and its surroundings, there are no official roads except for the provincial road located along the southern boundary of the Intensive Area. Roads (paths) created by the repeated use of vehicles can become impassable during and after rain due to deep ruts or mud and, in this case, vehicles simply try another path. Consequently, the existence of several roads (paths) side by side or some distance apart for the same destination is very common. These roads (paths) are hardly maintained.

There is a spur road constructed by a timber company in the southeastern part of Model Area 2. Some efforts have apparently been made to make it an adequate forest road by means of, cut, embankment, gravel, and culverts using logs, Because of poor route selection, insufficient side ditches and cross drains and failure to tidy up ruts, etc., its poor construction and maintenance have resulted in gullies on the road surface, road rupture, and the flow of sediment and gravel from the road. Moreover, trailers which are as long as some 25 m when loaded with tree length logs damage, peel, and scratch the standing trees by the road's curved sections of small curvature radius.

The systematic construction and maintenance of forest roads comprise the basis for not only forest management and the transportation of logs but also for the convenience of the local inhabitants. Until around 1985, the RIFW was in charge of advising on forest road construction but the lack of budgetary appropriation thereafter has meant a lack of any office responsible for forest road construction and maintenance at present. Consequently, there is no official programme concerning forest road construction and the matter is left in the hands of timber companies.