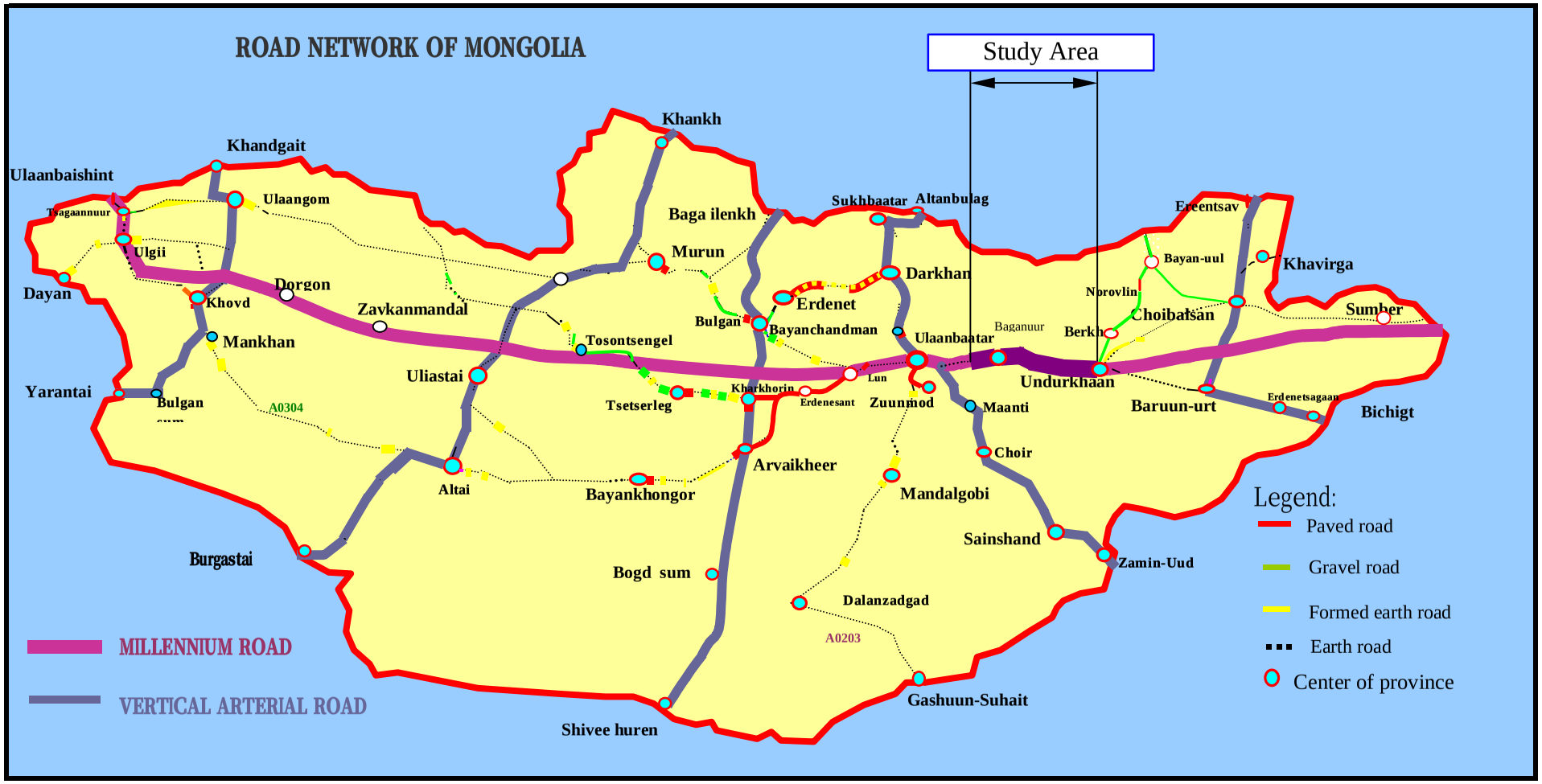


Map of Study Area

Photographs of Study Area (1)

1) Current Road Condition
Multiple shifting tracks are widely spread on plane area. It heavily affects vegetation and often leads to desertification. It also extends vehicle operating distance and time, resulting high transport cost.

2) Road Condition in Winter
Multiple shifting tracks are covered with snow in winter and become slippery due to uneven surface together with compacted snow. Vehicular movement becomes risky and travel speed is forced to decrease considerably.

3) Existing Wooden Bridge
Existing wooden bridge is severely deteriorated and danger always exists for heavy vehicles to go across. This is serious cause of disruption for traffic to cross the river. Heavy vehicles go across the river only when the flow is shallow.

Photographs of Study Area (2)

4) Existing the Kherlen River & Bridge
The flow of the Kherlen River narrows at the point of the picture. River flow has been stable as it is on the photograph for several decades. Revetment has set on the west bank (right side in the photograph) when the existing bridge was constructed.

5) Resting Area Formed by Ger beside the Existing Road
Ger (Mongolian traditional portable housing) forms resting area at several locations on the route. It serves meal, bed, toilette and others for the travelers. Present sanitary condition is not clean and it is wanted and needed to be improved.

6) Dust Raised by Vehicles
Current unpaved road surface produce considerable raised dust by running vehicles. It deprives drivers' sight and makes dangerous situation for the other vehicles. It also covers leaves and shuts the sunlight off. It can cause serious effects to vegetation.

ABBREVIATIONS

Authorities and Agencies

AASHTO	:	American Association of State Highway and Transportation Officials
ADB	:	Asian Development Bank
ASTM	:	American Society for Testing Materials
AZZAN	:	Road Repair and Maintenance Corporation
DNE	:	Department of Information, Inspection of the Ministry of Nature and Environment
DOR	:	Department of Roads
GOM	:	Government of Mongolia
ICT	:	International Consultants and Technocrats Pvt. Ltd.
JICA	:	Japan International Cooperation Agency
MNE	:	Ministry of Nature and Environment
MOFA	:	Ministry of Foreign Affairs
MOFE	:	Ministry of Finance and Economy
MOI	:	Ministry of Infrastructure
NSOM	:	National Statistics Office of Mongolia
SWK	:	Scott Wilson Kirkpatrick
TRRL	:	Transport and Road Research laboratory
WB	:	World Bank

Other Abbreviations

AADT	:	Annual Average Daily Traffic
AC	:	Asphalt Concrete
ADT	:	Average Daily Traffic
ALT	:	Alternative
BH	:	Borehole
BI	:	Bump Integrator
Br.	:	Bridge
BST	:	Bituminous Surface Treatment
CBD	:	Central Business District
CBR	:	California Bearing Ratio
COMECON	:	Council for Mutual Economic Assistance
CPS	:	Check Point Stations
cm	:	Centimeter
cm/sec^2	:	Centimeter per Square Second
DBST	:	Double Bituminous Surface Treatment
DEIA	:	Detailed EIA
EAR	:	Eastern Arterial Road
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EL	:	Elevation
ESAL	:	Equivalent Single Axle load
GDP	:	Gross Domestic Products
GE	:	Ground Elevation

GL	:	Ground Level
GRDP	:	Gross Regional Domestic Product
H	:	Height
ha	:	Hectare
ΔH	:	Clearance under Girders
HWL	:	High Water Level
ICB	:	International Competitive Bid
IEE	:	Initial Environmental Examination
IP	:	Implementation Plan
IRI	:	International Roughness Index
JIS	:	Japanese Industrial Standard
kgf/cm^2	:	Kilogram-force per Square Centimeter
kgf/cm^3	:	Kilogram-force per Cubic Centimeter
kgf/mm^2	:	Kilogram-force per Square Millimeter
km or KM	:	Kilometer
km/h	:	Kilometer per Hour
km^2	:	Square Kilometer
KN	:	Kilo Newton
Kw	:	Kilowatt
l	:	Litter
L	:	Length
LCC	:	Life Cycle Cost
M	:	Moment
m	:	Meter
m/s	:	Meter per Second
m^2	:	Square Meter
m^3	:	Cubic Meter
m^3/h	:	Cubic meter per Hour
m^3/s	:	Cubic meter per Second
MRP	:	Millennium Road Plan
mm	:	Millimeter
N	:	N. Value
No., Nos.	:	Number
NPV	:	Net Present Value
OD	:	Origin Destination
ODA	:	Official Development Assistance
PC	:	Prestressed Concrete
PCU	:	Passenger Car Unit
pop	:	population
Q	:	Design Discharge
R	:	Radius
RC	:	Reinforced Concrete
RED	:	Roads Economic Decision
RF	:	Road Fund
RND	:	Road Network Density
RRMC	:	Road Rehabilitation & Maintenance Center
SD	:	Deformed Steel Bar
SN	:	Pavement Structure Number

SNIP	:	Construction Norms & Regulations
SPA	:	Special Protected Area
SPT	:	Standard Penetration Test
Sta.	:	Station
t	:	Ton
Tg	:	Togrogs
TOR	:	Terms of Reference
UB	:	Ulaanbaatar
US$	:	United States Dollar
VOC	:	Vehicle Operating Costs
Vpd	:	vehicles per day
W	:	Width
WL	:	Water Level
σck	:	Concrete Design Stress
σpy	:	Concrete Yield Point Stress
σs	:	Stress of Steel
σsa	:	Allowable Stress of Steel
ϕ or Φ	:	Diameter
%	:	Percent

PROJECT SUMMARY

1. COUNTRY	Mongolia
2. NAME OF STUDY	The Feasibility Study on Construction of Eastern Arterial Road in Mongolia
3. COUNTERPART AGENCY	Department of Roads, Ministry of Infrastructure
4. OBJECTIVE OF STUDY	To carry out a feasibility study on construction of Eastern Arterial Road and transfer technology to Mongolian counterparts.

1. STUDY AREA Road section from Erdene to Undurkhaan on State Road A0501, approximately 250km in length and four eastern provinces.

2. TARGET YEAR Year 2015

4. TRAFFIC DEMAND FORECAST 1,417～994veh./day (1,986～1,484 PCU/DAY)

3. ECONOMIC FRAMEWORK

Population in Study Area	Thousand	544.1
GRDP per person	M Tg./Person	0.507
Annual Growth Rate	%	4.45

5. OUTLINE OF FEASIBILITY STUDY AND PRELIMINARY DESIGN

(1) ROAD

- First the route selection was made to select the crossing point of the Kherlen River. The existing bridge and its surrounding was selected as the most suitable point somewhere in 20 km stretch, considering river morphology, scale of required structures, maintenance, etc.
- Referring to the existing tracks along the study route, alternative routes were found in three sections, namely Baganuur, Kherlen East and Tsenkhermandal West. The proposed route was selected through quantitative and qualitative comparison at each section.

(2) PAVEMENT

- ALT-1: (The whole of the project road paved by asphalt concrete) is selected compared with ALT-2: (The road stretch up to Tsenkhermandal will be paved by asphalt concrete and the remaining road stretch will be paved by bituminous surface treatment). The design of pavement was conducted every 10km assuming the design CBR (8, 10 & 12 according to ground condition and fill material) and cumulative ESAL.

(3) BRIDGE

- Case-3: (Use of existing bridge for non-motorized traffic + new parallel bridge) was selected because of advantages such as high economy, short construction period and utilization of existing bridge as temporary bridge during construction.
- PC-T shape girder (33.6m in span length) is applied to the super-structure of Kherlen Bridge because of high economy, short construction period and less influence of obstacle against river stream. RC-T shape girders (15m & 17.5m in span length) are applied to other bridges.

6. ROAD IMPROVEMENT PLAN

- Study Road Length: 258.8 km between Erdene and Undurkhaan
- Highway Classification: Category III (as per Mongolian Standards)
- Road Width: 7m +2@1.5m (total 10m)
- Major Road Facilities: Five road stations and two observation platform
- Kherlen Bridge: Location: 30m down stream of existing bridge
  Superstructure: 8-span PC T Girder with 8m effective width and span length 8@33.6m = 268.8m
  Substructure: RC wall shaped elliptical column and beams
- Other Bridges: Superstructure: RC T Girder with 8m effective width, Khujirut River: 15.0m (Replacement due to lack of strength), Khutsaa River: 17.5m, Tsenkher River: 52.5m, Murun River: 52.5m(Replacement due to wooden bridge), Urt Valley: 15.0m(New Construction)
- New Box Culvert: 29 locations
- New Pipe Culvert: 197 locations
- Establishment of Road Rehabilitation and Maintenance Center with procured equipment in AZZAN and construction of operation depot in Khentii province for strengthening road maintenance capability.

7. ENVIRONMENTAL ASPECTS（IEE and EIA）

The assessment result concluded the Project is moderate negative impact thought IEE and EIA. Environmental management plans for each major item of environmental parameters and environmental monitoring programs for the same are made.

8. PROJECT IMPLEMENTATION PLAN AND EVALUATIONS

(1) Project Implementation Plan

The study road is divided into six construction sections based on consideration of the villages and connecting roads. The period of 4-year construction may be justified considering the achievements of other previous projects. Following two schemes are considered within the project implementation plan excluding Section I which is being constructed by DOR using the Government's own fund.

Scheme-I: Construction by international contractors selected through tendering in a competitive environment (The highest priority should be given to Section II and VI because relatively high economic return is anticipated due to the higher traffic volumes.)

Scheme-II: Construction by DOR as a pilot project (Section III, IV and V should be implemented by DOR using the proposed road rehabilitation and maintenance center.)

(2) Comprehensive Evaluation

The result of economic analysis, both alternatives has sufficient EIRR and is confirmed high feasibility for the project implementation. ALT-1 is suitable for the project in consideration of qualitative advantages compared with BST.

Section	Construction Period	Road Length	Project Cost (ALT-1)	EIRR	
				ALT-1	ALT-2
IP Section 1 (I, II)	2001 - 2005	67.6 km	9,780,675 US$	17.3%	17.3%
IP Section 2 (III, IV)	2003 - 2006	94.4 km	22,053,292 US$	9.4%	10.6%
IP Section 3 (V)	2003 - 2006	50.0 km	10,229,784 US$	17.6%	19.0%
IP Section 4 (VI)	2003 - 2005	46.8 km	8,134,068 US$	23.2%	25.6%
Total Section		258.8 km	50,197,819 US$	15.7%	16.8%

Notes: ALT-1: The whole of the project road will be paved by asphalt concrete.
ALT-2: The road stretch up to Tsenkhermandal will be paved by AC and remaining will be paved by BST.

9.CONCLUSION AND RECOMMENDATIONS

It is concluded that the Study reveals high feasibility for the project implementation. Namely, the project has high technical feasibility, the EIA concluded there is no substantial or irreversible adverse environmental impacts arising form the project, and it is concluded that the project is economically viable based on the economic analysis. It is recommended that the institutional arrangement for project implementation should be taken without delay.

OUTLINE OF THE PROJECT

The Feasibility Study on Construction of Eastern Arterial Road in Mongolia

- Study period :Mar. 2001 - Jun. 2002
- Counterpart Agency :Department of Roads, Ministry of Infrastructure, The Government of Mongolia

1. Background of the Study

Transport plays a crucial role in the efficient functioning of the domestic economy as well as development of international trade due to dependence on both coal-based energy production and imports. However, the issues in the transport sector of Mongolia are mainly derived from the salient features of a landlocked country with a low population and a long distance between population centers.

A major characteristic of transportation in Mongolia is the collection and distribution by road of both passenger traffic and cargo transport from the north-south transport axis centering on Ulaanbaatar. The main north-south axis comprises both rail and road. Within road transport, the density of the arterial road network remains very low and unpaved earth roads or multiple shifting tracks occupy a large portion of arterial roads. More than 30% of population and a half of the national car ownership are concentrated in Ulaanbaatar City, while very low level of mobility is found in rural area because non-motorized traffic such as horse and cart prevails. Recently, such gap of mobility level is increasing and under such circumstances, it is necessary to reverse this trend by reducing the gap. One method of achieving this is to develop the strategically important east-west arterial road by constructing to an all weather and international standard paved road.

Due to the road construction work in between Erdene and Baganuur which is being undertaken by Government of Mongolia (GOM), the agreed scope of work was amended in September 2001 to exclude the area where GOM have commenced the road construction work. Accordingly, the work items such as preliminary design, construction plan and cost estimation were carried out excluding the road section between Erdene and Baganuur. However, the Study still incorporates the work items such as environmental impact assessment, road maintenance plan, economic and financial analysis and implementation plan as these have a close relationship to the study context as a whole.

2. Objective of Study

Objective of Study is to carry out a feasibility study on construction of Eastern Arterial Road and to transfer technology to Mongolia counterparts.

3. Study Area

The study area of the Eastern Arterial Road is the road section from Erdene to Undurkhaan on State Highway No. A0501, approximately 250 km in length. The area influenced by the study road consists of four eastern provinces of Tuv, Khentii, Dornod and Sukhbaatar as well as the Kherlen river basin. The target year of the plan is the year 2015, which accords with that of relevant studies and projects implemented by the Government of Mongolia.

4. Outline of the Project

4.1 Selection of Route Alternatives

Selection of Route had been carried out by two methods. One is to establish the alternative routes and select the optimum route from these and the other is to improve the existing

multi-shifting tracks. The crossing point of the Kherlen River was set in the area of the existing bridge for both economical and technical reasons. This proposal was agreed with the Mongolian government in August 2001. The alternative routes were set in the three sections and the details are given below.

(1) Section A: Baganuur

There are two alternatives in Baganuur area that detour the Baganuur coal mine. Alternative A-1 is the southern route with railway crossing and A-2 is the northern route that goes through urban area of Baganuur city. The study team has selected A-2 as the optimum selection for economical and construction reasons.

(2) Section B: Kherlen East

This is located on the southern end of Nogoon Modot Mountains. Alternative B-1 passes Ust Valley (south side of the Mountains) and B-2 passes Jargalant Valley (north side of the Mountains). B-1 was selected as the optimum route for economical and construction reasons.

(3) Section C: Tsenkhermandal West

This section is located on Khunkh Mountain area. Alternative C-1 passes Bor Khujirt Pass which is located on the south side of the mountain and C-2 passes Naran Pass on the north side. C-2 was considered as the optimum route for economical and construction reasons.

4.2 Selection of Optimum Pavement Structure

Pavement structure was designed in 2 sections based on the traffic demand forecast, the first is Baganuur - Jargaltkhaan and the second is Jargaltkhaan - Undurkhaan.

To make the pavement structure economical, the Life Cycle Cost (LCC) was taken into account. LCC analysis was carried out in the 2 sections which are Erdene - Baganuur and Murun - Undurkhaan as a model case. The former represents high embankment section with heavy traffic and the latter represents low embankment with non-heavy traffic.

1) Analysis period is 20 years for both AC pavement and BST pavement.
2) Routine maintenance including thermal cracks filled with asphalt emulsion slurry for both AC pavement and BST pavement.
3) Overlay at 7 years interval on AC pavement as the result of comparison with 4 cases.
4) Surface dressing at 3 years interval on BST pavement due to the need to keep similar roughness as AC pavement and to avoid surface treatment problems.

The results of LCC analysis as shown below indicate that both pavement types are expected to have sufficient economic return and in the section of Erdene to Baganuur, both have almost equal EIRR.

Section	Length	Type	Initial Investment (M. $)	NPV (Thousand $)	EIRR
Erdene - Baganuur	33 km	AC	9,310	4,239	17.6%
		BST	8,619	4,610	18.4%
Murun - Undurkhaan	67 km	AC	7,834	11,895	26.7%
		BST	6,691	12,833	29.4%

The following two alternative schemes are examined for the purpose of optimum implementation plan in economic analysis, considering results of LCC analysis, equipment availability and ease of maintenance.

Section	Type of Pavement	
	Alternative - 1	Alternative - 2
Erdene - Tsenkhermandal	AC Pavement	AC Pavement
Tsenkhermandal - Undurkhaan	AC Pavement	BST Pavement

4.3 Selection of the Type of the Kherlen Bridge

The alternatives set in the area of the existing bridge are as follows:

Alternative	Location	Contents
1	Existing Route	Utilize the existing bridge after reinforcing it.
2	New Route	Construct a new bridge 1km downstream of the existing bridge
3	Existing Route	Utilize the existing bridge for light vehicles after repairing it and construct a new bridge beside the existing bridge.

After study, Alternative-3 was considered to be the optimum selection considering economical, technical and periodical reasons. The new bridge to be constructed is planned to be 268.8m long with 8 spans of 33.6m. It will be located 30 m downstream of the existing bridge. It will have a carriage way of 8m width. It is also designed to have the structure that is able to satisfy the design river section (360m long) in the future. Super-structure type is pre-stressed concrete (PC) T-shaped girder and sub-structure is elliptical shaped re-enforced concrete (RC) wall type pier with spread foundation.

4.4 Other Bridges and Culverts

5 other bridges, 29 box culverts and 197 pipe culverts are planned in this study based on research covering the geology, geography and hydrology. Of the 5 other bridges, 3 will be replacements of wooden bridges, 1 replacement of an RC bridge and 1 new construction of an RC bridge.

Super-structure was standardized due to the similar conditions. 2 types of RC T-shaped girder were set as standard girder and these are 15m and 17.5m long. The shape of girder is simplified considering the need for reducing the cost while at the same time satisfying the quality and construction difficulties.

The other types of standard girder are proposed in this study so as to be used for bridges in any other projects in Mongolia, which are RC T-shaped girder of 15 to 22.5m and PC T-shaped girder of 25 to 35m long.

Culverts for this project were also standardized to 4 boxes and 3 pipes. Mongolian current standards were taken into consideration to propose these culverts. The section of box culvert is also designed to be large enough for the livestock and big natural animals to go through.

4.5 Environmental Impact Assessment

The project of The East Arterial Road has moderate negative impact.

In the implementation of the project, it is necessary to set up a protection management plan to mitigate negative impacts both on the social and natural environment and on the pollution such as impacts to urbanized area, quarry sites, construction sites, permafrost, wastes and endangered species. Also it is imperative to set the control and monitoring program of the project and follow its criteria. It is also required to carry out the most appropriate mitigation measures by checking the differences between monitored values and control index. The two following instructions are especially needed to be carried out.

a) To provide adequate traffic and warning signs and information at the crossing points. These are provided to allow children and elder people to cross the road with safety and to avoid possible risks for drivers and passengers.
b) To use community leaders and public relations to inform the public especially drivers about safe use of the road during the construction and operation period.

4.6 Road Maintenance System

The Nalaikh branch of the state-owned Road Repair and Maintenance Corporation "AZZAN" maintains 70 km from the beginning point and also the Kherlen River Bridge. The State Stock-shared Road Maintenance Company of Khentii Province maintains the remainder of the project road. These two entities have similar problems such as follows:

- shortage of road and bridge construction equipment and machinery
- shortage of local engineers well-qualified in managing and supervising the operation
- lack of skillful construction equipment operators, mechanics, and electricians
- lack of repair facility and tools

The road rehabilitation/maintenance center is proposed to set in the AZZAN as a training center to solve the problems above and strengthen road maintenance capacity. The targets of the road rehabilitation/maintenance center are:

a) To establish one road rehabilitation/maintenance center that will serve as a training facility for construction operators and mechanics.
b) To procure equipment and machinery necessary for training and road rehabilitation/maintenance.
c) To train operators, mechanics, road-maintenance personnel, and managers.
d) To upgrade and update the existing technically skilled operators, mechanics, road-maintenance personnel, and managers.
e) To utilize and accumulate those skills through actual practices as a pilot model.
f) To establish regional sub-centers for further development.

4.7 Road Improvement Plan

The study area is planned to be improved based on following design criteria:

1) Highway Classification : Category III (as per Mongolian Standards)
2) Road Width : 7m + 2@1.5m (total 10m road width)
3) Design Speed : 100 km/h (flat terrain), 80 km/h (rolling) and 60 km/h (mountainous)

Road ancillaries such as road markings, guard posts, regulatory & warning signs, guide signs, kilometer posts and approach slope for domestic animals will be installed as traffic safety measures.

4.8 Project Implementation Plan

The project implementation plan covers the road stretch between Baganuur - Undurkhaan and totals 221.8 km. It excludes the Erdene - Baganuur 37 km long road section which is being constructed by the Department of Roads using the Government's own fund. However, since traffic demand forecast has been carried out to cover the road stretch between Erdene - Undurkhaan, the project implementation plan is made in recognition of the work to be done on the road stretch between Erdene - Undurkhaan. This is done particularly for the economic analysis based on the estimated benefit to be accrued from the forecasted traffic demand.

(1) Construction Section

The study area is divided into the six construction section as shown on the table in the next page. The following conditions were assumed considering the characteristics of this project.

1) Asphalt pavement work is limited to the period of 5 months (May to September) and earthwork is limited to the period of 7 months (April to October).
2) Stockpiling of aggregates, pre-cast concrete structures and other preparatory works are carried out through the year.
3) The period of 4-year construction to cover 221.8 km long road improvement may be justified considering the achievements of the previous projects by other donors.

(2) Implementation Plan for Sections II to VI

Following two schemes are considered within the project implementation plan:

Scheme-I: Construction by contractor selected through tendering.

The highest priority should be given to Section II and VI because they are located in the surroundings of urban area and relatively high economic return is anticipated due to the higher traffic volumes. Accordingly, these sections should be implemented by international contractors in a competitive environment.

Scheme-II: Construction by DOR as a pilot model

The remaining sections of Section III, IV and V should be implemented by DOR using the proposed road rehabilitation/ maintenance center.

Scheme-I has advantages in the aspects of using effective, efficient and accountable procedures to realize the project by fast track method and with less financial burden on the government. However, no resource except the constructed facilities will be developed and road maintenance on the constructed section may face both technical and financial difficulties.

Scheme-II has the possibility to cope with institutional requirements that are issued in the administration of road. It envisages the growth of the construction industry through actual practices to cope with incremental demand brought about by the government policy of road improvement, especially development of the “Millennium Road”.

(3) Implementation Plan for Economic Analysis

The implementation plan for the economic analysis is made to cover the entire road stretch between Erdene - Undurkhaan because it should coincide with the sections set by traffic demand forecast. This will allow comparison of the estimated costs and benefit that will accrue from forecasted traffic demand. The IP section is newly set for the proposed project implementation plan for the economic analysis. Section-I that is funded and being constructed by DOR is planned to be completed in 2006. The other sections are assumed to be done in 4 years as mentioned above. Table below shows the relationship between traffic section, construction section and the IP section.

Traffic	Erdene - Baganuur		Baganuur - Jargaltkhaan		Jargaltkhaan - Murun	Murun - Undurkhaan
Construction	Section-I	Section -II	Section -III	Section -IV	Section -V	Section -VI
	Erdene - Baganuur	Baganuur - Kherlen River East	Kherlen River East - Tsenkhermandal	Tsenkhermandal - Jargaltkhaan	Jargaltkhaan - Murun West	Murun West - Undurkhaan
IP Section	IP Section-1		IP Section-2		IP Section-3	IP Section-4

4.9 Economic Analysis

Project cost as a financial cost is estimated based on the results of preliminary design, quantity take-off of each work item, and the studies on construction planning and method.

The basic premises of project cost estimates are as follows:

1) The cost is estimated on US Dollar basis, considering the fluctuation of exchange rates against foreign currencies.
2) The unit cost of each cost component is determined based on the economic conditions prevailing in January 2002 (US$ 1.0 = ¥ 133 = 1,100 Togrog).
3) Detailed design and supervisory service costs is assumed to be 7 % of construction cost.
4) Unit prices of fill materials and fine/coarse aggregates are estimated by every 10 km, considering hauling distance of materials from individual borrow pits and quarry sites.
5) Equipment cost is based on the local market price as far as they are available. The cost analysis is made in case of special equipment that is not available in Mongolia.

The financial project costs for economic analysis including the cost of road section between Erdene and Baganuur are shown in table below and assumptions of the analysis are as follows:

- The economic analysis was conducted based on IP sections mentioned above.
- The economic costs include the capital and maintenance costs of the project valued in economic prices.
- The source of quantified benefits from the project is savings in VOCs. To be conservative, benefits attributable to savings in travel time were not considered. The VOC estimates are based on the Roads Economic Decision VOC model developed by the World Bank.

Section		Road Length	Project Cost (Thousand US$)	AT-1	ALT-2	Construction Section
IP Section 1	Erdene-Kherlen River East	67.6 km	9,781	17.3%	17.3%	I, II
IP Section 2	Kherlen River East -Jargaltkhaan	94.4 km	22,053	9.4%	10.6%	III, IV,
IP Section 3	Jargaltkhaan-Murun West	50.0 km	10,230	17.6%	19.0%	V
IP Section 4	Murun West -Undurkhaan	46.8 km	8,134	23.2%	25.6%	VI
Total Section	Erdene-Kherlen River East	258.8 km	50,198	15.7%	16.8%	-

It is now clear that this project can obtain sufficient EIRR (Economic Internal Ratio of Return) with any of the pavement structure alternatives

5. Conclusion and Recommendations

The project will realize the strategic transport axis in the eastern part of the country as a part of "Millennium Road Plan" by construction of arterial road to an all-weather international standard.

(1) Implementation of the Project

1) It is recommended that Section VI (Murun West - Undurkhaan L=46.8 km) be given the highest priority in the implementation plan due to its necessity and urgency together with high feasibility. This section is located in the surroundings of urban area and relatively high economic return is anticipated due to the higher traffic volumes.
2) Section II (Baganuur - Kherlen River East L=30.6 km) involves the construction of Kherlen River Bridge for which the superstructure type is designed as PC girder totaling 268.8m (span 8@ 33.6m) in length. It is recommended that this section should also be given the highest priority in the implementation plan due to its necessity and urgency together with high feasibility.

3) It is recommended that Section III (Kherlen River East - Tsenkhermandal L=49.7 km), Section IV (Tsenkhermandal - Jargaltkhaan L=44.7 km) and Section V (Jargaltkhaan - Murun West L=50.0 km) be implemented by MOI/DOR using the proposed scheme of the road rehabilitation / maintenance center.

(2) It is proposed that the project road should be implemented using the recommended alternative of ALT-1. This will mean that the whole of the project road is paved by asphalt concrete pavement. Asphalt concrete pavement has many advantages compared to bituminous surface treatment, especially for high durability and certainty of performance.

(3) It is crucial for MOI/ DOR to levy a toll on Kherlen River Bridges and charge the private sectors for the privilege of utilizing the roadside spaces to cope with the increased fund requirement and alleviate the financial burden of the Government. Furthermore, MOI/ DOR should seize the initiative to withhold the revenues from equipment leasing at the proposed road rehabilitation/ maintenance center and earmark them for road maintenance.

(4) It is important that the development within and along the proposed route should be effectively controlled to prevent indiscriminate development and to facilitate the realization of road and road related facilities such as road station and observation platform.

(5) It is recommended that the Government request a donor country to assist in the realization of the project including procurement of equipment at the proposed road rehabilitation/ maintenance center, using bilateral ODA or loan from a multi-lateral lending agency so as to alleviate the financial burden of the Government.

(6) The scheme for a road rehabilitation / maintenance center aims to establish personnel training with construction equipment and machinery required for the road development within AZZAN and to restructure the existing organization. It is recommended that the Government request a donor country to assist in the strengthening of a road rehabilitation/ maintenance center by utilizing the system of technical cooperation in the fields of road maintenance.

THE FEASIBILITY STUDY
ON
CONSTRUCTION OF EASTERN ARTERIAL ROAD
IN
MONGOLIA

FINAL REPORT

TABLE OF CONTENTS

VOL. I: MAIN REPORT

CHAPTER 2 CURRENT TRANSPORT AND ROAD CONDITIONS

CHAPTER 3 SOCIOECONOMIC STUDY, FRAMEWORK AND FUTURE FORECAST OF TRAFFIC DEMAND

CHAPTER 4 EXISTING ROAD, PAVEMENT AND BRIDGE CONDITIONS AND ITS INVENTORY SURVEY

CHAPTER 6 ENVIRONMENTAL ASPECTS

CHAPTER 7 ESTABLISHMENT OF DESIGN CRITERIA

CHAPTER 8 SELECTION OF OPTIMUM PAVEMENT STRUCTURES

CHAPTER 14 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

LIST OF TABLES

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

CHAPTER 6

CHAPTER 7

CHAPTER 8

CHAPTER 9

CHAPTER 10

CHAPTER 11

CHAPTER 12

CHAPTER 13

CHAPTER 14

CHAPTER 15

CHAPTER 16

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

CHAPTER 6

CHAPTER 7

CHAPTER 8

CHAPTER 9

CHAPTER 10

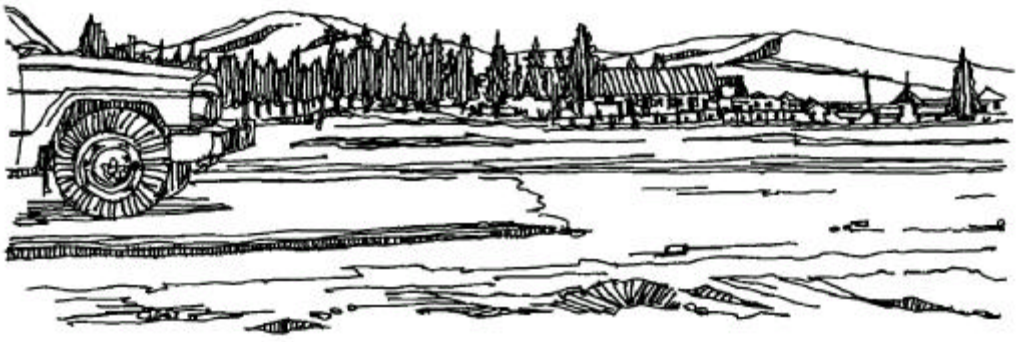
CHAPTER 11

CHAPTER 13

CHAPTER 14

CHAPTER 15

CHAPTER 1 INTRODUCTION



CHAPTER 1 INTRODUCTION

1.1 Introduction

The transport plays a crucial role in the efficient functioning of the domestic economy as well as development of international trade due to dependence on both coal-based energy production and imports. However, the issues in the transport sector of Mongolia are mainly derived from the salient features of a landlocked country with a low population and a long distance between population centers.

The characteristics of transportation in Mongolia are to collect and distribute both passenger traffic and cargo transport by road from the north-south transport axis centering Ulaanbaatar that comprises rail and road to penetrate the country. Focusing road transport, the density of arterial road network remains very low and unpaved earth roads or multiple shifting tracks occupy large portion of arterial roads. More than 30% of population and a half of national car ownership are concentrated in Ulaanbaatar City, while very low level of mobility is found in rural area because non-motorized traffic such as horse and cart prevail. Recently, such gap of mobility level is widening.

Under such circumstances, in response to the request of the Government of Mongolia (hereinafter referred to as "GOM"), the Government of Japan decided to conduct the Feasibility Study on Construction of Eastern Arterial Road in Mongolia (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan.

Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, dispatched the preparatory study team headed by Mr. Kenichiro OI in December 2000 to have a series of meetings with related agencies of the GOM and the GOM and the JICA have agreed to the Scope of Work for the Study that is given in Appendix-H.

The JICA entrusted the study team headed by Mr. Kenji MARUOKA in March 2001 to conduct the Study based on the agreed Scope of Work.

Due to the road construction work commenced by the GOM, the agreed Scope of Work was amended in September 2001 to exclude the area where the GOM commences the road construction work. Accordingly, the work items that are scheduled to start from Step 5 such as preliminary design, construction plan, preparation of management and maintenance plan and cost estimation are carried out excluding the road section between Erdene and Baganuur. However, the Study incorporates the work items that have close relationship with study context as a whole such as environmental impact assessment, economic and financial analysis and implementation plan even though they are on the road section between Erdene and Baganuur.

1.2 Study Objectives

The objectives of the Study are as follows;

(1) to carry out a feasibility study on construction of the Eastern Arterial Road; and

(2) to transfer technology to Mongolia counterparts.

1.3 Scope of the Study

1.3.1 Study Area

The study road of the Eastern Arterial Road is the road section from Erdene to Undurkhaan on National Highway No. A0501, approximately 250 km in length. The area influenced by the study road consists of four eastern provinces of Tuv, Khentii, Dornod and Sukhbaatar as well as the Kherlen river basin.

1.3.2 Target Year

The target year of the plan is the year 2015, which accords with that of relevant studies and projects implemented by the Government of Mongolia.

1.3.3 Concept of Work Flow

Figure 1-3-1 shows the workflow concept for the Study and its progress.

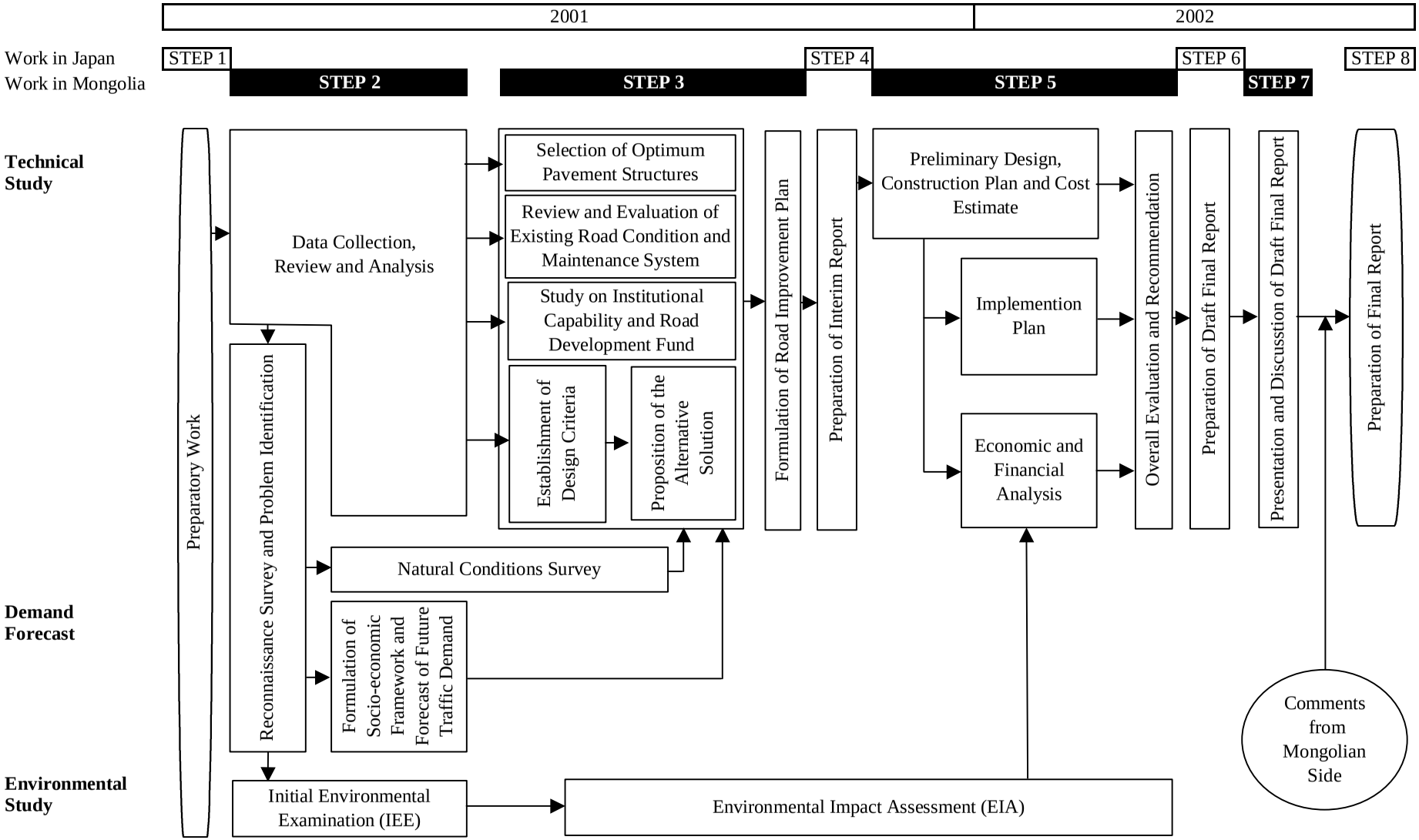


Figure 1-3-1 Concept of Work Flow

1.4 Study Organization

The JICA Study Team closely collaborates with the Mongolian counterpart personel from various organizations of the GOM. The following committees were set up for the entire duration of the Study:

- Steering Committee of the Mongolian Government, and
- JICA Advisory Committee.

The Study Organization is shown in Figure 1-4-1.

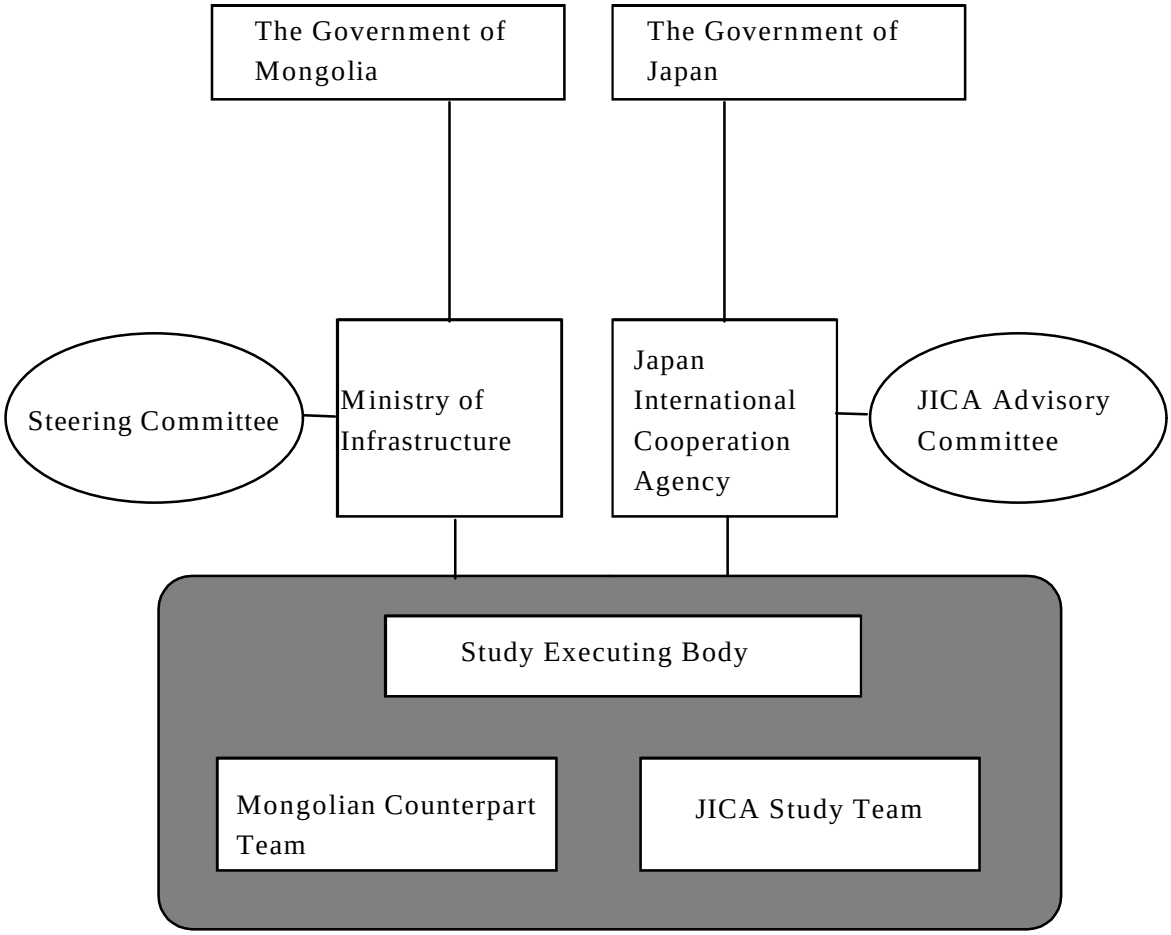


Figure 1-4-1 Study Organization

The members of the Government's steering committee (Mongolian Steering Committee) and counterparts (Mongolian Counterparts), JICA Advisory Committee and JICA Study Team for execution of the Study are shown in Appendix-A.

1.5 Final Report

The Final Report reflects the results of the study considering survey results, analysis, findings and discussions with MOI, DOR and relevant agencies. It was completed after receiving the official comments of the Draft Final Report from MOI and DOR.

1.6 Review of Related (Superordinate) Projects

the Road Development Master plan was formulated in 1994 under ADB financing and the GOM has exerted to improve arterial roads utilizing official development assistance from the Asian Development Bank, the World Bank, Kuwait and Japan. The GOM recently announced the scheme of Millennium Road Plan targeting to strengthen East-West transport axis, envisaging not only the improvement of road transport in Mongolia but also the promotion of regional cooperation with Russia, China and other surrounding countries.

The Study covers a part of the East-West transport axis on which the Millennium Road Planning emphasizes the necessity and urgency of improvement much more than before.

1.6.1 Review of the ADB Master Plan

The ADB Master Plan was prepared in January 1995 by Intercontinental Consultants and Technocrats Pvt. Ltd., (ICT) and Scott Wilson Kirkpatrick (SWK) under ADB Technical Assistance. The primary objectives of the study were to develop a Medium-term Road Master Plan and to identify the priority road sections for improvement.

The Medium-term Road Master Plan identified 24 priority links plus a major east-west link and the strategic link from Khovd – Mankhan – Bulgan to the Chinese border, totaling 5,362 km at an estimated cost of US$ 427 million. Top priority was given to (i) Ulaanbaatar – Altanbulag, (ii) Darkhan – Erdenet, (iii) Nalaikh – Sainshand and (iv) Nalaikh – Baganuur.

Among the top priority road sections, the 312 km road section from Ulaanbaatar to Altanbulag, on the Russian border, was selected to be rehabilitated first in 1995 to 1999 under ADB finance and the 183 km road section from Darhan to Erdenet was improved from 1996 to 2000 by the Kuwait Fund.

Detailed design and tendering is underway on the 200 km section of Nalaikh – Maanti – Choir under ADB finance.

An ADB fact finding mission was reported to visit Ulaanbaatar in May 2001 to conduct a survey on the road section between Choir and Sainshand.

1.6.2 Review of the Millennium Road Plan

The Government of Mongolia approved the implementation of the Millennium Road Project on 27 December 2000 by Cabinet Resolution No. 204, and charged the Minister of Infrastructure with the works.

The Millennium Road Plan (MRP) was proposed to comprise one horizontal (east-west) arterial road as “Millennium Road” and five vertical (north-south) arterial links as

relevant infrastructure, and its routes were approved on 25 January 2001 by the Parliament Resolution No. 9. It was also approved that the Government was charged to utilize the domestic sources and to get the support and aids from the donor countries and international banks and financial institutions for the construction of the road.

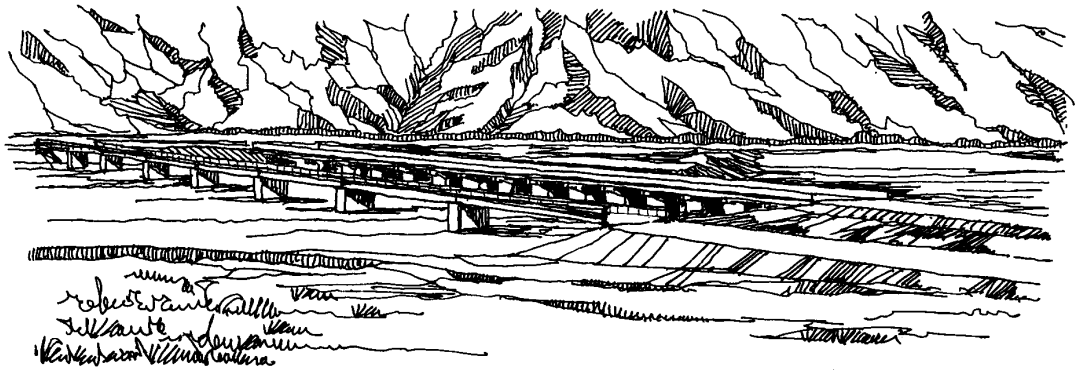
The MRP will connect long-distance regions by road, facilitate provision of consumer's production and service, develop road transport and improve living standard in the regions.

The MRP is strategically important for hastening socio-economic and regional development and improvement for the relation with foreign countries since 77% of total population of Mongolia, 72 % provinces in the country, 52% of the whole livestock are existing along the horizontal and vertical arterial roads.

The horizontal (east-west) arterial road in "Millennium Road" can be separated in two sections. One section is the western section starting from Ulaanbaatar, passing Lun, Dashinchilen Bridge over the Ugii Lake, Battsengel Bridge over the Khanui river, Tariat, Tsakhir, Zagastai hill, Ider, Zavkhanmandal, Durgun, Ulgii, Tsagaannuur, Ulaanbaishint and the western state border. The western section is 1,635 km long and the implementation of the project will improve 1,497 km of earth/gravel roads and construct 21 concrete bridges, totaling 995 m in length. The another is the eastern section starting from Ulaanbaatar, passing Undurkhaan, Sumber and the eastern state border. The eastern section is 960 km long including 861 km of earth/gravel road and 12 concrete bridges, totaling 1,089 m in length and 5 wooden bridges, totaling 82 m in length. 829 km of earth/gravel road will be improved and 1,036 m long concrete bridges will be constructed under the MRP.

The Ministry of Infrastructure accepted the offer made by Intercontinental Consultants and Technocrats Pvt. Ltd., (ICT) on 23 March 2001 to conduct a pre-feasibility study for the 2,600 km long Millennium Road. The study was completed in November 2001 and stated sufficient feasibility of the MRP.

CHAPTER 2 CURRENT TRANSPORT AND ROAD CONDITIONS



CHAPTER 2 CURRENT TRANSPORT AND ROAD CONDITIONS

2.1 Present Road Network

2.1.1 Roads in Mongolia

Roads in Mongolia are administratively classified into two (2) categories as follows:

- State roads: to connect the capital to the provincial center (Aimag centers), important towns and important border crossings and designated as such by resolutions passed by the Government.
- Local roads: to connect provincial centers (Aimag centers) and provincial centers to district centers (Sum centers), to the extent these are not connected by State Roads. There are also Internal roads to connect Sum centers to other population centers and farms.

Table 2-1-1 shows the present road conditions in Mongolia. Figure 2-1-1 shows the present road network. There are 30 State Roads in Mongolia totaling about 11,063 km in length. The Local Roads network length is about 38,187 km. The configuration of the state road network is simple: six (6) major state roads radiate outwards from Ulaanbaatar capital city as distributors to the provincial centers. The state roads A0301-A0302-A0303-A0304-A0305-A0306, A0401-A0402, A0501-A0502-A0503 and A0601-A0602-A0603-A0604 connect to the Russian border. The state roads A0101-A0102-A0103 and A0201-A0202-A0203 connect to the Chinese border. These state roads are main gateways to Ulaanbaatar capital city. Ulaanbaatar capital city in central Mongolia is traversed from south to north by state roads A0101-A0102-A0103 and A0401-A0402 which serve as the biggest corridors for the area. State roads A0501-A0502-A0503 and A0601-A0602-A0603-A0604 are the major east-west corridor axis for the whole of Mongolia. The radial state roads from Ulaanbaatar are:

- State Road. No.A0101-A0102-A0103 for the Southern East
- State Road. No.A0201-A0202-A0203 for the South
- State Road. No.A0301-A0302-A0303-A0304-A0305-A0306 for the West
- State Road. No.A0401-A0402 for the North
- State Road. No.A0501-A0502-A0503 for the East
- State Road. No.A0601-A0602-A0603-A0604 for the West

Parts of the state road network is indicated as natural earth roads, but are in effect tracks, which are not clearly defined roads due to the lack of clear road carriageway. As much as 75.6% of the state road network and 97.7% of the local roads are earth roads. Of the total road length, the ratio of unpaved surface is very high in Mongolia. As shown in Table 2-1-1, road surfaces are classified into four types: paved road, gravel road, improved earth road and earth road. The share by surface type of the total road length for the state roads are as follows: 11.9% paved roads, 12.5% gravel roads, 12.7% improved earth

roads and 62.9% earth roads. The share by surface type for local roads are: 1.0% paved roads, 1.3% gravel roads, 1.4% improved earth roads and 96.3% earth roads.

2.1.2 Roads in Eastern Region

The total road length by road type in the eastern region is 3,502 km of state roads and 7,155 km of local roads. The road network in the eastern region is composed of five (5) major state roads: A0101-A0102-A0103, A0501-A0502-A0503, A0019, A0021 and A2001-A2002. As mentioned above, A0101-A0102-A0103 is the major corridor from the Chinese border to Ulaanbaatar capital city covering Tuv and Dornogovi provinces. The east-west corridor axis for Khentii and Dornod provinces is served by A0501-A0502-A0503, which connects to the Russian border from Ulaanbaatar. A0019, A0021 and A2001-A2002 radiate from the major cities of Undurkhaan and Choibalsan connecting to the east-west corridor axis. The local road network is formed by many radial roads; they are generally intended to connect provincial centers and district centers. The share of surface types as follows: as for state roads, paved roads 15.6%, gravel roads 15.9%, improved earth roads 8.7% and earth roads 59.8%. And as for the local roads, paved roads 3.0%, gravel 0.8%, improved earth 0.1% and earth roads 96.1%.

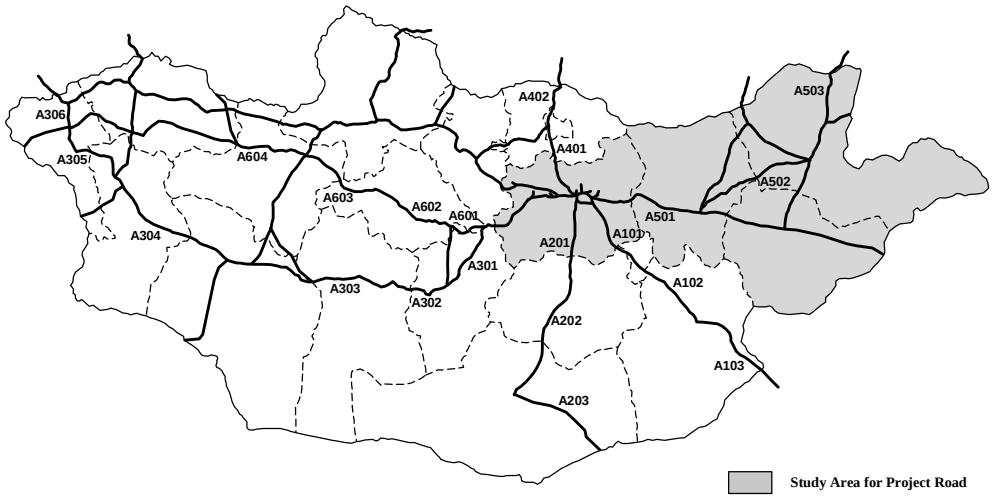


Figure 2-1-1 Present State Road Network

Table 2-1-1 Present Road Conditions in Mongolia

Items	Unit	Province																					Eastern Regional Area	Total
		Arkhangai	Bayankhongor	Bayan-Ulgii	Bulgan	Govi-Altai	Darkhan-Uul	Dornogovi	Dornod	Dundgovi	Zavkhan	Orkhon	Umnugovi	Selenge	Sukhbaatar	Tuv	Uvs	Ulaanbaatar	Khovd	Khentii	Govisumber	Uvurkhangai	Khuvsgul		
1. State Road	km	344.1	282.0	557.0	477.0	716.0	181.0	448.0	871.0	258.0	1,067.0	80.0	483.0	181.0	535.0	1,010.0	774.0	51.0	799.0	639.0	6.0	502.0	802.0	3,502.9	11,063.0
a. Paved Road	km	15.6	16.0	8.2	40.6	4.0	108.0	10.5	10.0	1.0	4.5	39.0	0.0	119.1	0.0	523.4	56.0	51.0	38.7	2.0	0.0	255.2	14.0	545.8	1,316.8
Cement Concrete Pavement	km	3.1	1.0	0.0	0.8	0.0	0.0	1.0	10.0	0.0	3.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	31.0	38.9
Asphalt Concrete Pavement	km	10.0	15.0	2.7	5.0	4.0	9.0	4.5	0.0	0.0	0.0	8.0	0.0	61.5	0.0	338.6	56.0	51.0	36.5	0.0	0.0	145.0	13.0	343.1	759.8
Asphalt Surface Treated Pavement	km	2.5	0.0	5.5	34.8	0.0	99.0	5.0	0.0	1.0	1.5	31.0	0.0	57.6	0.0	166.8	0.0	0.0	2.2	0.0	0.0	110.2	1.0	171.8	518.1
b. Gravel Road	km	170.3	4.0	133.0	53.0	71.3	0.0	5.4	267.0	0.0	75.0	41.0	3.0	46.0	4.6	7.7	90.4	0.0	7.5	271.0	0.0	33.0	96.0	555.7	1,379.2
c. Improved Earth Road	km	18.0	29.4	89.0	66.5	72.5	0.0	0.0	136.0	54.6	269.5	0.0	17.0	0.0	0.0	95.7	57.5	0.0	178.3	74.5	0.0	95.1	154.0	306.2	1,407.6
d. Earth Road	km	140.2	232.6	326.8	316.9	568.2	73.0	432.1	458.0	202.4	718.0	0.0	463.0	15.9	530.4	383.2	570.1	0.0	574.5	291.5	6.0	118.7	538.0	2,095.2	6,959.5
2. Local Road	km	1,246.0	2,101.0	2,510.0	2,253.0	2,220.1	6.0	235.0	1,748.0	2,503.0	2,778.0	1,995.0	122.0	1,432.0	2,477.0	2,430.0	2,775.0	1,914.0	1,332.0	265.0	2,306.0	1,539.0	1,997.0	7,155.0	38,184.1
a. Paved Road	km	0.3	9.0	6.7	1.5	10.0	0.0	25.3	7.3	4.0	0.0	2.0	14.0	3.8	2.8	1.4	15.0	74.6	10.1	178.6	13.3	10.2	4.5	215.4	394.4
Cement Concrete Pavement	km	0.0	0.0	3.0	0.0		0.0	2.0	0.8	4.0	0.0	0.0	0.0	3.8	2.8	1.4	1.5	0.0	1.6	26.0	0.3	1.2	3.5	33.0	51.9
Asphalt Concrete Pavement	km	0.3	3.0	3.7	0.0	3.0	0.0	20.0	0.0	0.0	0.0	1.0	14.0	0.0	0.0	0.0	2.0	74.6	6.0	137.4	6.0	5.0	0.0	157.4	276.0
Asphalt Surface Treated Pavement	km	0.0	6.0	0.0	1.5	7.0	0.0	3.3	6.5	0.0	0.0	1.0	0.0	0.0	0.0	0.0	11.5	0.0	2.5	15.2	7.0	4.0	1.0	25.0	66.5
b. Gravel Road	km	6.0	30.0	0.0	10.0	7.8	0.0	3.0	10.0	26.9	0.0	1.0	68.0	7.0	0.0	0.0	215.4	7.0	8.8	47.0	2.0	45.0	3.0	60.0	497.9
c. Improved Earth Road	km	43.0	88.0	74.7	6.0	16.0	6.0	0.9	0.0	32.0	0.0	0.0	10.0	7.1	4.0	0.0	13.0	92.4	0.0	0.0	74.0	48.9	0.0	4.9	516.0
d. Earth Road	km	1,196.7	1,974.0	2,428.6	2,235.5	2,186.3	0.0	205.8	1,730.7	2,440.1	2,778.0	1,992.0	30.0	1,414.1	2,470.2	2,428.6	2,531.6	1,740.0	1,313.1	39.4	2,216.7	1,434.9	1,989.5	6,874.7	36,775.8
Total	km	1,590.1	2,383.0	3,067.0	2,730.0	2,936.1	187.0	683.0	2,619.0	2,761.0	3,845.0	2,075.0	605.0	1,613.0	3,012.0	3,440.0	3,549.0	1,965.0	2,131.0	904.0	2,312.0	2,041.0	2,799.0	10,657.9	49,247.1
a. Paved Road	km	15.9	25.0	14.9	42.1	14.0	108.0	35.8	17.3	5.0	4.5	41.0	14.0	122.9	2.8	524.8	71.0	125.6	48.8	180.6	13.3	265.4	18.5	761.2	1,711.2
Cement Concrete Pavement	km	3.1	1.0	3.0	0.8	0.0	0.0	3.0	10.8	4.0	3.0	0.0	0.0	3.8	2.8	19.4	1.5	0.0	1.6	28.0	0.3	1.2	3.5	64.0	90.8
Asphalt Concrete Pavement	km	10.3	18.0	6.4	5.0	7.0	9.0	24.5	0.0	0.0	0.0	9.0	14.0	61.5	0.0	338.6	58.0	125.6	42.5	137.4	6.0	150.0	13.0	500.5	1,035.8
Asphalt Surface Treated Pavement	km	2.5	6.0	5.5	36.3	7.0	99.0	8.3	6.5	1.0	1.5	32.0	0.0	57.6	0.0	166.8	11.5	0.0	4.7	15.2	7.0	114.2	2.0	196.8	584.6
b. Gravel Road	km	176.3	34.0	133.0	63.0	79.1	0.0	8.4	277.0	26.9	75.0	42.0	71.0	53.0	4.6	7.7	305.8	7.0	16.3	318.0	2.0	78.0	99.0	615.7	1,877.1
c. Improved Earth Road	km	61.0	117.4	163.7	72.5	88.5	6.0	0.9	136.0	86.6	269.5	0.0	27.0	7.1	4.0	95.7	70.5	92.4	178.3	74.5	74.0	144.0	154.0	311.1	1,923.6
d. Earth Road	km	1,336.9	2,206.6	2,755.4	2,552.4	2,754.5	73.0	637.9	2,188.7	2,642.5	3,496.0	1,992.0	493.0	1,430.0	3,000.6	2,811.8	3,101.7	1,740.0	1,887.6	330.9	2,222.7	1,553.6	2,527.5	8,969.9	43,735.3

Source: Ministry of Infrastructure, 2001.

2.2 Existing Traffic Characteristics

2.2.1 Public Transport

There are three public transport modes in the Study Area; railway, bus and civil aviation. Current land transport conditions are described below:

(1) Railway Transport

The total route length of Mongolian Railways is 1,815 km. The trunk route from Sukhbaatar, on the Russian border, to Ulaanbaatar to Zamin Uud on the Chinese border is 1,111 km. There is a 164 km link to Darkhan between Ulaanbaatar and Sukhbaatar. In the eastern region, there are two separate railway lines. One is a line 238 km linking Choibalsan to Ereentsav on the Russian border, and another is a branch line 96 km long to Baganuur connected to the main line at Bagakhangai.

In the Study Area, operation schedule on the line between Choibalsan and Ereentsav is few: 2 trains in two directions for passengers/week and irregular freight operations depending on demand. The major purpose of passenger travel is to carry daily necessities. The branch line between Bagakhangai and Baganuur is in operation every other day, and the maximum capacity of the line is around 6-7 trains to both directions per day. The seasonal operation is different; in wintertime 6-7 trains run each directions per day and in summertime 3 trains run each direction per day, mainly to carry coal.

At present, the railways in the eastern region are operating according to demand. The share of railway transport is low compared to road transport.

(2) Bus Transport

Bus transport comprises three main segments: long distance inter-city, shorter distance intra province and urban mass transit. The long distance bus service is operated less frequently many routes are operated only once a week, or at even lower frequency. Among the total 39 routes, there are four operational long distance inter-city routes using the project road, namely Ulaanbaatar-Undurkhaan: 331 km, Ulaanbaatar-Choibalsan: 655 km, Ulaanbaatar-Bayan Uul: 602 km, and Ulaanbaatar-Baruun Urt: 560 km. Table 2-2-1 shows the present condition of long distance bus operation along the project road.

The service from Ulaanbaatar to Choibalsan is operated daily by 2 microbuses and the service from Ulaanbaatar to Baruun Urt is operated every other day by 1 microbus. However, other services to Undurkhaan and the Bayan Uul operate only a few days a week with 1 microbus. 27 Bus drivers cover all the long distance bus services at Ulaanbaatar inter-city bus terminal. The number of annual passengers along the project road is shown in Table 2-2-2. The number of annual passengers

toward the eastern region ranges between 6,000 and 8,000 passengers per route. Only Ulaanbaatar to Dornod province in 2000 indicated a sharp increase in passengers.

Table 2-2-1 Operational Conditions of Long Distance Bus Route along Project Road

No.	Name of Route	Operational Route	Length (km)	Bus Operators	Time Schedule	No. of Bus Operated
1	Ulaanbaatar-Undurkhaan	Ulaanbaatar-Baganuur-Tsenkhermandal-Undurkhaan	331	AutoAyan	2 days	1 Microbus
2	Ulaanbaatar-Choibalsan	Ulaanbaatar-Tsenkhermandal-Undurkhaan-Bayan Ovoo-Choibalsan	655	Achit teever	4 days	2 Microbus
				Min Trans	3 days	2 Microbus
				Total	7 days	4 Microbus
3	Ulaanbaatar-Bayan-Uul	Ulaanbaatar-Tsenkhermandal-Undurkhaan-Bayan Ovoo-Noroblin-Bayan Uul	602	Amirlangui	1 days	1 Microbus
4	Ulaanbaatar-Baruun Urt	Ulaanbaatar-Baganuur-Tsenkhermandal-Undurkhaan-Davsanbadrakh-Munkhhaan-Baruun Urt	560	Arvin Zam	2 days	1 Microbus
				Khan Kharaatsai	1 days	1 Microbus
				Total	3 days	2 Microbus

Source: Transport Policy Implementing Division, Ministry of Infrastructure,

Table 2-2-2 Numbers of Annual Passengers on Project Road

Unit: '000 Persons

Locations	Number of Annual Passengers (Persons per year)				
	1996	1997	1998	1999	2000
Khentii	7.9	7.9	8.3	7.5	7.8
Dornod	7.6	7.1	5.6	7.9	17.2
Sukhbaatar	7.6	8.2	7.6	5.9	4.7

Source: Transport Policy Implementing Division,
Ministry of Infrastructure, 2001

2.2.2 Analysis of Traffic Survey

(1) Outline of Traffic Survey

1) Survey Purpose and Survey Location

Five kinds of traffic surveys (traffic count survey, vehicle OD survey, travel time survey, axle load survey and roughness survey) were conducted to obtain vehicle characteristics data on the project road. The obtained traffic data will be used to provide the necessary information for identifying traffic characteristics for traffic demand forecast and road design. Figure 2-2-1 shows the locations of traffic survey. A summary of the traffic survey is described below.

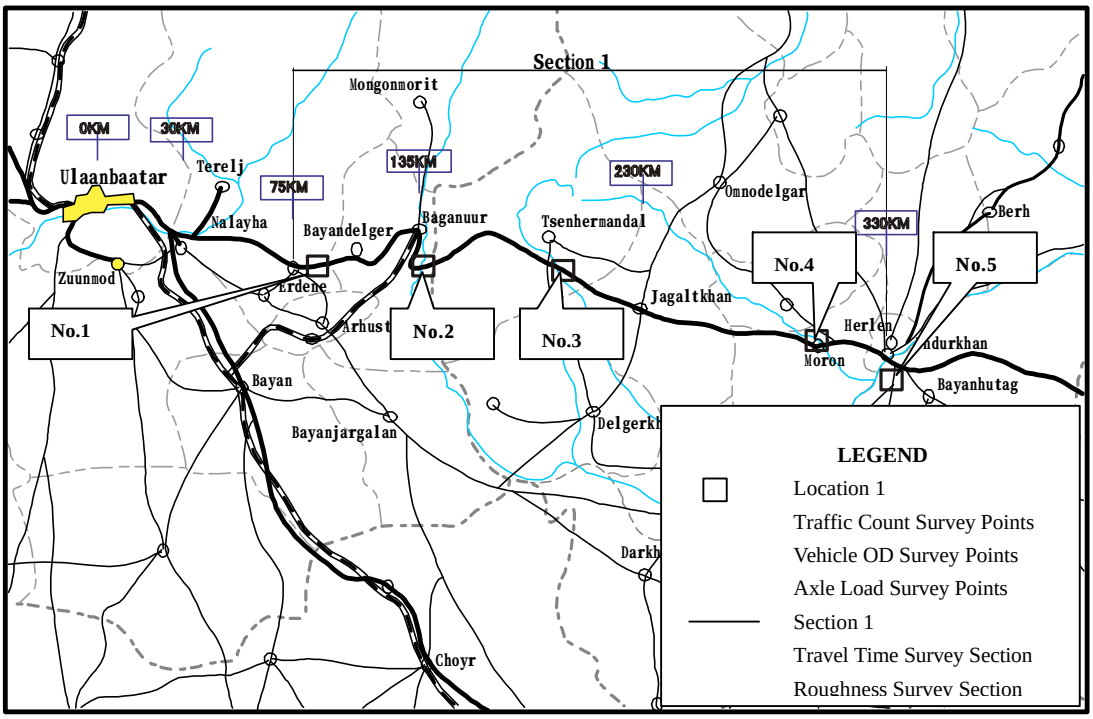


Figure 2-2-1 Locations of Traffic Survey

2) Traffic Count Survey

The traffic count survey was carried out in each direction according to vehicle type. The surveyor recorded the number of traffic every fifteen-minute. The survey was carried out in two directions: direction 1 to Erdene and direction 2 to Undurkhaan. 24-hour traffic counting was carried out continuously for three days. The type of vehicles were classified into the following eleven types: car (sedan, 4WD, pickup, van), microbus, small bus, large bus, small rigid truck (under 3.5 ton), middle rigid truck (3.5-12 ton), large rigid truck (over 12 ton), articulated truck (3.5-12 ton), large articulated truck including trailer (over 12 ton), tractor and motorbike.

3) Vehicle OD survey

The interviewers directly interviewed the vehicle owner or driver. The vehicle OD survey was carried out in two directions as the traffic count survey. 24-hour vehicle OD survey was carried out continuously for three days. The survey was conducted for all vehicles at each location. There were eight major interview items as follows: type of vehicle, car ownership, number of passengers, origin/destination, trip purpose, type of freight carried (only for trucks) and loading, capacity and others. The types of vehicles were classified into eleven types as it was in the traffic count.

4) Travel Time Survey

The travel time survey was carried out along the existing road for approximately 250 km. The survey team recorded the time at each checkpoint. The checkpoints were set at the main inter modal points of towns along the road. The travel time survey was conducted by direction for traffic count. The survey was carried out for three round trips within 3 days.

5) Axle Load Survey

The axle load survey was carried out by using an axle load scale. The survey was carried out in two directions as same as traffic count survey. The survey was carried out for 24-hours at each location. The survey location were as follows: sections between Erdene and the Kherlen river, 2 locations: 20% of trucks and buses excluding empty goods vehicles, eastern sections from the Kherlen river, 3 locations: 50% of trucks and buses excluding empty goods vehicles.

6) Roughness Survey

The roughness survey was carried out by using a roughness meter. The test car drove at an average speed of approximately 32 km/h. The survey was carried out in two directions as same as traffic count survey. The survey was conducted for five round trips within six days.

(2) Results of Traffic Survey

1) Traffic Count Survey

a) Traffic Volume

The average traffic volumes per day at each location are as follows: 377 vehicles at Bayandavaa (location No.1), 179 vehicles at the Kherlen river bridge (location No.2), 124 vehicles at the Tsenkher river bridge (LocationNo.3), 125 vehicles at Khentii the Murun river bridge (location No.4) and 44 vehicles at Sukhbaatar road fork (location No.5). The traffic volume by direction and by location is shown in Table 2-2-3. In addition, comparison of daily traffic volume during the past few years is shown in Figure 2-2-2. The daily traffic volume increased until year 2000; however, the traffic volume in 2001 decreased by about 20-50%. Obviously, the results of the traffic count survey in 2001 are not representative due to the foot and mouth disease.

Table 2-2-3 Daily Traffic Volume at Each Location

No.	Location	Direction	Daily Traffic Volume (Vehicles per Day)			
			1st day	2nd day	3rd day	3 days average
1	Bayandavaa	To Erdene	180	149	225	185
		ToUndurkhaan	225	134	219	193
		Total	405	283	444	378
2	Kherlen River Bridge	To Erdene	100	69	105	92
		ToUndurkhaan	107	58	98	88
		Total	207	127	203	180
3	Tsenkher River Bridge	To Erdene	59	54	77	63
		ToUndurkhaan	89	32	61	61
		Total	148	86	138	124
4	Murun River Bridge	To Erdene	54	50	81	61
		ToUndurkhaan	82	57	51	63
		Total	136	107	132	124
5	Sukhbaatar Road Fork	To Erdene	16	18	33	22
		ToUndurkhaan	16	24	25	22
		Total	32	42	58	44

Source: JICA Study Team, 2001

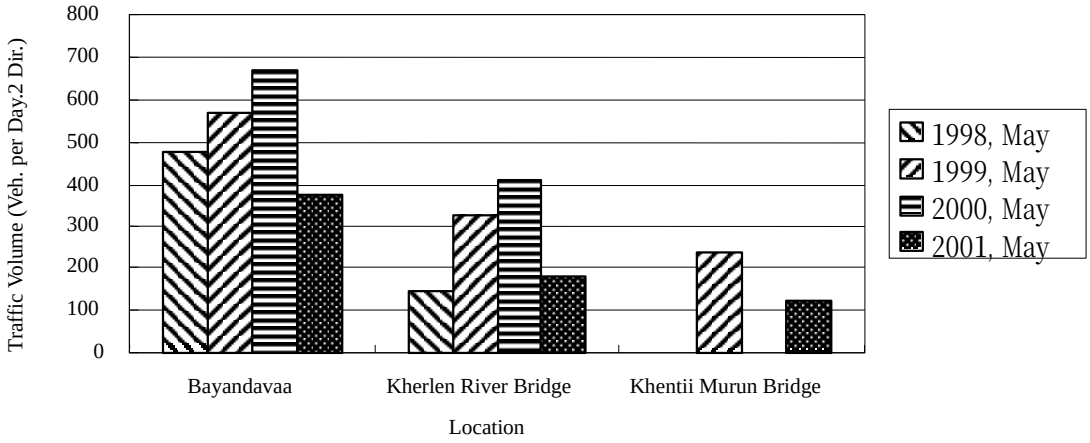


Figure 2-2-2 Comparison of Daily Traffic Volume of Each Year

b) Vehicle Type Composition

The composition of vehicular type on the project road is shown in Figure 2-2-3. The share of each vehicle type at each location on the project road within 3 days are as follows: cars 48.1-58.3%, microbuses 8.3-21.4%, small bus 0.0-1.5%, large buses 0.0-0.1%, small trucks 1.5-5.1%, medium rigid trucks 4.5-7.8%, large rigid trucks 0.8-3.7%, medium articulated trucks 2.8-9.4%, large articulated trucks 1.3-9.1%, tractors 0.2-3.0% and motorcycles 1.1-19%. The share of cars is high at about 52%, while the share of trucks is 21%.

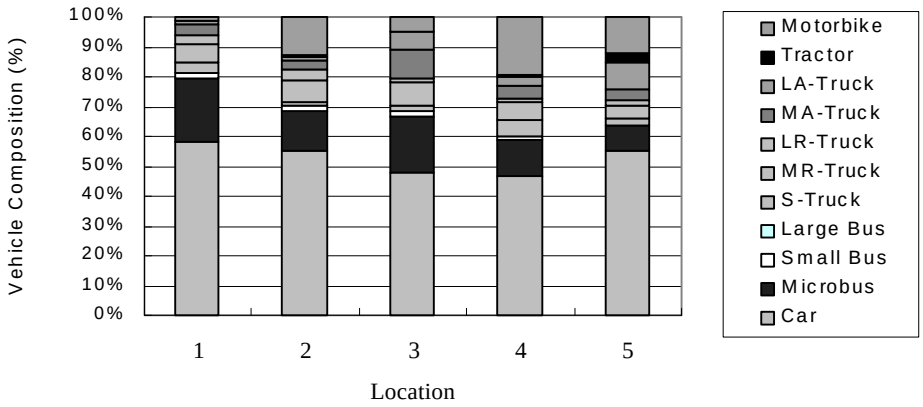


Figure 2-2-3 Vehicle Type on Project Road

c) Hourly Fluctuation

Figure 2-2-4 shows the fluctuation of hourly traffic volume at each location. The fluctuation patterns are for the three peak periods: 8:00-9:00 in the morning, 13:00-15:00 mid day, 19:00-21:00 in the evening. Especially large fluctuations are seen in the evening hours. The ratio of peak traffic volume to 24-hour traffic volume ranges between 7% and 9%. Figure 2-2-5 shows the traffic volume in 12 hours and 24 hours. The traffic volume by type of vehicles varies as follows: cars including motorbike 45-60%, buses 47-61% and trucks 45-70%. The total traffic volumes in 12 hours and 24 hours vary from 46% to 60% on average.

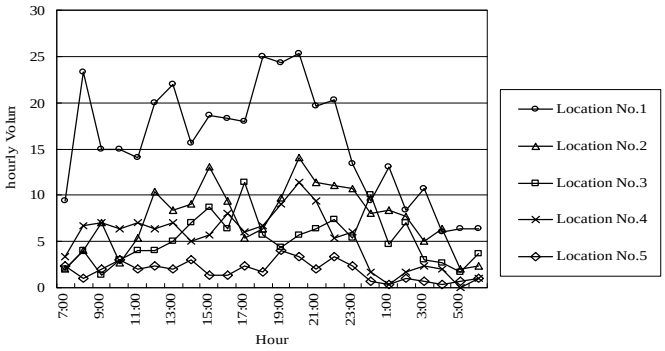


Figure 2-2-4 Fluctuation of Hourly Traffic Volume at Each Location

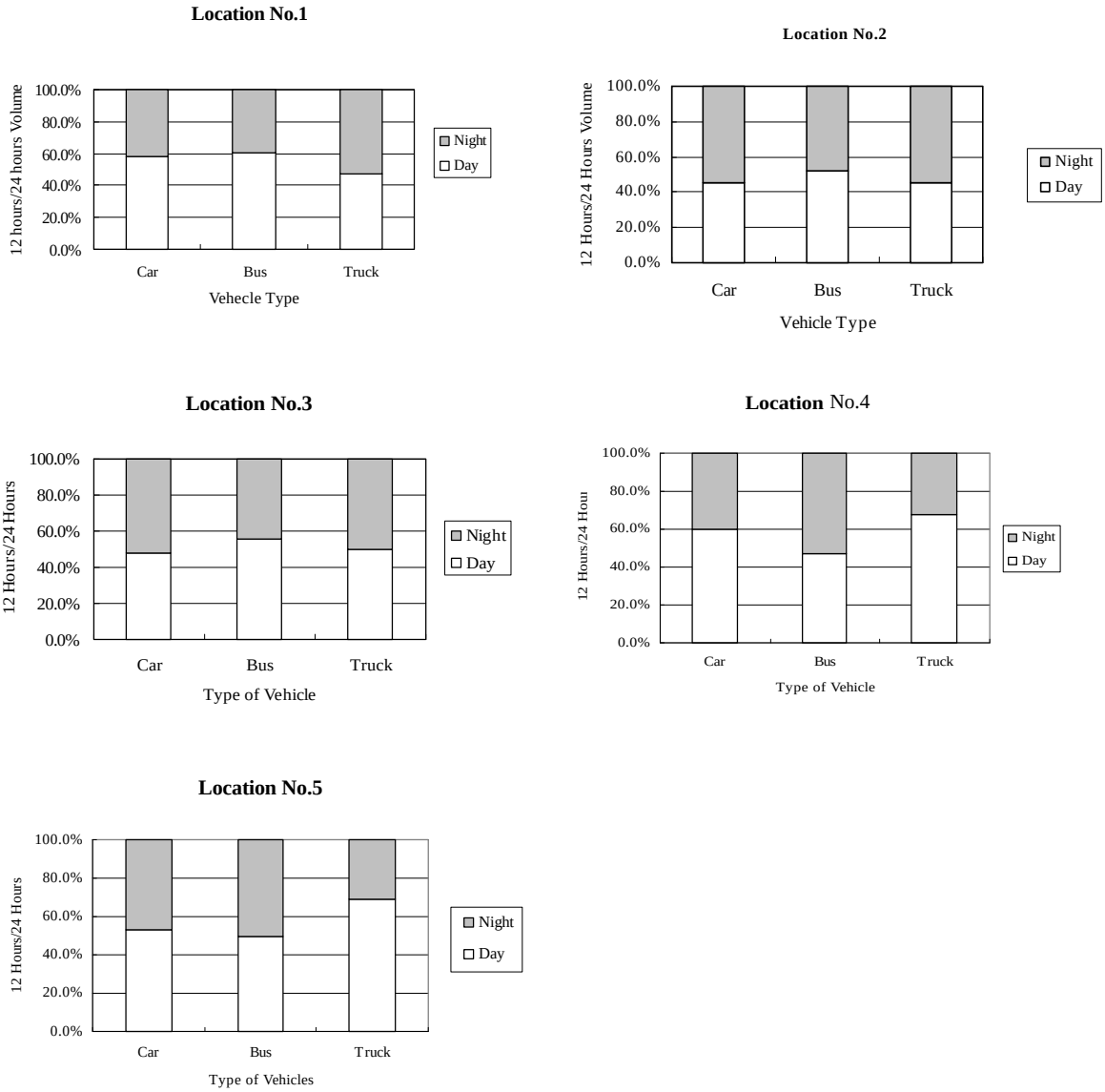


Figure 2-2-5 Traffic Volume in 12 Hours and 24 Hours

2) Vehicle OD Survey

a) Trip Purpose

The share of trip purpose of total is as follows: go home 1.8%, go to office 1.5%, business 30.7%, shopping 0.2%, private matters 64.9%, go to restaurant 0.1%, tourism 0.2%, others, 0.6%. Figure 2-2-6 shows the composition of trip purpose of truck and car. The share of private trips is higher than business trips.

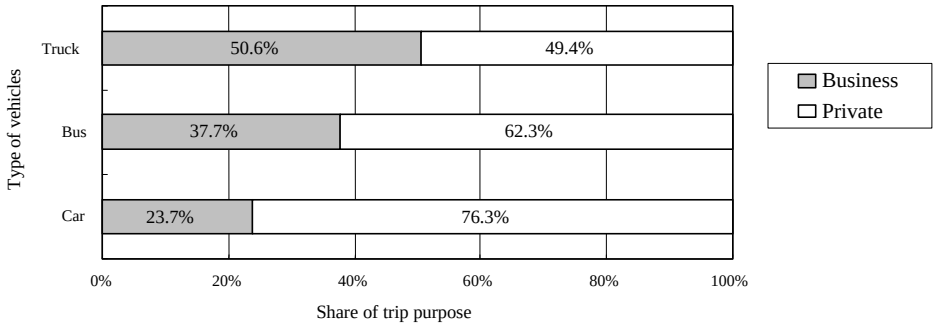


Figure 2-2-6 Composition of Trip Purpose by Vehicle Type

b) Composition of Goods

Figure 2-2-7 shows composition of goods transported by trucks. The three most transported goods are machinery, transport equipment and manufactured products followed by others 15.5%, food stuff and animal food 14.3% and crude, manufactured minerals and building material 9.3%. The average loading factor is about 61%.

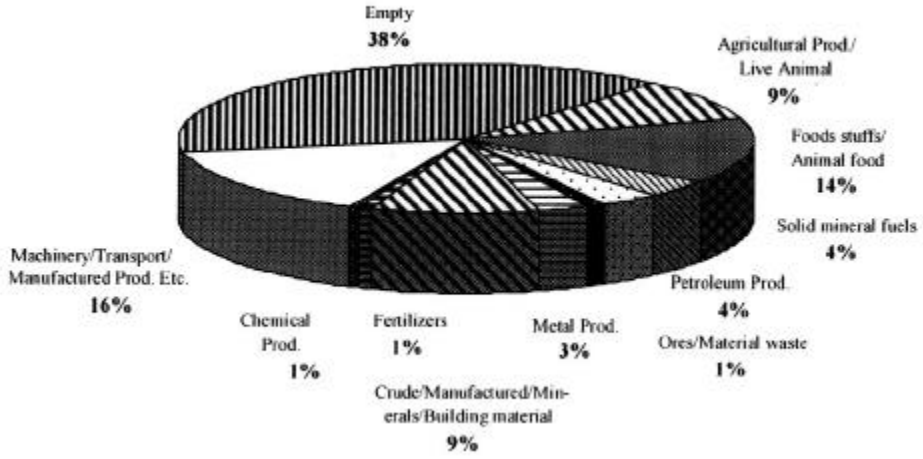


Figure 2-2-7 Goods Composition by Trucks

c) Average Number of Passengers

Figure 2-2-8 shows the average number of passengers according to the types of vehicle: cars 4.1 persons, bus 7.5 persons, small truck 3.4 persons, medium truck 3.5 passengers and large truck 2.6 persons.

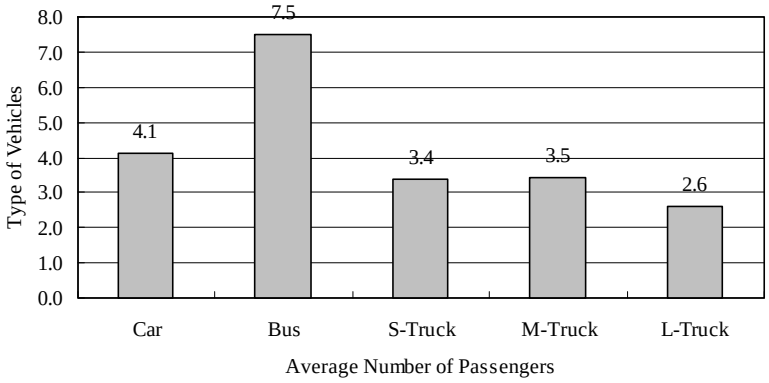


Figure 2-2-8 Average Number of Passengers by Vehicle Type

d) Vehicle Ownership

Figure 2-2-9 shows composition of vehicle ownership. Of the total number of vehicles on the project road, the share of private ownership is 74.8%, while the share of company owned vehicles is 24.9%. The shares of private ownership by vehicle type are as follows: cars 80.3%, buses 79.3%, small trucks 64.6%, medium truck 63.8% and large trucks 25.9%.

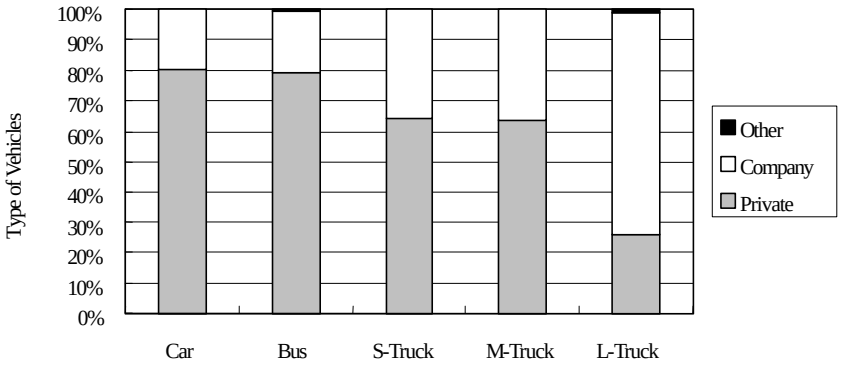


Figure 2-2-9 Ownership Composition by Vehicles Type

e) OD Pairs

Table 2-2-4 shows share of OD pairs. The highest share of 27.7% is observed between Ulaanbaatar and Baganuur. Others are as follows: Ulaanbaatar–Undurkhaan 10.1%, Ulaanbaatar-Umnudelger sum (Khentii province) 5.5% and Ulaanbaatar-Dornod province 5.4%. The share of 10 most frequent OD pairs was 69.2 % of total traffic.

Table 2-2-4 Main OD Pairs

No.	OD Pair	Share (%)
1	Ulaanbaatar - Baganuur	27.7%
2	Ulaanbaatar - Undurkhaan	10.1%
3	Ulaanbaatar - Umnudelger sum(Khentii province)	5.5%
4	Ulaanbaatar - Dornod province	5.4%
5	Ulaanbaatar -Sukhbaatar province	4.7%
6	Baganuur - Tsenkhermandal sum (Khentii province)	3.9%
7	Darkhan sum (Khentii province) - Undurkhaan	3.9%
8	Ulaanbaatar - Tsenkhermandal sum (Khentii province)	2.9%
9	Murun sum (Khentii province) - Undurkhaan	2.6%
10	Bayanmunkh sum (Khentii province) - Undurkhaan	2.5%
	Other 61 pairs	30.8%
	Total	100.0%

Source: JICA Study Team, 2001

3) Travel Time Survey

The checkpoints for the travel time survey between Erdene and Undurkhaan are shown in Table 2-2-5.

Table 2-2-5 Checkpoints for Travel Time Survey

Section No.	Check point	Name of check point
1	1-2	Erdene - Bayandelger
2	2-3	Bayandelger - Entrance of Baganuur
3	3-4	Entrance of Baganuur - Khutsaa river bridge
4	4-5	Khutsaa river bridge - Kherlen river
5	5-6	Kherlen river - Tsenhermandal sum
6	6-7	Tsenhermandal sum - Tsenher river bridge
7	7-8	Tsenher river bridge - Jargaltkhaan sum
8	8-9	Jargalthaan sum - Top of Duut pass
9	9-10	Top of Duut pass - Murun river bridge
10	10-11	Murun river bridge - Undurkhaan

Average travel speeds of the test car and the bus are shown in Figure 2-2-10. Directional average travel speeds by vehicle type are shown as follows: car 32.7-33.2 km/h, bus 28.3-29.0 km/h. The difference of average travel speed of vehicles type is about 4 km/h. The average travel speed decreases significantly at the section between Khutsaa and Tsenkher River Bridge due to the bad road surface condition. The highest average travel speeds by car and bus towards Undurkhaan show 59.3 km/h and 44.5 km/h respectively at the section between Entrance of Baganuur and Khutsaa River Bridge because of the asphalt paved road around Baganuur city. The lowest car travel speed is 22.4 km/h between Jargaltkhaan sum and the Top of Duut pass, while for buses it is between Tsenkhermandal sum and Tsenkher River Bridge. Bus speed towards Erdene is slightly lower than that towards Undurkhaan.

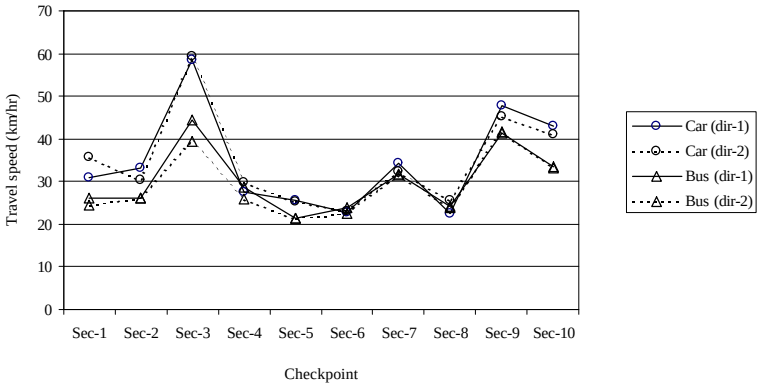


Figure 2-2-10 Travel Speed by Section

4) Axle Load Survey

Axle road survey for 24 hours was conducted from May 7th to May 12th at 5 locations showing Table 2-2-6.

Table 2-2-6 Axle Road Survey Location

No.	Location
1	**Erdene sum**, end point of JICA's Road Construction Project
2	West side of **Kherlen River**, where traffic gate is located
3	West side of **Tsenkher River**
4	West side of **Murun River**
5	East of **Undurkhaan City**, west of Kherlen River

Axle loads were divided into 4 types of vehicles as shown in Table 2-2-7.

Table 2-2-7 Axle Load Vehicle Types

1	Ordinary truck	3	Trailer
2	Heavy truck	4	Bus

Also by Cargo types, axle load was divided into 10 categories as shown in Table 2-2-8.

Table 2-2-8 Axle Load Cargo Types

1	Empty	6	Chemicals and Fertilizer
2	Agricultural Products	7	Machinery
3	Minerals	8	Foods
4	Petroleum	9	Consumer Goods
5	Construction materials	10	Others

a) Result of Axle Road Survey

Total number of vehicles surveyed for each direction at 5 locations is shown in Table 2-2-9.

Table 2-2-9 Total Number of Vehicles Surveyed

Ordinary Truck	Heavy Truck	Trailer	Bus
68	20	18	3

The survey results are from shown Figure 2-2-11 to 2-2-13 and average load for the vehicle is 7.6 ton for ordinary truck, 15.2 ton for heavy truck and 22.2 ton for Trailer. The numbers of buses surveyed was only three and its average was 5.9 tons.

However, this data includes pulled trailers. 31 ordinary trucks pulled trailers (45.6%), five heavy trucks pulled trailers (25%) and 16 trailer pulled trailers (88.9%).

After deleting loads of trailers, average loads for vehicles themselves were changed to 4.7 ton for ordinary truck, 12.3 ton for heavy truck and 4.5 ton for trailer.

Types of cargo are not described in this chapter, since number of data is not enough to evaluate; it is described in OD survey.

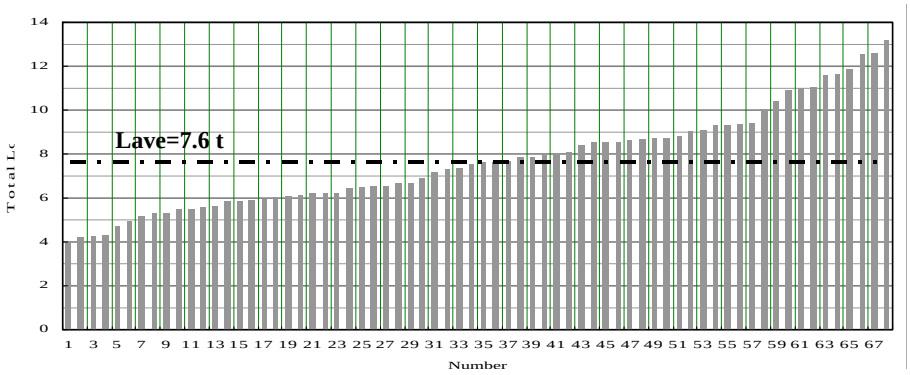


Figure 2-2-11 Ordinary Truck Total Weight

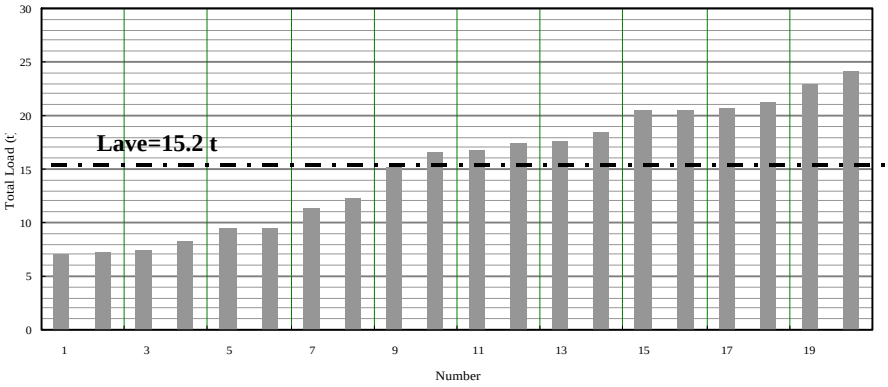


Figure 2-2-12 Heavy Truck Total Weight

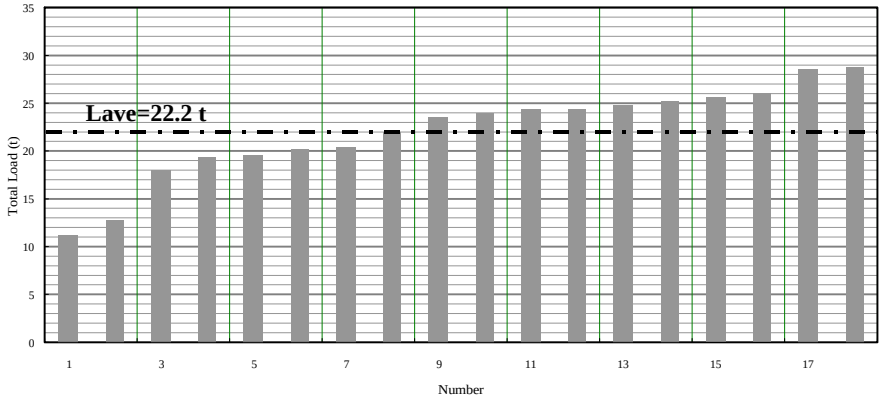


Figure 2-2-13 Trailer Total Weight

At Erdene sum, 20 vehicles were surveyed in each direction (Direction 1 toward Ulaanbaatar and Direction 2 toward Undurkhaan) and Table 2-2-10 shows results of the survey as follows: 67.5% ordinary trucks, 20.0% heavy trucks and 12.5% trailers.

At the next survey point, the Kherlen River, 21 vehicles were surveyed in total. Of the 21 vehicles, 52.4% were ordinary trucks, 28.6% heavy trucks, 9.5% trailers and 9.5% buses. The data is shown in Table 2-2-11.

At the Tsenkher River, 24 vehicles were surveyed in total. Of the 24 vehicles, 62.5% were ordinary trucks, 12.5% heavy trucks, 20.8% trailers and 4.2% buses. The data is shown in Table 2-2-12.

At the Murun River, 15 vehicles were surveyed in total 80.0% were ordinary trucks, 6.7% heavy trucks and 13.3% trailers. The details are shown in Table 2-2-13.

At Undurkhaan city, 9 vehicles were surveyed in total. 22.2% were ordinary trucks, 33.3% heavy trucks and 44.5% trailers. The details are shown in Table 2-2-14.

Analysis of Axle Load Survey is described in Chapter 8.

Table 2-2-10 Result of Axle Road Survey at Erdene Sum **(Direction 2)**

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 5 (t)	Axle Load 6 (t)
1	1	1	2.40	2.90	-	-	-	-
2	1	1	2.35	2.60	-	-	-	-
3	1	1	1.55	3.20	-	-	-	-
4	1	1	2.45	3.05	1.30	1.40	-	-
5	1	2	2.35	1.90	-	-	-	-
6	1	2	2.80	4.10	-	-	-	-
7	1	2	2.55	4.65	2.00	1.30	-	-
8	1	4	3.35	7.55	3.60	3.20	-	-
10	1	5	3.85	7.75	2.60	2.60	-	-
11	1	5	2.65	5.90	4.45	3.95	-	-
12	1	8	2.40	6.35	-	-	-	-
13	1	9	2.60	5.45	-	-	-	-
14	2	1	3.70	**2.10**	**2.40**	1.60	1.85	-
15	2	1	3.80	3.55	-	-	-	-
16	2	2	4.80	**6.25**	**5.70**	-	-	-
9	2	4	3.55	**8.05**	**6.00**	7.70	**1.40**	**1.25**
17	3	1	4.40	**5.90**	**2.50**	2.70	-	-
18	3	1	3.65	**3.65**	**3.90**	-	-	-
19	3	5	5.10	**9.10**	**9.80**	6.30	6.50	-
20	3	5	4.80	**9.30**	**10.30**	6.70	6.80	-

***Bold letter is tandem axle**

(Direction 1)

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 5 (t)	Axle Load 6 (t)
1	1	1	1.98	2.30	-	-	-	-
2	1	1	2.55	4.00	-	-	-	-
3	1	1	2.55	3.50	2.10	1.70	-	-
4	1	1	2.70	3.40	-	-	-	-
5	1	1	2.60	3.90	2.90	2.30	-	-
6	1	1	2.45	2.85	-	-	-	-
7	1	2	2.75	3.80	-	-	-	-
8	1	2	2.75	4.80	4.10	3.75	-	-
9	1	2	2.75	4.60	-	-	-	-
10	1	4	3.15	6.90	6.00	7.10	-	-
11	1	5	2.90	9.70	-	-	-	-
12	1	6	2.60	5.50	-	-	-	-
13	1	7	2.75	3.50	-	-	-	-
14	1	9	2.85	10.35	4.20	3.70	-	-
15	1	9	2.75	6.05	-	-	-	-
16	2	1	3.40	3.80	-	-	-	-
17	2	7	3.70	**9.75**	**9.40**	-	-	-
18	2	8	3.10	6.30	-	-	-	-
19	2	9	4.65	15.80	-	-	-	-
20	3	9	5.90	**10.35**	**8.60**	9.90	-	-

***Bold letter is tandem axle**

Table 2-2-11 Result of Axle Road Survey at Kherlen River **(Direction 2)**

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 4 (t)
1	1	2	2.60	5.95	3.20	3.30	-
2	1	5	2.75	6.35	2.50	3.05	-
3	1	8	2.70	8.30	-	-	-
4	1	8	2.80	9.05	-	-	-
5	2	4	2.45	**7.40**	**8.60**	7.35	-
6	2	9	3.65	**6.05**	**7.75**	-	-
7	3	5	2.80	**7.75**	**9.95**	-	-
8	4	10	1.80	4.05	-	-	-
9	4	10	2.00	3.60	-	-	-

(Direction 1)

1	1	1	2.45	6.10	-	-	-
2	1	1	2.50	3.10	1.30	1.30	-
3	1	7	2.50	3.95	-	-	-
4	1	8	2.55	8.50	-	-	-
5	1	8	2.75	9.80	8.40	8.85	-
6	1	9	2.75	6.00	-	-	-
7	1	10	2.70	6.35	-	-	-
8	2	8	3.10	6.30	-	-	-
9	2	9	4.65	15.80	-	-	-
10	2	10	3.20	**2.05**	**1.80**	-	-
11	2	10	4.60	**8.20**	**7.90**	-	-
12	3	9	5.90	**10.10**	**8.40**	9.90	-

***Bold letter is tandem axle**

Table 2-2-12 Result of Axle Road Survey at Tsenkher River (Direction 2)

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 5 (t)
1	1	1	2.65	3.20	1.30	1.20	-
2	1	1	2.65	3.60	2.80	2.35	-
3	1	2	2.55	6.15	3.70	4.00	-
4	1	2	2.65	6.65	4.10	4.20	-
5	1	4	2.95	6.45	-	-	-
6	1	7	2.75	5.65	2.80	3.05	-
7	1	8	2.65	5.05	4.40	4.90	-
8	2	2	4.15	**7.25**	-	-	-

(Direction 1)

1	1	1	1.50	2.55	-	-	-
2	1	1	2.18	3.00	-	-	-
3	1	1	2.50	3.15	-	-	-
4	1	2	2.70	5.30	-	-	-
5	1	4	2.65	3.50	-	-	-
6	1	4	2.80	5.05	3.65	4.55	-
7	1	6	2.65	5.00	1.40	1.40	-
8	1	9	2.60	6.75	4.50	4.70	-
9	2	1	3.75	8.45	-	-	-
10	2	7	4.10	**10.00**	**10.10**	8.80	9.60
11	3	5	3.30	**8.40**	**8.60**	8.80	9.90
12	3	7	5.10	**8.30**	**8.60**	10.50	10.90
13	3	7	4.95	**10.50**	**10.60**	11.50	12.10
14	3	7	4.90	**10.20**	**10.55**	11.75	12.70
15	3	7	4.55	**10.20**	**10.50**	14.55	13.55
16	4	10	2.60	3.60	-	-	-

***Bold letter is tandem axle**

Table 2-2-13 Result of Axle Road Survey at Murun River **(Direction 2)**

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 5 (t)	Axle Load 6 (t)
1	1	1	2.55	2.95	1.30	1.30	-	-
2	1	1	2.55	3.30	1.40	1.25	-	-
3	1	1	1.55	2.75	-	-	-	-
4	1	2	1.50	4.45	-	-	-	-
5	1	2	2.60	5.05	4.40	4.70	-	-
6	3	7	4.90	**11.70**	**12.10**	14.70	**15.10**	**15.40**

(Direction 1)

1	1	1	2.70	4.00	-	-	-	-
2	1	1	2.60	3.30	2.30	-	-	-
3	1	1	2.80	3.45	1.60	1.35	-	-
4	1	2	2.50	4.80	-	-	-	-
5	1	2	2.40	4.30	-	-	-	-
6	1	2	2.75	5.90	-	-	-	-
7	1	8	2.85	5.00	4.15	4.50	-	-
8	2	5	3.95	**6.20**	**6.40**	-	-	-
9	3	7	5.00	**11.70**	**12.15**	15.00	**15.45**	**15.70**

***Bold letter is tandem axle**

Table 2-2-14 Result of Axle Road Survey at Undurkhaan City **(Direction 2)**

No.	Type of Vehicle	Type of cargo	Axle Load 1 (t)	Axle Load 2 (t)	Axle Load 3 (t)	Axle Load 4 (t)	Axle Load 5 (t)	Axle Load 5 (t)
1	1	3	3.85	6.55	6.70	-	-	-
2	2	3	4.15	**9.10**	**7.95**	7.05	6.90	-
3	2	10	2.35	**6.95**	**5.40**	6.50	-	-
4	2	10	2.80	**6.30**	**6.05**	-	-	-
5	3	3	3.35	**7.90**	**8.45**	7.60	7.75	-
6	3	10	4.45	**9.10**	**10.05**	11.85	12.05	-

(Direction 1)

1	1	5	2.70	8.95	-	-	-	-
2	3	10	3.70	**7.85**	**7.85**	7.95	8.50	-
3	3	5	3.40	**6.60**	**7.95**	7.85	8.40	-

***Bold letter is tandem axle**

5) Roughness Survey

Roughness Survey for five round trips was conducted from May 5th to May 12th between Erdene sum and Undurkhaan. It was approximately 265 km passing through Baganuur district.

The roughness measurement was done for every 250-meter and converted into International Roughness Index (IRI m/km). For the conversion from the value of Bump Integrator to IRI, the calibration was carried out by a Merlin Type Road

Roughness Measurement Machine for these locations: near Baganuur, east side of Kherlen bridge, near Kherlen bridge, east of Tsenkher river bridge (near drive inn), Jargaltkhaan valley, near Undurkhaan and Undurkhaan.

The relation between the value of Bump Integrator and IRI value is shown in Figure 2-2-14.

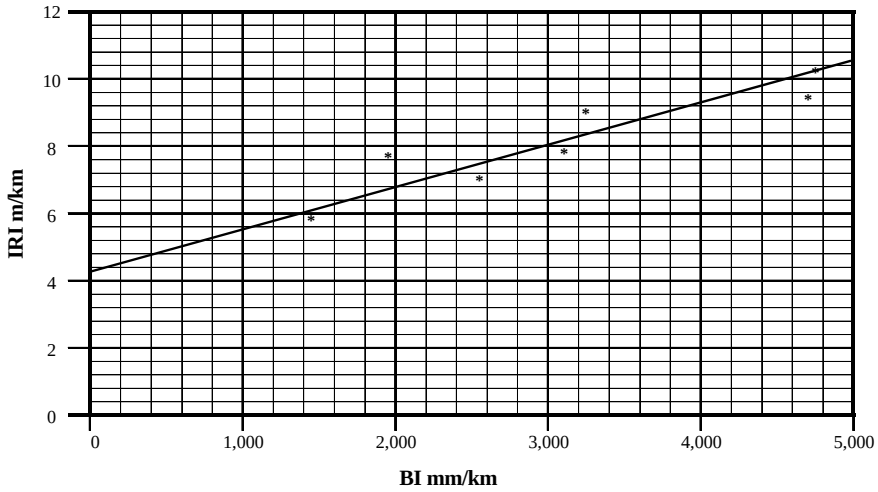


Figure 2-2-14 Correlations between BI and IRI

Correlation is defined by the following equation.

$$IRI = 4.344 + 0.00124 \times BI$$

The data was arranged to the average of five trips in each kilometer. The result is shown in Figure 2-2-15.

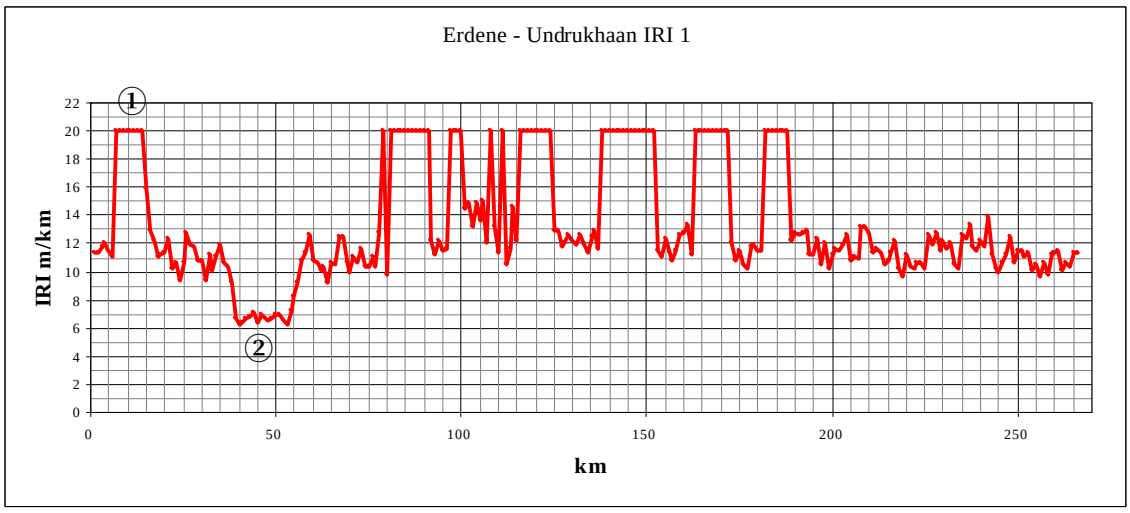


Figure 2-2-15 Result of IRI Measurements between Erdene and Undurkhaan

The Figure gives an average IRI of 13.8 and IRI values ranges from 6 to 20 (m/km). For example, location ① is a typical rocky mountain pass, where large rocks are exposed on the road surface and riding comfort is extremely poor, while location ② has an asphaltic concrete surface, which is a fairly old but it is a smooth paved road.

To calibrate for typical three road conditions such as paved road (Asphalt Concrete Surface), smooth natural earth road and extremely bad road section, another calibration was conducted on June 13th between Bayan pass and Baganuur. The results are shown in Figure 2-2-16.

From the results are as follows:

- Asphalt Concrete Surface: IRI = 5 to 7
- Smooth Natural Earth Road: IRI = 9 to 12
- Extremely Bad Road Surface: IRI = 14 to 20*

According to Figure 2-2-17, the surveyed IRI values on Asphalt Concrete Surface are a little high because the section was not continuously paved and only a surface treatment were provided. The IRI values on natural earth road are average. However, it is noted that some sections were extremely rough, and measurement was not performed because of equipment trouble. In these cases, the value is set at 20 as a maximum value.

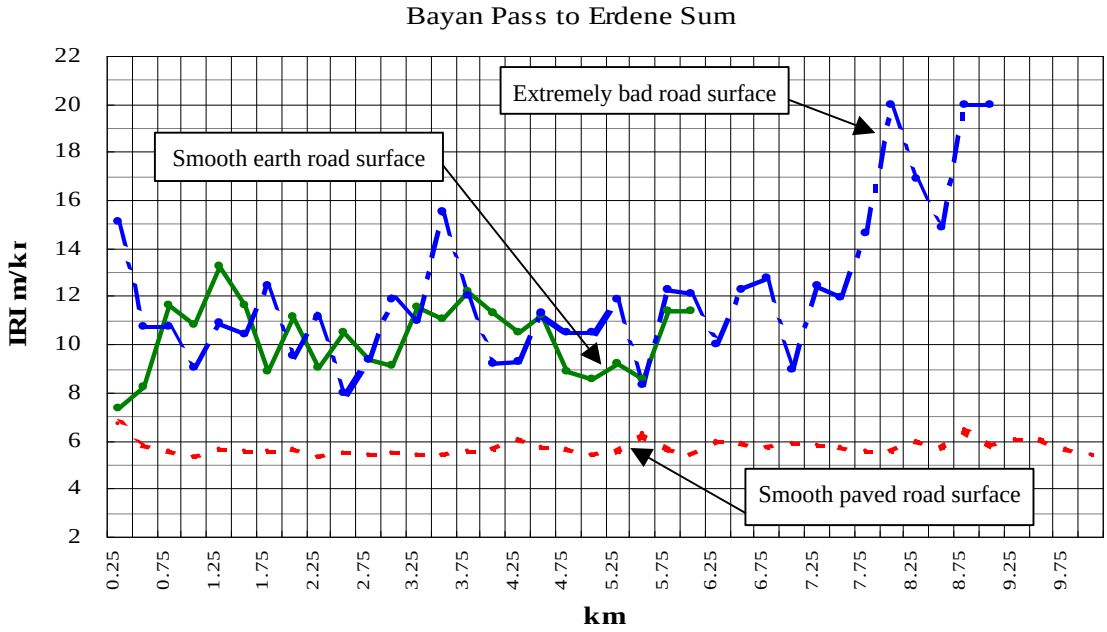


Figure 2-2-16 IRI Measurements on Typical Road Surface

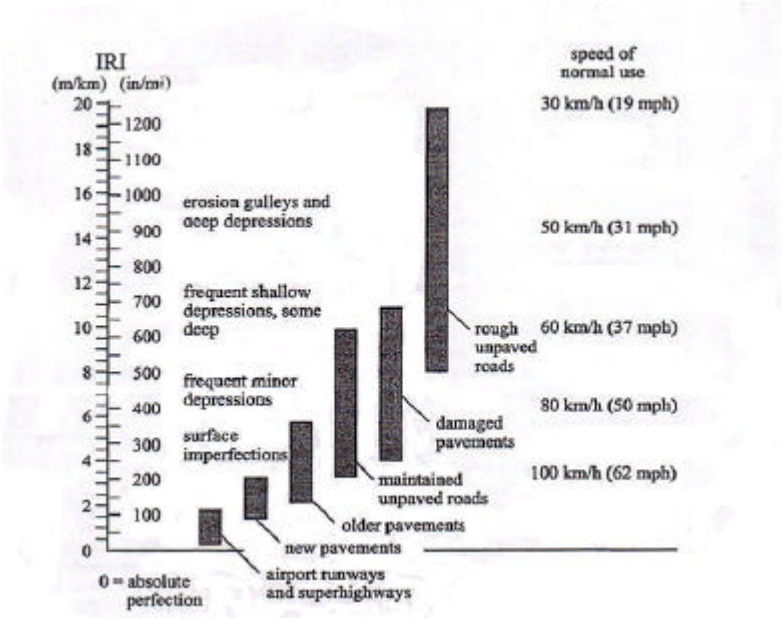


Figure 2-2-17 The IRI Roughness Scale

The analysis of IRI is described in Chapter 8.

2.2.3 Existing OD Conditions

(1) Expansion of Interview Data

The 24-hour vehicle OD survey and the traffic count survey were carried out at five locations. However, Result of Traffic Count Survey mentioned in 2.2.2, 2), the daily traffic volume in 2001 was not representative due to the recent "foot and mouth" disease of livestock. The daily traffic volume indicated a reduction of about 20-50% from 2000. Therefore, the interviewed data in 2001 was expanded to 2000 data, in order to generate the average daily OD table. The annual average daily traffic volume for generating the average daily OD table is discussed below.

(2) Estimate of Annual Average Daily Traffic

For economic analysis, the annual average daily traffic (AADT) figure is needed to reflect average traffic conditions throughout the year, including seasonal variations. In order to provide annual average daily traffic (AADT), weekly variation factors and monthly variation factors have been provided based on the data from other project. At present, there is no systematic traffic count undertaken that would reveal trends throughout the year. The Study Team, therefore, made use of the data from the results of traffic count survey on Nalaikh-Baganuur road in 1993 to 1994 and data from toll collection check point stations (CPS) at the city boundary of Ulaanbaatar in 1999.

Table 2-2-15 and Figure 2-2-18 show the results of the traffic count survey and weekly variation factor of ADB Road Master Plan & Feasibility Study in 1993 to 1994. The 24-hour traffic surveys carried out by the JICA Study Team were converted into average daily traffic (ADT) for the month. The weekly variation factors were calculated by comparing weekly daily traffic with the daily mean of total one-week traffic. The results of weekly variation factors on Wednesday were 0.84 in December, 1.22 in January, 1.51 in February and 0.95 in March. The value of factors has varied between 0.84 and 1.51. Since the weekly factor on Wednesday in March were close to the period of JICA traffic study on Wednesday in May, this indicator was proposed as a reasonable value for the ADT and the factor 0.95 used as the weekly variation factor.

Traffic variation during the year for AADT in 2000 has been analyzed. The Study Team attempted to analyze from check point station (CPS) data. The CPS data indicates the number of vehicles by converting toll revenue. Table 2-2-16 and Figure 2-2-19 show the results of monthly traffic at 4 checkpoint stations (CPS) in 1999. AADT was calculated by using monthly variation factors in 1999. The monthly variation factors were calculated by comparing daily traffic of each month with the daily mean of the whole year. The results of monthly variation factors in May range between 0.92 and 1.05, which are stable. Therefore, it was proposed that 0.97 (the average value of 4 CPS) should be interpreted as reasonable value for AADT. Table 2-2-17 gives the estimated value of annual average daily traffic (AADT).

Table 2-2-15 Results of Traffic Counts and Weekly Variation Factors on Nalaikh-Baganuur

Month		Weekly Variation (Vehicles per Day)								Daily Mean
		Mon-day	Tues-day	Wednes-day	Thurs-day	Fri-day	Satur-day	Sun-day	Total	
December (1993)	Volume	159	177	110	95	169	132	75	917	131
	Factors	1.21	1.35	0.84	0.73	1.29	1.01	0.57	-	1.00
January (1994)	Volume	186	210	189	153	224	79	45	1,086	155
	Factors	1.20	1.35	1.22	0.99	1.45	0.51	0.29	-	1.00
February (1994)	Volume	154	289	242	109	140	100	85	1119	160
	Factors	0.96	1.81	1.51	0.68	0.88	0.63	0.53	-	1.00
March (1994)	Volume	80	316	161	262	145	99	119	1182	169
	Factors	0.47	1.87	0.95	1.55	0.86	0.59	0.70	-	1.00

Source: Road Master Plan & Feasibility Study, T.A.No.1820-MON, Asia Development Bank, 1995

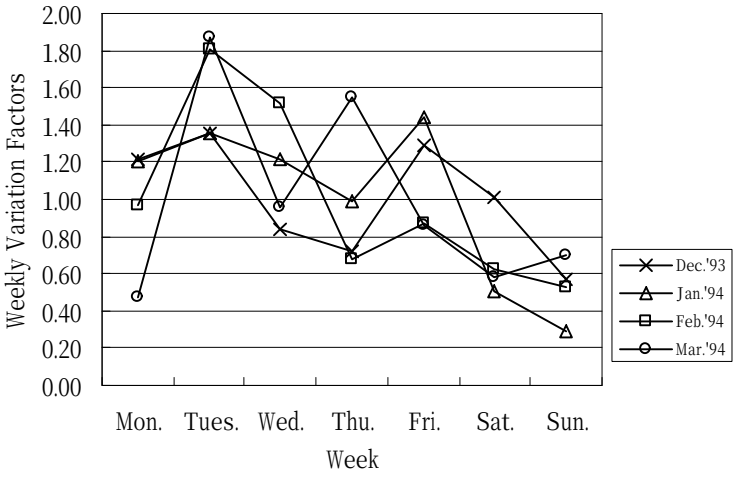


Figure 2-2-18 Weekly Variation Factors

Table 2-2-16 Monthly Traffic at Check Point Stations in 1999

Check Point Stations		Monthly Variation (Vehicles per DaY)												
		Jan.	Feb.	Mar.	Apri.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Bayanzurh CPS	Volume	16,676	18,247	9,824	15,520	17,850	22,680	21,640	26,940	20,740	23,400	17,760	17,340	228,617
	Daily Mean	538	652	317	517	576	756	698	869	691	755	592	559	626
	Factors	0.86	1.04	0.51	0.83	0.92	1.21	1.12	1.39	1.10	1.21	0.95	0.89	1.00
22nd CPS	Volume	9,616	16,600	17,110	21,580	25,410	31,000	35,500	37,200	28,660	30,600	23,910	23,270	300,456
	Daily Mean	310	593	552	719	820	1,033	1,145	1,200	955	987	797	751	823
	Factors	0.38	0.72	0.67	0.87	1.00	1.26	1.39	1.46	1.16	1.20	0.97	0.91	1.00
Airport CPS	Volume	2,725	2,758	2,453	3,810	4,380	4,820	5,440	5,730	4,530	4,850	3,890	3,790	49,176
	Daily Mean	88	99	79	127	141	161	175	185	151	156	130	122	135
	Factors	0.65	0.73	0.59	0.94	1.05	1.19	1.30	1.37	1.12	1.16	0.96	0.91	1.00
Yarmag CPS	Volume	6,296	7,285	5,260	9,315	10,900	13,090	15,240	16,000	11,970	13,190	10,590	10,310	129,446
	Daily Mean	203	260	170	311	352	436	492	516	399	425	353	333	355
	Factors	0.57	0.73	0.48	0.87	0.99	1.23	1.38	1.45	1.12	1.20	0.99	0.94	1.00
Total	Volume	35,313	44,890	34,647	50,225	58,540	71,590	77,820	85,870	65,900	72,040	56,150	54,710	707,695
	Daily Mean	285	401	279	419	472	597	628	693	549	581	468	441	485
	Factors	0.59	0.83	0.58	0.86	0.97	1.23	1.29	1.43	1.13	1.20	0.96	0.91	1.00

Source: Ulaan Baatar City Government, Transport Coordination Department, 2001

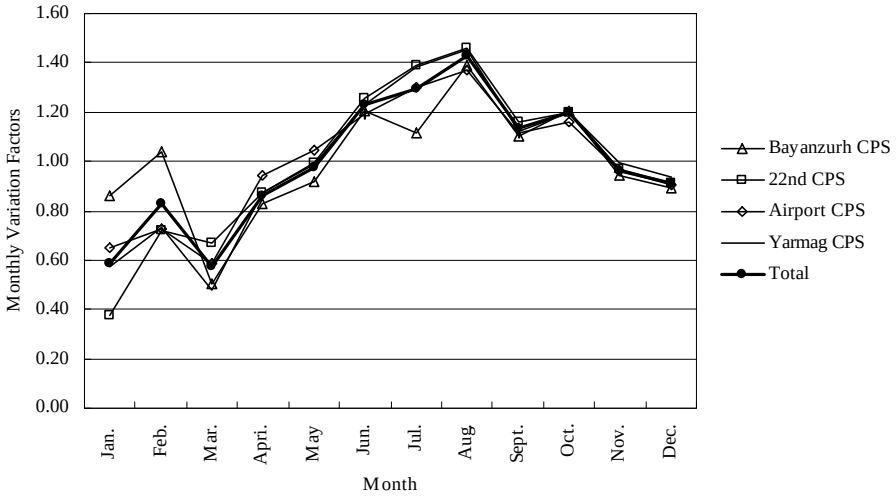


Figure 2-2-19 Monthly Variation Factors

Table 2-2-17 Estimation of ADT and AADT by Section

Unit: Vehcles per Day

Section & Type of Vehicles	Erdne-Baganuur	Baganuur-Murun	Murun-Undurkhaan
1. Car	373	249	120
2. Bus	163	69	18
3. Small Truck	17	8	4
4. Medium Truck	127	80	93
5. Heavy Truck	44	41	20
Total	724	447	255

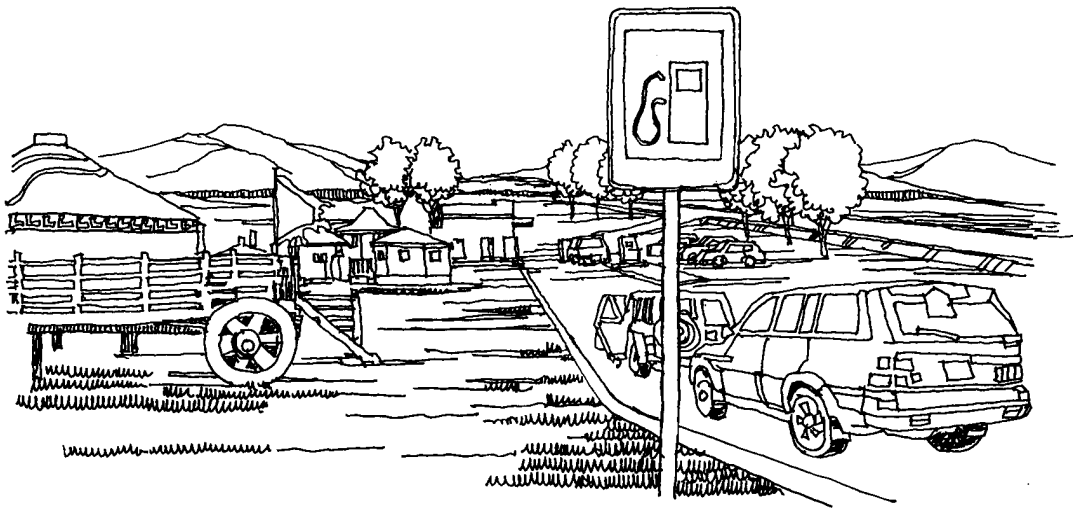
Source: JICA Study Team

(3) Existing OD Matrix

Existing OD matrices were calculated. Total traffic volume related to the project road between Ulaanbaatar and Undurkhaan is 959 trips per day. Traffic volumes by vehicle types are as follows: cars including motorbike 505 trips per day, bus 188 trips per day, small truck 22 trips-end per day, medium truck 175 trips per day and large truck 69 trips per day. Figure 2-2-20 shows the desire line of existing OD pairs.

Figure 2-2-20 Desire Line of Existing OD Pairs

CHAPTER 3 SOCIOECONOMIC STUDY, FRAMEWORK AND FUTURE FORECAST OF TRAFFIC DEMAND



CHAPTER 3 SOCIOECONOMIC STUDY, FRAMEWORK AND FUTURE FORECAST OF TRAFFIC DEMAND

3.1 Socioeconomic Studies

3.1.1 Resources in the Study Area

(1) Mining

1) Current Conditions

Mongolia has abundant mineral resources. About 40 kinds of mines are developed at 150 of the 500 main deposits. There is a wide diversity of minerals such as coal, copper, fluorspar, molybdenum, ferrous, nonferrous metals, uranium, zinc, gold, silver, phosphorous and marble. Mineral products of the Mongolia were around 65% of total export values in 1995; however, this declined to 41% in 1999 due to plunging raw material prices.

Among the mines in Mongolia, Erdenet is the largest copper mine and is operated as a Mongolian/Russian joint venture. The Erdenet mine has been in operation since 1978 and at present has a capacity of approximately 20 million tons of ore per year, which produces about 354,000 tons per year of copper concentrate and 3,500 tons per year of molybdenum concentrate.

Most of the product is exported to foreign countries such as Russia, China and Japan due to the small domestic market in Mongolia. The major issue obstructing development and trade is high transport cost caused by insufficient internal transport infrastructure. Therefore, construction of arterial roads and railway lines will be the main factors for future development of new mines. Mining is a very favorable industry to be developed in Mongolia for the future, and is suitable for acquisition of foreign currency. The output of major mines in Mongolia is shown in Table 3-1-1.

Table 3-1-1 Major Mines in Mongolia

Mines	Year ('000 Tons / Year)								
	1990	1993	1994	1995	1996	1997	1998	1999	2000
Coal	7,157	5,617	5,158	5,019	5,110	4,924	5,057	4,964	5,185
Fluorspar	455.9	536.8	383.2	526.2	565.1	567.1	612.0	597.1	733.5
Copper Concentrate	354.1	334.3	343.3	346.4	351.5	357.9	358.4	361.9	357.8
Molybdenum Concentrate	4,208	4,367	4,396	3,906	4,684	4,238	4,240	4,157	2,843
Gold (kg)	0	0	1,789	4,504	6,976	8,451	9,531	10,246	11,808

Source: Mongolian Statistical Yearbook, 2001

a) Coal

In the country, coal production in 1990 was around 7.2 million tons; however, it declined to 4.9 million tons in 1999. There are 16 operational coal mines in the country. In the 4 provinces of the eastern area along the project road, there are 5 coal mines as shown in Figure 3-1-1: namely, 1) Nalaikh, 2) Baganuur, 3) Chandgana steppe, 4) Talbulag and 5) Aduunchuluun. The mine with the largest production in the country is Baganuur. The output in 2000 was approximately 3.1 million tons. The shares of total production in the study area of eastern Mongolia are: Nalaikh (0.6%), Baganuur (90.2%), Chandgana (0.9%), Talbulag (1.3%) and Aduunchuluun (7.0%). Most of coal has been used for thermal power plants in the cities. Nalaikh and Baganuur are adjacent to the railway system for transport by rail. Other mine's product is transported along sections of the road network.

Table 3-1-2 Annual Coal Production in the Eastern Area of Mongolia

Mines	Year ('000 Tons/Year)		
	1998	1999	2000
Nalaikh	30	20	19
Baganuur	3,100	2,990	3,060
Chandgana	22	20	31
Talbulag	38	38	43
Aduunchuluun	219	225	239
Total	3,409	3,293	3,391
Source: Fuel and Energy Policy and Coordination Department of the Ministry of Infrastructure, 2001			

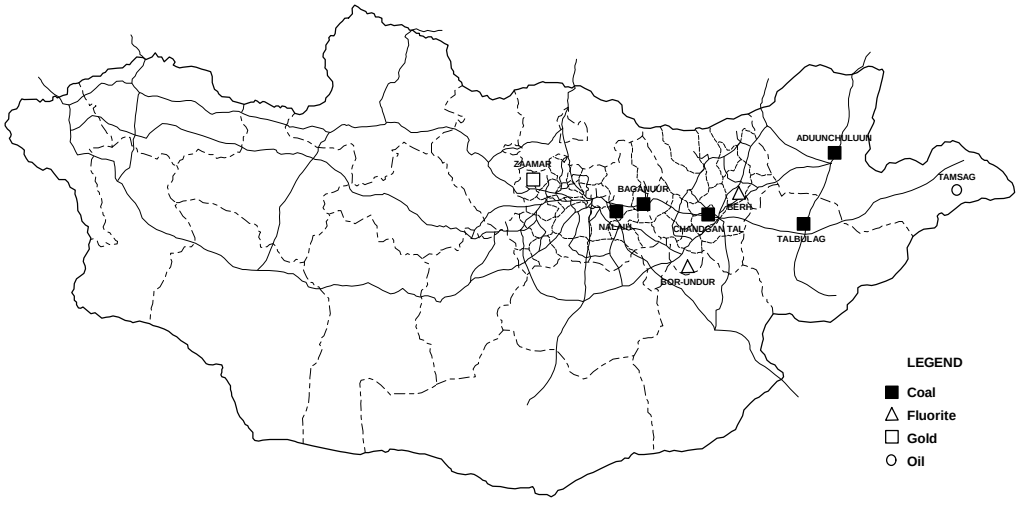


Figure Location of Mines in Eastern Region

Source: Mineral Resources Authority of Mongolia, 1999
ADB Road Master Plan & Feasibility Study, 1995

Figure 3-1-1 Location of Major Mines in Eastern Area of Mongolia

b) Others

The product of mineral resources beside coal is shown in Table 3-1-1 such as fluorspar, copper concentrate, molybdenum concentrate, oil and gold. In particular, Mongolia produces nearly 15% of the world's fluorspar and is a major producer of copper. Production has fluctuated over the past 10 years as follows:

- Output of fluorspar varies between 0.38 and 0.61 million tons, output in 1999 being 0.59 million tons.
- Copper concentrate output varies between 0.33 and 0.36 million tons, output in 1999 being 0.36 million tons.
- Molybdenum concentrate output varies between 3.91 and 4.68 million tons, output in 1999 being 4.16 million tons.
- Gold output has increased gradually since 1995, the average growth rate during 5 years is 45.2%. Output in 1999 was 10.2 tons.

The major mines in the eastern area along the project road are located above. Figure 3-1-1 shows the locations of the mines in the study area. Conditions of each mineral in the 4 provinces of the study area describe as below:

- Fluorspar: In the eastern area along the project road, there are 2 operating fluorspar mines. They are Bor-Undur Ore and Berkh. Berkh still contains deposits; however, it closed in 1998. The Bor-Undur Ore field is the largest mineralized area in Mongolia. The annual output of Bor-Undur in 2000 was 111,500 tons. Bor-Undur Ore was developed along the Mongolian Railway line from Sukhbaatar on the Mongolian-Russian border to Zamin-Uud on the Mongolian-Chinese border. A significant proportion of the railway's freight comes from the fluorspar mine at Bor-Undur.
- Gold: Zaamar is a producer of gold in the western Tuv province. This is, however, located outside the Study Area.
- Oil: Production of oil in the Tamsag area started in 1998 (initially 1,500 barrels per day) which is transported to Daquing in China by truck.

2) Future Deposits of Major Mining to be Developed

The eastern area of Mongolia in the study area has broad resources of minerals such as fluorspar, crude oil, lead, tungsten, molybdenum, gold, coal, construction materials and salt. In 1996, the Government of Mongolia issued a regional plan for the eastern 3 provinces of Khentii, Dornod and Sukhbaatar,

with project plans to be developed between 2000 and 2010. The mineral resources in 3 provinces of the eastern area of Mongolia are described below:

- Coal — There are about 20 coal deposits, with 10 located in Dornod province, 5 in Sukhbaatar province and others in Khentii province. These deposits are main sources to supply local demand. Total amount of the deposit is estimated over 1,563 million tons.
- Oil — At present, exploration works are ongoing in Tamsagbulag contract field for resource evaluation.
- Iron — There are 2 deposits in Khentii province with total resource of 79 million tons.
- Lead/Zinc — There are 9 deposits of lead and zinc with total amount of 8 million tons in 3 provinces. The share of eastern region is estimated to be 98% of the total national reserves of lead and zinc.
- Tin — There are 22 deposits of tin in Khentii province of the eastern region with total resource of 6,130 tons, which is approximately 99% of the national reserves.
- Tungsten — Resource of tungsten in the eastern region is 944,000 tons, which is 95% of the national resources.
- Molybdenum — There are 3 deposits with total resource of about 200,000 tons in the eastern region. This is equivalent to 39% of the national resources.
- Gold — Resource of gold in the eastern region is 5,300 kg, which is equivalent to 1.7% of the national resources.
- Silver — There is a source in Khentii province, namely, Mungun-Undur. The deposit is estimated at 4.4 tons and is 0.1% of the national resources.
- Fluorspar — Fluorspar in the 3 provinces of the eastern region share about 59% of the national resources and the deposit is 55.976 million tons.
- Salt — Salt deposits of the eastern region contain 1.2 billion tons of common salt, equivalent to 98% of the national resources. There is also deposit of glauber's salt of 7.4 billion tons, which accounts for 90% of the national resources.
- Uranium — There are 4 deposits in the Dornod provinces, namely at Erdes. The deposits are estimated at 24 million tons.

- Others — There are granite, basalt, volcanic slag, clay, sand and sand/gravel in 3 provinces of the eastern region. These deposits are: 2.039 million m^3, 1.988 million m^3, 3.841 million m^3, 20.454 million m^3, 23.464 million m^3 and 1.450 million m^3 respectively.

In this context, future mining is a very favorable industry to be developed along the project road. The project road will be established as an inter-city productive axis for regional development. The axis is the most productive corridor in the eastern region of Mongolia and has high development potential for mining production for export. Obviously, the freight volume from the exploitation of deposits will increase in future. This leads to an increase in truck traffic. Taking vehicle-handling cost into consideration, the mining resource area of about 100 km both sides along the project road has a high influence potential for generating vehicle traffic. Based on such an assumption, there are natural resources of about 120 deposits. The favorable mining to be developed along the project road is shown in Figure 3-1-2.

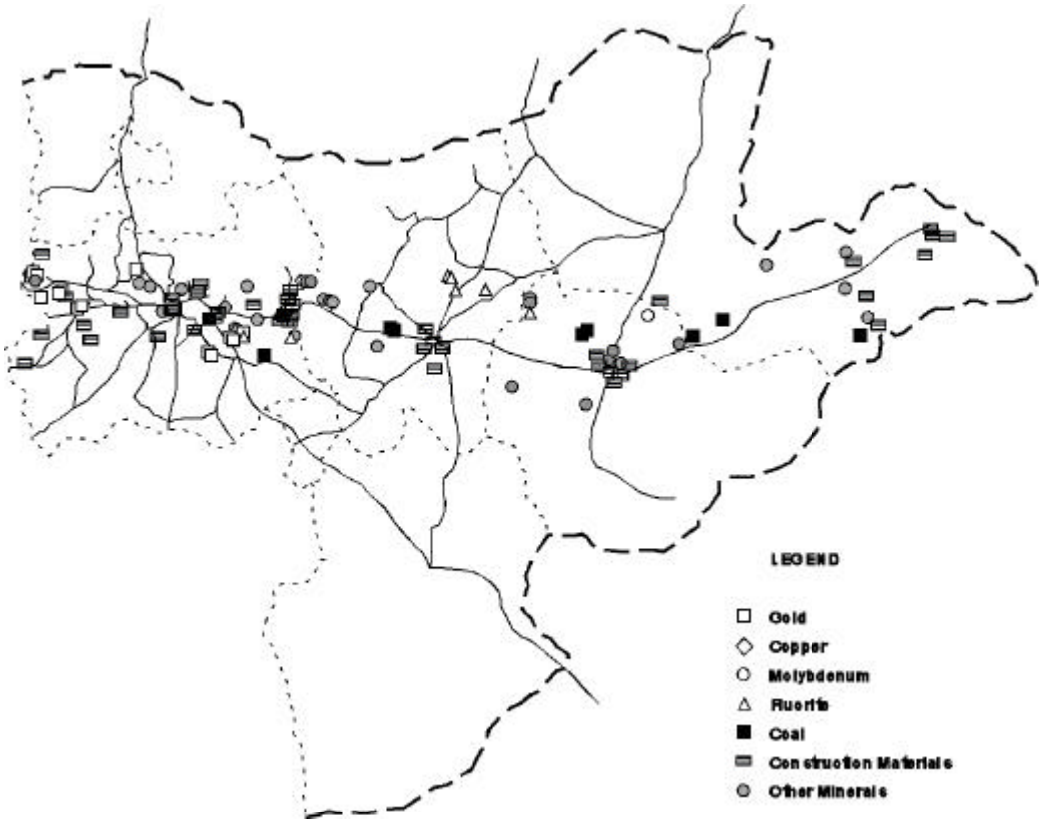


Figure 3-1-2 Mining to be Developed along the Project Road in Future

(2) Agriculture

The extreme climatic conditions with long cold winters, short summers and low precipitation makes Mongolia a predominately pastoral nation. The Mongolian economy has industrialized during the past 30 years, however, agriculture and livestock are still important with a 35% share of total GDP in 1999.

1) Current Conditions

a) Agricultural Area

Despite of the large area of land, the agricultural potential is severely limited by the climate and soils. The agriculture area in Mongolia between 1995 and 1999 expanded; however, the annual growth rate has remained small at 2.4%. There are 22.16 million ha of agricultural land in the eastern region, which equals about 18% of the national total. In the eastern region, approximately 95 % (21.1 million ha) is pasture and 810,000 ha is hay harvest land, which equals about 60% of the national total. Virgin land occupies 30,000 ha in the Eastern Region.

b) Agricultural Production

Table 3-1-3 shows main agricultural production in the study area. The total national agricultural crops in terms of tonnage declined about 28% over the period 1995-1999. In line with this tendency, the total tonnage of agricultural crops in Tuv, Dornod and Sukhbaatar provinces have also declined. However, in Khentii province there has been a gradual increase since 1997. The share of agricultural products by each province is as follows: Tuv province 17.8%, Khentii province 5.2%, Dornod province 1.9% and Sukhbaataar 0.2%. Main agricultural productions in the study area are cereals, potatoes, vegetables, fodder crops and wheat. The production of potatoes by province has increased gradually since 1996, with the highest product of 13,500 tons in 1999 in Tuv province, equivalent to 21.3% of total national tonnage. Other agricultural products deceased generally during the past 5 years. In Khentii province however, crop production has been increasing, and the share in 1999 is 2-6% of total national tonnage, apparently indicating the expansion of agricultural potential in Khentii province.

Table 3-1-3 Production of Main Agricultural Crops

Items		Year ('000 tons)											
Types	Area	1995	%	1996	%	1997	%	1998	%	1999	%	2000	%
Cereals	Mongolia	261.4	100.0	220.1	100.0	240.4	100.0	194.9	100.0	169.5	100.0	142.0	100.0
	Tuv	56.5	21.6	54.1	24.6	47.5	19.8	14.2	7.3	29.9	17.6	15.4	10.8
	Khentii	6.0	2.3	10.4	4.7	5.2	2.2	10.2	5.2	10.3	6.1	2.0	1.4
	Dornod	6.2	2.4	9.1	4.1	2.6	1.1	4.7	2.4	3.2	1.9	2.0	1.4
	Sukhbaatar	3.9	1.5	6.0	2.7	2.0	0.8	2.8	1.4	0.3	0.2	-	-
Potatoes	Mongolia	52.0	100.0	46.0	100.0	54.2	100.0	65.2	100.0	63.8	100.0	58.9	100.0
	Tuv	15.3	29.4	12.3	26.7	13.4	24.7	12.7	19.5	13.5	21.2	12.1	20.5
	Khentii	1.0	1.9	1.1	2.4	1.1	2.0	1.5	2.3	1.5	2.4	1.3	2.2
	Dornod	1.0	1.9	1.1	2.4	1.2	2.2	1.4	2.1	1.3	2.0	1.1	1.9
	Sukhbaatar	0.4	0.8	0.3	0.7	0.1	0.2	0.5	0.8	0.3	0.5	0.1	0.2
Vegetables	Mongolia	27.3	100.0	23.8	100.0	34.0	100.0	45.7	100.0	39.0	100.0	44.0	100.0
	Tuv	7.9	28.9	4.7	19.7	8.9	26.2	9.6	21.0	5.7	14.6	6.4	14.5
	Khentii	0.4	1.5	0.6	2.5	0.6	1.8	1.0	2.2	1.1	2.8	1.0	2.3
	Dornod	0.5	1.8	0.5	2.1	0.7	2.1	0.8	1.8	0.8	14.0	0.8	1.8
	Sukhbaatar	0.2	0.7	0.2	0.8	0.0	0.1	0.2	0.4	0.1	0.2	0.3	0.7
Fodder Crops	Mongolia	18.7	100.0	18.8	100.0	14.3	100.0	14.7	100.0	5.3	100.0	4.1	9.3
	Tuv	10.0	53.4	7.3	38.8	6.2	43.4	6.3	42.9	1.2	22.6	0.2	0.5
	Khentii	-	-	-	-	-	-	-	-	-	-	-	-
	Dornod	-	-	-	-	-	-	-	-	-	-	-	-
	Sukhbaatar	-	-	8.2	43.6	-	-	-	-	-	-	-	-
Wheat	Mongolia	256.7	100.0	215.3	100.0	237.7	100.0	191.8	100.0	166.7	100.0	-	-
	Tuv	53.3	20.8	51.2	23.8	45.9	19.3	13.6	7.1	28.8	17.3	-	-
	Khentii	6.0	2.3	10.2	4.7	5.2	2.2	10.1	5.3	10.3	6.2	-	-
	Dornod	6.2	2.4	9.2	4.3	2.6	1.1	4.7	2.5	3.2	1.9	-	-
	Sukhbaatar	3.9	1.5	6.0	2.8	2.0	0.8	2.8	1.5	0.3	0.2	-	-
Total	Mongolia	616.1	100.0	524.0	100.0	580.6	100.0	512.3	100.0	444.3	100.0	249.0	100.0
	Tuv	143.0	23.2	129.6	24.7	121.9	21.0	56.4	11.0	79.1	17.8	34.1	13.7
	Khentii	13.4	2.2	22.3	4.3	12.1	2.1	22.8	4.5	23.2	5.2	4.3	1.7
	Dornod	13.9	2.3	19.9	3.8	7.1	1.2	11.6	2.3	8.5	1.9	3.9	1.6
	Sukhbaatar	8.4	1.4	20.7	3.9	4.1	0.7	6.3	1.2	1.0	0.2	0.4	0.0

Source: Mongolian Statistical Yearbook, 2000

c) Livestock and Dairy Production

Production of main livestock in the study area past 5 years is shown in Table 3-1-4. Livestock husbandry in Mongolia has a high potential due to abundant land, and its share is about 70% of total agricultural production. The production of livestock in the study area increased up to 1998; however, the production declined in 1999 caused by livestock deaths during a hard winter. The annual growth rates of livestock production range between 4.1% and 11.0%.

Table 3-1-5 shows the livestock products such as beef, mutton/goat, pork and milk. Livestock products in Mongolia has increased constantly past 5 years and is approximately 1.024 million tons in 1999. Especially, the production of milk is the highest tonnage at 492,000 tons, 48% of total livestock products.

Table 3-1-4 Production of Livestock in the Study Area

Items		Year ('000 heads)											
Types	Area	1995	%	1996	%	1997	%	1998	%	1999	%	2000	%
Camel	Mongolia	367.5	100.0	357.9	100.0	355.4	100.0	356.5	100.0	355.6	100.0	322.9	100.0
	Tuv	4.3	1.2	4.2	1.2	4.1	1.2	4.1	1.2	4.2	1.2	3.6	1.1
	Khentii	7.1	1.9	7.1	2.0	7.1	2.0	7.3	2.0	7.3	2.1	7.3	2.3
	Dornod	6.8	1.9	6.2	1.7	6.1	1.7	6.0	1.7	6.0	1.7	5.9	1.8
	Sukhbaatar	11.4	3.1	11.2	3.1	11.8	3.3	12.1	3.4	12.5	3.5	12.2	3.8
Horse	Mongolia	2,648.4	100.0	2,770.5	100.0	2,893.2	100.0	3,059.1	100.0	3,163.5	100.0	2,660.7	100.0
	Tuv	247.3	9.3	261.6	9.4	280.3	9.7	302.7	9.9	303.6	9.6	249.5	9.4
	Khentii	154.6	5.8	162.3	5.9	172.3	6.0	183.2	6.0	194.3	6.1	192.8	7.2
	Dornod	88.4	3.3	87.0	3.1	89.9	3.1	95.4	3.1	104.0	3.3	105.5	4.0
	Sukhbaatar	134.9	5.1	139.8	5.0	154.9	5.4	169.4	5.5	188.3	6.0	192.2	7.2
Cattle	Mongolia	3,317.1	100.0	3,476.3	100.0	3,612.8	100.0	3,725.8	100.0	3,824.7	100.0	3,097.6	100.0
	Tuv	214.4	6.5	235.5	6.8	248.9	6.9	263.5	7.1	241.2	6.3	184.2	5.9
	Khentii	178.4	5.4	186.4	5.4	201.9	5.6	216.9	5.8	229.1	6.0	218.0	7.0
	Dornod	11.7	0.4	111.1	3.2	121.8	3.4	132.9	3.6	146.2	60.6	142.7	4.6
	Sukhbaatar	162.6	4.9	155.9	4.5	167.5	4.6	184.3	4.9	168.0	4.4	209.6	6.8
Sheep	Mongolia	13,718.6	100.0	13,560.6	100.0	14,165.6	100.0	14,694.2	100.0	15,191.3	100.0	13,876.4	100.0
	Tuv	1,004.2	7.3	1,020.3	7.5	1,094.8	7.7	1,172.6	8.0	1,175.1	7.7	1,101.2	7.9
	Khentii	520.3	3.8	527.5	3.9	567.7	4.0	626.9	4.3	677.9	4.5	688.6	5.0
	Dornod	319.4	2.3	314.0	2.3	343.6	2.4	385.2	2.6	432.1	2.8	438.5	3.2
	Sukhbaatar	496.3	3.6	499.6	3.7	534.2	3.8	605.6	4.1	689.8	4.5	717.3	5.2
Goat	Mongolia	8,520.7	100.0	9,134.8	100.0	10,265.3	100.0	11,061.9	100.0	11,033.9	100.0	10,269.8	100.0
	Tuv	296.1	3.5	346.3	3.8	420.3	4.1	495.6	4.5	494.0	4.5	483.6	4.7
	Khentii	240.5	2.8	267.2	2.9	305.1	3.0	354.4	3.2	353.7	3.2	364.7	3.6
	Dornod	65.1	0.8	75.8	0.8	95.8	0.9	116.2	1.1	123.5	1.1	133.5	1.3
	Sukhbaatar	210.4	2.5	234.3	2.6	264.8	2.6	316.4	2.9	348.7	3.2	361.1	3.5
Total	Mongolia	28,572.3	100.0	29,300.1	100.0	31,292.3	100.0	32,897.5	100.0	33,569.0	100.0	30,227.5	100.0
	Tuv	1,766.3	6.2	1,867.9	6.4	2,048.4	6.5	2,238.5	6.8	2,218.1	6.6	2,022.1	6.7
	Khentii	1,100.9	3.9	1,150.5	3.9	1,254.1	4.0	1,388.7	4.2	1,462.3	4.4	1,471.4	4.9
	Dornod	491.4	1.7	594.1	2.0	657.2	2.1	735.7	2.2	811.8	2.4	826.2	2.7
	Sukhbaatar	1,015.6	3.6	1,040.8	3.6	1,133.2	3.6	1,287.8	3.9	1,407.3	4.2	1,492.5	4.9
Total of 4 provinces			4,374.2		4,653.3		5,092.9		5,650.7		5,899.5		5,812.2
Growth Rate (%)			4.1		6.4		9.4		11.0		4.4		19.2

Source: Mongolian Statistical Yearbook, 2000

Table 3-1-5 Livestock Products in Mongolia

Product	Year ('000 tons)											
	1995	%	1996	%	1997	%	1998	%	1999	%	2000	%
Total	766.3	100.0	846.2	100.0	856.4	100.0	927.3	100.0	1,024.0	100.0	927.2	100.0
Meat	211.7	27.6	259.9	30.7	240.5	28.1	268.3	28.9	289.0	28.2	310.6	33.5
Beef	69.4	9.1	90.0	10.6	86.6	10.1	99.3	10.7	104.6	10.2	113.4	12.2
Mutton/Goat	111.5	14.6	121.3	14.3	104.4	12.2	120.2	13.0	128.9	12.6	120.0	12.9
Pork	0.6	0.1	0.3	0.0	0.2	0.0	0.2	0.0	0.3	0.0	0.9	0.0
Milk	369.6	48.2	369.8	43.7	418.6	48.9	430.8	46.5	491.6	48.0	375.6	40.5
Eggs	3.5	0.5	4.9	0.6	6.1	0.7	8.5	0.9	9.6	0.9	6.7	0.7

Source: Mongolian Statistical Yearbook, 2000

2) Potential of Agricultural Production

Although the land in the eastern region appropriate for agriculture is about 180,000 ha, it is necessary to take complex measures for irrigation, protection of soils and planting of forest before their utilization. According to the Eastern Region Development Project of Mongolia prepared by the Urban and City Planning Bureau of the National Center of Mapping Research, total capacity of pastures in eastern region may be estimated at approximately 14.8 million head of livestock. There is a thus possibility to double existing livestock numbers. Based on pasture and climate conditions and landscape features, it is possible to

intensively increase number of cows in Dornod province and number of camels in Sukhbaatar province.

(3) Tourism

Mongolia has abundant natural beauty and tourism is a favorable sector to be developed. Eastern region is comparatively rich with natural sites, historical and cultural heritage for development of tourism. In particular the Khentii region with its relation to the history of Chingis Khaan will become a center for future development of tourism. However, road access is very bad. Air transport is used for long distance travel. However, air transport has significant problems because of unsatisfactory aircraft availability, and weather conditions that make reliability of air services difficult. Therefore, tour operators place a high priority on the provision of good roads. The construction of the eastern arterial road has high potential for tourism development. Before transformation to a market economy, all foreign tourism was in the hands of State run companies. Tourism was only allowed if tourists used the services of these companies. Recently, private companies have taken over responsibility for handling the majority of organized tourism in the country. In 1999, 36,540 tourists visited Mongolia.

(4) External Trade

1) Value of Imports and Exports

The value of imports and exports in Mongolia are shown in Table 3-1-6. The major export commodities in Mongolia are primary goods ; it is, therefore, subject to influence by fluctuation of international market prices. In 1996, owing to a decline of international market prices for copper, molybdenum, gold and cashmere, the value of major exports fell by 10%. An annual trade deficit has occurred since 1996.

Table 3-1-6 Value of Imports and Exports in Mongolia (US $ million)

	1993	1994	1995	1996	1997	1998	1999	2000
Total Value	761.6	614.5	888.6	875.2	919.8	848.4	871.1	1080.6
Exports	382.6	356.1	473.3	424.3	451.5	345.2	358.3	466.1
Imports	379.0	258.4	415.3	450.9	468.3	503.3	512.8	614.5
Trade Balance	3.6	97.7	58.0	-26.6	-16.8	-158.1	-154.5	-148.4

Source: mongolian Statistical Yearbook, 2000

With regard to goods exported/imported, trade during the past 5 years towards Russia and the former Soviet block still dominates; however, there has been a significant switch to trading with China, Japan, South Korea and USA. In 1990, Russian and East European countries accounted for 95% of exports and 93% of imports; however, the figures by 1999 were reduced to 23% for exports and 40% for imports. Exports to China significantly increased from 1.7% in 1990 to 58%

in 1999, and imports from China rose from 2.4% in 1990 to 15% in 1999. On the other hand, Russian trade was as follows: exports fell from 78% in 1990 to 13% in 1999, and import declined from 78% in 1990 to 29% in 1999. Given the burgeoning economies of China and countries to the east of Mongolia and the decline of the economy of Russia and the Eastern European countries, these dramatic changes in the direction of trade are likely to continue.

2) Goods Exported and Imported

The share of major goods exported and imported in Mongolia is shown in Table 3-1-7. Major goods exported in 1999 are mineral products, raw/processed materials, textiles, base metals/articles and livestock, which accounted for 66%, 17%, 5%, 4% and 2% of total goods exported respectively. With regard to commodities exported in the past few years, mineral products and base metals/articles have declined. On the other hand, livestock, raw/processed goods and textile sectors increased in the period 1995-1999. Major goods imported are machinery/equipment electric, mineral product, auto/air/water transport, textile and food products, which accounted for 35%, 17%, 11%, 9% and 7% in 1999 respectively.

Table 3-1-7 Share of Major Goods Exported/Imported in Mongolia

Commodities	Goods Exported (%)				Commodities	Goods Imported (%)			
	1995	1998	1999	2000		1995	1998	1999	2000
Total Commodities	100.0	100.0	100.0	100.0	Total Commodities	100.0	100.0	100.0	100.0
1. Livestock	2.2	5.4	6.1	5.0	1. Food product	4.5	9.3	7.0	7.7
2. Mineral product	65.5	45.3	41.0	40.5	2. Mineral product	20.0	18.1	16.6	19.6
3. Raw and processed	5.0	8.0	8.4	9.1	3. Texitiles	6.8	6.3	9.0	13.0
4. Texitiles	17.1	22.6	35.5	41.3	4. Machinery/equipment electric	20.5	25.2	34.5	21.7
5 Base metals/articles	3.6	3.2	2.3	1.3	5. Auto/air/water transport	15.2	13.5	10.6	10.9

Source: Mongolian Statistical Yearbook, 2000.

3.1.2 Development Plan and Projects in the Study Area

(1) General

The Government of Mongolia issued a regional development plan of the eastern area of Khentii, Dornod and Sukhbaatar province in 1996. The regional plan was formulated by the National Design & Research Center of the Ministry of Infrastructure and targets 2010. The main purpose of the development plan is to develop the region with a complex, independent and strong economy based on assessment of the climate conditions, mineral resources, commerce, finance, and labor resources of the region. In accordance with the regional development plan, the Road Development Master Plan was already formulated in 1994 under a donor group composed of Asian Development Bank, World Bank, Kuwait and Japan. The Government of Mongolia has improved the arterial roads utilizing official development assistance from these donors. The development plans and projects are described below.

(2) Road Development Master Plan

The Road Development Master Plan is shown in Table 3-1-8 and Figure 3-1-3. The Master Plan was formulated in 1996, which identified the plan of construction and rehabilitation for the whole of Mongolia up to the target year 2010. Construction and rehabilitation were identified in the prioritization of project links. In addition, the Government of Mongolia has recently planned the "Millennium Road" which aims to strengthen the east-west transport axis, envisaging not only the improvement of road transport in Mongolia but also the promotion of regional links with Russia, China and other surrounding countries.

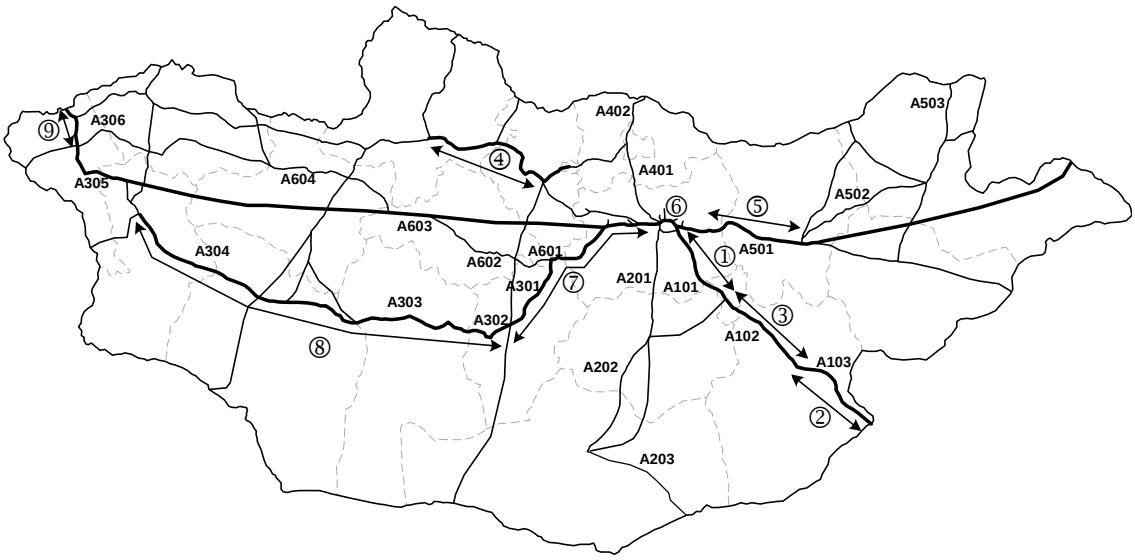


Figure Development Plan by Road Sector (Target Year 2010)

Figure 3-1-3 Road Development Master Plan in Mongolia

Table 3-1-8 Road Development Master Plan in Mongolia

Priority	Section	Length (km)	Type	Donor	Fund Type	Comments
1	Nalaikh - Choir	200	NC	ADB	Loan	In August 31 1994, the assembly approved to start the road construction of this section from 1995. Feasibility Study was conducted by ADB, and prepared detailed design drawings between Nalaikh and Maanit.
2	Zamiin Uud - Sainshand	220	NC	The Government of Japan	Loan	Application of Feasibility Study for JICA was submitted to the Ministry of Foreign Affairs. Average daily traffic was 210 vehicles.
3	Choir - Sainshand	224	NC	The Government of South Korea	Loan	This section is part of Asian Highway. Application of Feasibility Study for KOICA was submitted to the Ministry of Foreign Affairs. Average daily traffic was 247 vehicles.
4	Erdenet - Bulgan - Murun	58 15 338 Total 441	NC RH NC	Kuwait Fund	Loan	Feasibility Study was conducted between Erdenet and Bulgan by ADB. B/C was 19.1. Average daily traffic was between 214 and 315 vehicles.
5	Erdene sum - Baganuur - Undurkhaan	35 16 168 Total 219	NC RH NC	The Government of Japan	Loan	Application of Feasibility Study for JICA was submitted to the Ministry of Foreign Affairs. Average daily traffic was between 328 and 536 vehicles.
6	Feasibility Study for the Bridges in Ulaanbaatar	105.5m	NC and RH	The Government of Japan	Grant's Aid	Application of Basic Study by Japan's Grant Aid was submitted to the Ministry of Foreign Affairs on the basis of preparatory study, was conducted by IECA.
7	Ulaanbaatar (19km) - Erdenesant - Arvaikheer	259 154 Total 413	RH NC	WB and ADB	Loan	Feasibility Study was conducted this section by ADB. Beginning point is 19 km away from Ulannbaatar. Average daily traffic was between 645 and 1,349 vehicles.
8	Arvaikheer - Bayankhongor - Govi-Altai - Khovd	25 175 371 427 Total 998	RH NC NC NC	WB and The Government of Mongolia	Loan and Road Fund of Mongolia	Average daily traffic was 356 vehicles.
9	Ulgii Ulaanbaishint	38 66 Total 104	RH NC	The Government of Mongolia	Road Fund of Mongolia and National Finance	This section is a part of North – South Axis Road in Western of Mongolia, and Euro – Asia International Highway. Average daily traffic was 198 vehicles.
	Grand Total	2,796				
	Breakdown：RH NC	508 2,288				

Note: NC: New Construction, RH: Rehabilitation
[Source: Notification No.175, 1999 July 1]

(3) Eastern Regional Development Plan

The summary of main points in the eastern region development project is described below.

- Mongolian regional development policy is stated in the Mongolian national development strategy and Mongolian Government action program.
- Rich resources of oil, minerals and fertile land for crop production should be used in commerce with South-East Asian countries.
- A consistent infrastructure network in the region needs to be established.
- Raw material, labor and technical linkage among the provinces is weak.
- Development conditions to become independent in terms of the economy in the near future should be formed.
- Manufacturing and service centers should be developed in provinces and neighboring sums in the region in order to remove direct linkages of provinces with the city and sums with the provinces, and reduce their dependence on the centers in terms of manufacturing and services.

The major regional development plan consists of a population development plan, infrastructure development plan, population settlement plan and natural environment/historical and cultural monuments/tourism plan. The population development plan and infrastructure development plan are described as follows:

1) Population Development Plan

The plan aims are as follows:

- To formulate a plan leading to satisfactory living conditions for the inhabitants assuring equality of population, economic stable growth and environment.
- To assure the health of children, education and good living conditions.
- To ensure sustainable growth of population, and changes in the policy of civil income, tax, finance and loans with the purpose of creating equal settlement in urban/rural area, and providing people with employment possibilities either in urban/rural areas.

Based on the current population survey in the eastern region, age classification, labor resources, workers by industry sector and poverty situation by location, future regional population in 2000 and 2010 was estimated for the sums and major cities. The population forecast by sum in the eastern region is shown in Table 3-1-9.

Table 3-1-9 Population Forecast in 2000-2010

Unit: '000 Parsons

Province	Total population				Population of the center			
	1989	1995	2000	2010	1989	1995	2000	2010
Dornod	73.9	83.4	98.8	126.7	61.4	68.5	82.5	109
Khentii	69	72.7	80.9	93.5	49.6	46.1	52.8	62.8
Sukhbaatar	50.9	57.7	62	69.3	33.5	29.4	31.9	36
Dornogovi	4.7	5.6	6	6.7	2.2	2.4	2.6	2.9
Total	198.5	219.4	247.7	296.2	146.7	146.4	169.8	210.7

Source: Eastern Development Plan, the National Design & Research Center of the Ministry of Infrastructure,

2) Urban Classification Plan

The eastern region presently consists of 3 cities (above 15,000 pop.) and 50 sums (500-15,000 pop.). Approximately 144,000 people reside in these urban areas, which represent about 67% of the total population in the eastern region. Compared to the western region, the percentage of urban residents are substantially higher in the eastern region. Choibalsan city is one of the biggest cities followed by Ulaanbaatar, Darkhan, Erdenet. In terms of a city planning strategy, Choibalsan city has advantages for further development as a main center of the region.

The population settlement plan in 2010 formulated for the eastern region envisages: 1 big city of Choibalsan,3 small cities of Tamsagbulag, Undurkhaan and Baruun-Urt, 11 urbanized sums and 42 rural sums. Table 3-1-10 shows urban classification of the eastern region in 2010.

Table 3-1-10 Urban Classification of the Eastern Region in 2010

Urban Classificaiton	No.	Name of Urban Areas	Population (thous. prs)	Urban Classificaiton	No.	Name of Urban Areas	Population (thous. prs)
1. Big city	1	Choibalsan	53.7	4. Rural	15	Dashbalbar	1.7
2. Small city	1	Tamsagbulag	20.0	Villages	16	Bayan-Adarga	1.6
	2	Undurkhaan	18.5		17	Batshireet	1.6
	3	Baruun-Urt	16.2		18	Omnodelger	1.6
3. Urban	1	Bor-Undur	10.0		19	Uulbayan	1.6
Villages	2	Erdene	7.5		20	Bulgan	1.6
	3	Berkh	5.3		21	Matad	1.5
	4	Chandgana	2.5		22	Sergelen	1.4
	5	Hajuu-Ulaan	1.6		23	Holonbuir	1.4
	6	Ereen	1.7		24	Batnorov	1.4
	7	Burentsogt	1.2		25	Dariganga	1.4
	8	Zulegt	0.9		26	Tuvshinshiree	1.4
	9	Talbulag	0.6		27	Bayandelger	1.3
	10	Burenhaan	0.5		28	Munkhhaan	1.3
	11	Dalanturuun	0.5		29	Ulziit	1.2
4. Rural	1	Bayan-Uul	3.8		30	Asgat	1.1
Villages	2	Khalkha river	3.6		31	Sukhbaatar	1.1
	3	Erdentsagaan	2.9		32	Bayan-Ovoo	1.0
	4	Choibalsan (2)	2.5		33	Galshar	0.9
	5	Dadal	2.2		34	Murun	0.9
	6	Norovlin	2.2		35	Bayanhutag	0.9
	7	Chuluunhoroot	2.2		36	Halzan	0.9
	8	Gurvan bayan	2.2		37	Naran	0.9
	9	Binder	2.1		38	Jargaltkhaan	0.9
	10	Tumentsogt	2.1		39	Darkhan	0.8
	11	Bayantumen	2.0		40	Bayanmunkh	0.8
	12	Ongon	2.0		41	Gurvanzagal	0.8
	13	Tsagaan-Ovoo	1.9		42	Ihhet	0.6
	14	Bayandun	1.7				

Source: Eastern Development Plan, the National Design & Research Center of the Ministry of Infrastructure, 1996

3) Infrastructure Development Plan

The infrastructure development plan of road, railway and air transport is described as follows:

a) Road Development Plan

Road network has been planned to provide the local industrial and social needs to link with neighboring countries, other regions, and provinces of the country. Major planned roads in the eastern region are shown as below:

- An international road in the region planned to be approximately 900 km linking Rashaant (Province of China) – Sumber – Tamsagbulag – Choibalsan – Undurkhaan – Baganuur.
- A state standard road for regional axis is planned to be approximately 700 km linking Bichigt – Baruun-Urt – Choibalsan – Norovlin – Bayan Uul - Ulikhan.

World Bank, Asian Development Bank and donor countries could finance the international roads, and national roads could be constructed with domestic resources and regional road funds.

b) Railway Development Plan

Railway will be the main factor for future development of the eastern region. The regional railway network is proposed considering the potentials of mining Tavantolgoi coal reserve of Umnugovi, Tamsagbulag oil reserve, extending links with South-east Asian countries and participation in the international project at Tumengol. There are three alternatives. First alternative is in direction of Bor-Undur – Galshar – Tuvshinshiree – Baruun-Urt – Choibalsan – Kharkh River. Second alternative is Tsagaan Suvarga of Dornogovi – Baruun-Urt – Choibalsan – Kharkh River. With respect to these options, the Chinese railway will be linked via Rashaant, and will be connected with South-east Asian countries by railway in the framework of the Tumengol project. The third alternative is to link with Manjuur in China from Chingisval station of the railway between Choibalsan – Solovyevsky, which will have a total length of 180 km. As a result, the eastern region will be linked with northern China without passing through the Russian Federation.

c) International Airport Plan

The plan envisages construction of an international airport at Choibalsan city, which is the main center in the region.

3.2 Socioeconomic Framework

3.2.1 Establishment of a Socioeconomic Framework

A socioeconomic framework targeting 2005, 2010 and 2015 has been formulated based on sources described below. The basic procedure for the socioeconomic framework is shown in Figure 3-2-1.

1) Population based on the forecast of National Statistics Office of Mongolia (NSOM) and Eastern Region Development Plan from the National Design & Research Center of the Ministry of Infrastructure.

2) Future Gross Domestic Products (GDP) based on Ministry of Finance and Economy (MOFE) and statistical data from National Statistics Office.

3) Employed Population based on statistical data from the National Statistics Office.

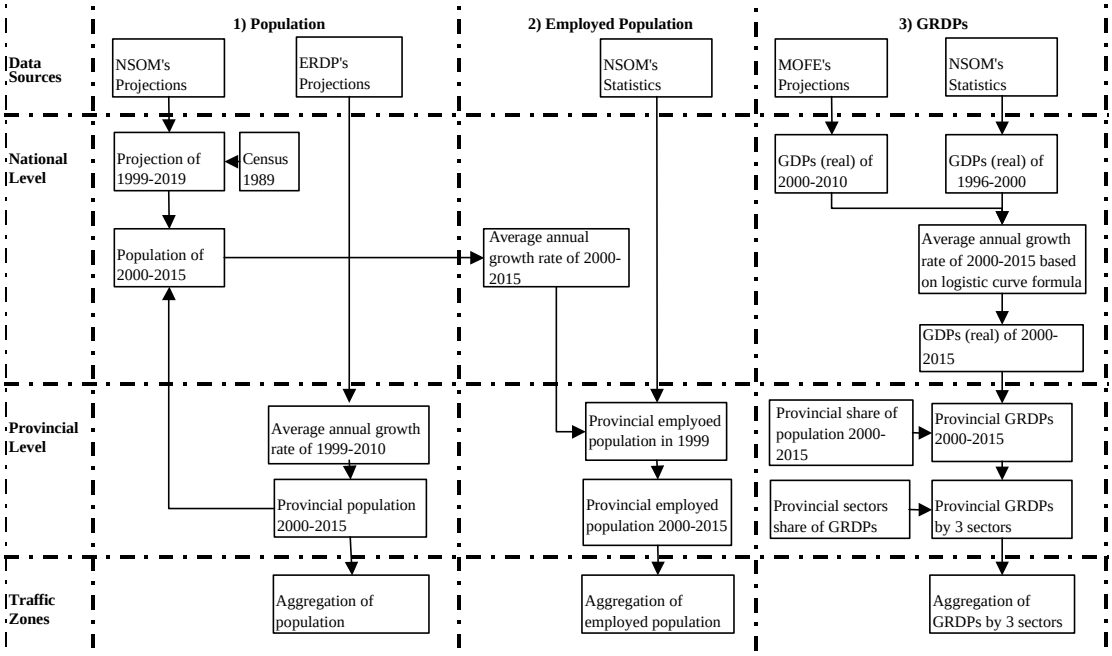


Figure 3-2-1 Basic Procedure for Socioeconomic Framework

3.2.2 National and Provincial Framework

(1) Population

1) Current Conditions

Table 3-2-1 shows population by province and capital city. The population of Mongolia has increased from 2,050,000 in 1990 to 2,407,500 in 2000. Although the annual growth rate has varied between 2.7 and 2.9% up until 1989, the average growth rate during the past decade from 1990 was approximately 1.5%.

About 50% of provinces have been declining during the past 5 years, and only Ulaanbaatar has seen significant increase. This is seemingly mainly due to the emigration of residents toward Ulaanbaatar. Total population in the 4 provinces of the study area is around 346,000 people, which accounts for 14.5 % of national population in 2000. It is almost 50% of the national population, if Ulaanbaatar is included.

2) Future Projected population

NSOM estimated population projections based on the 1989 National Census; it was, however, only for total national population by sexes and age up to year 2019. Besides, NSOM may update the future population prediction by using the new 1999 National Census. The 1999 National Census is currently under data processing with a publication date set for the end of July 2001. On the other hand, the department of regional development of the Ministry of Infrastructure has projected future population by province for the Eastern and Western Regional Development Plans in 2010. The population projection was given in accordance with the main Project for Development of Human Settlements in Mongolia. In this context, the Study Team estimated the provincial population of 2000-2015 by average annual growth rates of 1999–2010, in accordance with the future projected population of the Eastern and Western Regional Development Plans. These were used for the national and provincial framework in the study. Table 3-2-2 shows future projected population by province.

Table 3-2-1 Current Population by Provinces and Capital City

Unit: Persons

Provinces & Capital City		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Total Mongolia		2,050,044	2,256,982	2,253,632	2,218,246	2,221,285	2,234,386	2,245,492	2,270,208	2,290,839	2,373,493	2,407,500
1	Arkhangai	87,354	96,296	102,728	102,716	100,196	100,842	98,441	95,910	96,753	97,091	97,500
2	Bayan-Ulgii	98,105	102,817	92,989	75,043	79,284	82,259	83,562	85,441	87,341	91,068	94,600
3	Bayankhongor	76,389	81,584	83,675	85,301	82,677	86,025	86,824	87,812	88,627	84,779	85,300
4	Bulgan	55,734	60,976	62,456	60,999	61,439	60,546	61,180	63,798	64,093	61,776	62,600
5	Govi-Altai	63,299	69,840	71,703	71,528	72,236	72,921	69,012	70,249	70,442	63,673	63,600
6	Dornogovi	55,180	49,999	49,861	47,773	45,985	45,734	46,575	47,097	47,739	50,575	51,100
7	Dornod	74,787	86,909	87,048	83,722	81,915	79,869	76,403	74,475	73,813	75,373	74,200
8	Dundgovi	51,324	56,195	55,705	51,291	50,882	50,511	50,431	51,402	52,081	51,517	51,300
9	Zavkhan	91,960	99,371	102,824	101,697	103,150	101,443	102,341	102,242	100,905	89,999	87,200
10	Uvurkhangai	97,805	105,296	111,719	109,387	109,818	111,561	111,045	113,408	113,476	111,420	113,000
11	Umnugovi	41,932	44,923	46,993	45,014	42,839	43,551	44,324	44,594	45,102	46,858	46,900
12	Sukhbaatar	52,466	57,408	56,066	56,084	57,546	55,850	56,534	55,731	55,523	56,166	55,900
13	Selenge	88,927	95,883	93,725	90,690	95,725	93,270	95,507	97,771	98,389	99,950	100,900
14	Tuv	103,943	110,503	112,855	108,210	105,741	103,721	104,238	104,592	103,537	99,268	98,000
15	Uvs	90,154	98,702	100,096	98,197	98,756	99,624	98,625	94,734	94,834	90,037	86,800
16	Khovd	78,663	89,365	89,029	87,171	88,421	88,494	90,083	91,339	90,855	86,831	87,800
17	Khuvsgul	104,140	113,849	119,133	116,867	117,391	117,678	113,312	116,120	117,123	119,063	119,800
18	Khentii	72,622	76,973	77,631	73,096	72,639	70,267	71,212	71,519	70,164	70,946	71,400
19	Darkhan-Uul	80,140	90,547	91,292	91,303	85,808	87,084	87,368	87,767	89,114	83,271	84,800
20	Ulaanbaatar	536,594	600,985	575,000	588,000	596,000	612,100	624,896	638,442	652,231	760,077	786,500
21	Orkhon	48,526	57,054	59,138	62,868	61,640	59,105	61,495	63,541	66,616	71,525	76,000
22	Govi-Sumber	-	11,509	11,966	11,289	11,197	11,931	12,084	12,224	12,072	12,230	12,300

Source: Mongolian Statistical Yearbook, 2000

* denotes that the original figures in the statistical yearbook are shown in thousand persons.

Table 3-2-2 Future Projected Population by Province and Provincial Capital

Unit: '000 parsons

	Provinces & Capital City	1999	2000	2005	2010	2015	Annual Growth Rate 1999-2015
	Total Mongolia	**2373.7**	**2427.8**	**2732.3**	**3104.0**	**3562.1**	**2.47%**
1	Arkhangai	97.1	99.6	112.8	127.8	144.8	2.53%
2	Bayan-Ulgii	91.1	92.5	100.0	108.0	116.7	1.56%
3	Bayankhongor	84.8	87.4	101.7	118.4	137.8	3.08%
4	Bulgan	61.8	62.3	64.8	67.5	70.3	0.81%
5	Govi-Altai	63.7	66.4	82.0	101.3	125.1	4.31%
6	Dornogovi	50.6	51.6	56.8	62.5	68.8	1.94%
7	Dornod	75.4	79.3	102.4	132.2	170.6	5.24%
8	Dundgovi	51.5	52.7	59.4	66.9	75.3	2.41%
9	Zavkhan	90.0	95.8	131.2	179.5	245.7	6.48%
10	Uvurkhangai	111.4	116.0	142.0	173.9	212.9	4.13%
11	Umnugovi	46.9	48.1	54.9	62.6	71.4	2.66%
12	Sukhbaatar	56.2	58.0	68.0	79.8	93.6	3.24%
13	Selenge	100.0	102.4	115.1	129.4	145.5	2.37%
14	Tuv	99.3	101.8	115.2	130.3	147.4	2.50%
15	Uvs	90.0	94.8	123.2	160.1	208.0	5.38%
16	Khovd	86.8	90.5	111.3	137.0	168.6	4.24%
17	Khuvsgul	119.0	121.2	132.9	145.7	159.7	1.86%
18	Khentii	71.0	73.8	89.7	109.0	132.4	3.97%
19	Darkhan-Uul	83.3	85.7	98.8	113.9	131.3	2.89%
20	Ulaanbaatar	760.1	760.4	761.8	763.3	764.8	0.04%
21	Orkhon	71.5	74.0	87.7	103.9	123.1	3.46%
22	Govi-sumber	12.2	13.3	20.4	31.4	48.3	8.97%

Source: JICA Study Team, 2001. National Statistical Office, 2001. Regional Development Plan, 2001, Department of Regional Development of Ministry of Infrastructure.

3) Employed Population

The employed population by province during the past decade from 1990 is shown in Table 3-2-3. The annual growth rate of employed population in total Mongolia is 0.42% approximately, and the annual growth rates of provincial employed population have varied between – 4.96% and 3.14%. Table 3-2-4 shows the growth rate and share of employed population in total Mongolia. The share of employed population in total Mongolia is stable at approximately 34%, and the growth rate of employed population based on logarithmic regression formula using ratios of 1990 to 1999 is about 0.42%. The share of future employed population will decrease gradually if compared to the growth rate of the future total population. In this context, taking consideration of the proportion of the future provincial population, the future employed population by province in 2005, 2010 and 2015 was estimated based on the population growth rates. Table 3-2-5 shows the results. The rate of provincial employment ranges between 23% and 46%.

Table 3-2-3 Employed Population by Provinces during Past Decade

Unit: Persons

Provinces & Capital City		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Total Mongolia		783,579	789,800	806,025	765,364	759,760	767,638	769,618	765,092	792,570	813,559	809,000
1	Arkhangai	34,746	35,805	36,157	38,322	38,691	38,864	39,499	37,321	37,317	38,125	38,600
2	Bayan-Ulgii	30,246	28,066	26,700	22,037	23,150	23,397	23,188	23,465	29,244	30,924	29,100
3	Bayankhongor	28,435	28,874	28,388	29,854	31,532	35,085	33,518	34,105	35,053	34,211	34,600
4	Bulgan	22,191	21,604	22,503	21,370	25,027	24,279	23,156	21,275	22,681	22,719	22,700
5	Govi-Altai	22,861	25,335	26,882	25,300	26,425	26,887	28,996	29,485	30,414	30,031	28,500
6	Dornogovi	22,400	19,546	19,180	17,078	16,502	16,777	15,531	16,815	16,120	17,162	17,400
7	Dornod	26,845	27,328	30,797	27,623	22,890	22,501	18,066	18,184	15,467	16,991	16,700
8	Dundgovi	17,929	20,510	21,601	19,874	21,043	22,114	21,598	21,737	22,027	22,136	21,800
9	Zavkhan	33,965	37,303	38,784	38,409	41,436	42,770	43,677	43,489	42,033	41,693	37,400
10	Uvurkhangai	37,496	39,060	40,456	40,826	41,843	43,404	43,018	45,984	47,221	49,521	49,700
11	Umnugovi	16,444	18,016	17,878	17,422	15,683	16,371	16,529	16,754	18,848	19,971	20,100
12	Sukhbaatar	18,114	19,534	18,373	17,051	21,686	20,649	21,681	20,458	21,317	21,674	22,400
13	Selenge	33,720	31,751	34,242	27,260	28,933	26,102	25,438	26,249	28,801	31,750	30,700
14	Tuv	41,350	38,953	38,377	34,681	34,128	34,365	35,523	33,727	35,389	35,836	37,600
15	Uvs	31,085	34,719	35,112	33,708	33,424	35,157	34,779	33,454	34,466	31,311	32,700
16	Khovd	28,458	29,344	32,598	32,595	32,897	32,749	36,430	31,390	32,470	32,826	32,400
17	Khuvsgul	39,681	39,411	40,919	39,584	40,509	42,060	41,921	42,353	44,026	46,555	46,300
18	Khentii	28,271	28,562	29,026	25,473	24,132	25,877	25,105	22,710	22,548	22,865	23,600
19	Darkhan-Uul	30,076	32,081	28,383	26,941	25,719	29,120	28,525	25,323	25,273	27,224	20,600
20	Ulaanbaatar	217,254	203,741	206,279	195,848	194,410	186,738	182,628	191,994	201,714	209,838	215,500
21	Orkhon	22,012	25,405	28,586	30,105	16,818	19,341	28,104	26,243	26,716	26,663	27,000
22	Govi-Sumber	-	4,852	4,804	4,003	2,882	3,031	2,708	2,577	3,425	3,533	3,600

Source: National Statistical Office, 2001, Mongolian Statistical Yearbook, 2000

* denotes that the original figures in the statistical yearbook are shown in thousand persons.

Table 3-2-4 Growth Rate and Share of Employed Population in Total Mongolia

Provinces & Capital City	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Population	2,050,044	2,256,982	2,253,632	2,218,246	2,221,285	2,234,386	2,245,492	2,270,208	2,290,839	2,373,493	2,407,500
Employed Population	783,579	789,800	806,025	765,364	759,760	767,638	769,618	765,092	792,570	813,559	809,000
Employed Population Rates	38.2%	35.0%	35.8%	34.5%	34.2%	34.4%	34.3%	33.7%	34.6%	34.3%	33.60%

Source: JICA study team, National Statistical Office, 2001., Mongolian Statistical Yearbook, 2001

Table 3-2-5 Future Provincial Employed Population

Provinces & Capital City		1999	2000	2005	2010	2015
Total Mongolia		813,559	833,871	948,335	1,088,317	1,260,567
1	Arkhangai	38,125	39,089	44,288	50,179	56,853
2	Bayan-Ulgii	30,924	31,406	33,932	36,661	39,609
3	Bayankhongor	34,211	35,265	41,042	47,766	55,592
4	Bulgan	22,719	22,902	23,839	24,814	25,830
5	Govi-Altai	30,031	31,325	38,678	47,757	58,968
6	Dornogovi	17,162	17,495	19,258	21,198	23,334
7	Dornod	16,991	17,881	23,080	29,791	38,452
8	Dundgovi	22,136	22,669	25,531	28,755	32,386
9	Zavkhan	41,693	44,394	60,758	83,154	113,807
10	Uvurkhangai	49,521	51,567	63,138	77,304	94,650
11	Umnugovi	19,971	20,502	23,378	26,656	30,395
12	Sukhbaatar	21,674	22,376	26,242	30,776	36,093
13	Selenge	31,750	32,503	36,543	41,085	46,191
14	Tuv	35,836	36,732	41,560	47,023	53,205
15	Uvs	31,311	32,994	42,869	55,699	72,369
16	Khovd	32,826	34,217	42,104	51,811	63,754
17	Khuvsgul	46,555	47,420	51,990	57,001	62,494
18	Khentii	22,865	23,774	28,888	35,103	42,654
19	Darkhan-Uul	27,224	28,009	32,290	37,225	42,913
20	Ulaanbaatar	209,838	209,918	210,319	210,721	211,124
21	Orkhon	26,663	27,584	32,692	38,745	45,919
22	Govisumber	3,533	3,850	5,917	9,093	13,974

Source: JICA Study Team, 2001.

(3) Gross Regional Domestic Product (GRDP)

1) Gross Domestic Product (GDP)

a) Current Conditions

GDP composition by sector in Mongolia during the past 10 years is shown in Table 3-2-6. The share of industry in 1990 was about 36%; it has, however, decreased gradually since then, by 1999 it had declined to approximately 20%. On the other hand, the share of agriculture has increased to about 35% since 1993 due to the change to a market economy. The share of trade, material and technical provision in 1994 also declined; however, it recovered to 21% by 1997.

Table 3-2-6 GDP Composition by Sectors in Mongolia

sectores	Year (GDP: %)									
	1990	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1. Industries	35.7	32.0	30.9	30.5	25.9	18.5	24.0	18.3	19.9	17.4
2. Agriculture	15.2	30.2	35.1	37.0	37.0	42.0	34.3	35.7	34.5	33.4
3. Construction	5.0	1.9	1.6	2.1	1.7	2.8	2.2	2.5	2.3	2.3
4. Transport/ communication	12.0	5.5	4.6	5.8	6.4	7.4	7.7	8.8	8.7	9.5
5. Trade/ material/ technical provision	19.4	15.4	16.0	11.7	17.0	16.7	21.0	21.1	20.6	21.6
6. Services	11.5	12.9	9.5	10.5	11.9	12.4	10.6	13.3	13.7	15.5
7. Others	1.2	2.1	2.3	2.4	0.1	0.2	0.2	0.3	0.3	0.3

Source: Mongolian Statistical Yearbook, 2000

b) Projected Gross Domestic Product (GDP)

The GDP growth rate at 1995 prices in recent years ranged between 2.4% and 4.0%. Ministry of Finance and Economy (MOFE) projected annual real GDP in 2000 and 2010 as shown in Table 3-2-7. Current GDP increased gradually up to 2000; however, MOFE projected real GDP growth rate of 3.48% in 2000 to 2005. Subsequently, GDP is predicted to increase sharply in 2005 to 2010, at 7.34% annual growth rate. In this context, the Study Team estimated GDPs for 2005, 2010 and 2015.

If projection is made on the basis of the Ministry predictions using logarithmic regression, this would suggest very high rates of growth after 2010 which does not seem reasonable. Consequently a curve fitting method was used to produce an S curve by the logistic curve method. This was thought to best model the pattern of recent low growth rates, an increased rate 2005-2010, and a slightly reduced rate subsequently.

The maximum growth rate for the logistic curve was 9.0% based on the 9th Five Years Development Plan of Government. This is an intermediate value which the government has formulated with growth rate of 8-10% in 2010-2020. The results are as follows: 4.86% in 2000-2005, 6.84% in 2005-2010 and 8.1% in 2010-2015. Table 3-2-8 shows adopted real GDP rates during 2005 and 2015.

Table 3-2-7 Projected Annual Real GDP in 2005 and 2010

(Million Tg. of 1995)

Year	1995	1996	1997	1998	1999	2000	2005	2010
GDP	550,253.7	563,201.0	585,719.8	606,409.8	624,723.2	640,300.0	759,800.0	1,082,600.0
Grouth Rates	-	2.35%	4.00%	3.53%	3.02%	2.49%	3.48%	7.34%

Source: National Statistics Office of Mongolia, Mongolian Statistical Yearbook, 1999
Ministry of Finance and Economy in Mongolia, 2001

Table 3-2-8 Study Adopted Real GDP during 2005 and 2015

(Million Tg of 1995)

Year	2000	2005	2010	2015
GDP	640,300.0	811,701.2	1,129,918.4	1,667,897.0
Grouth Rates	-	4.68%	6.84%	8.10%

Source: JICA Study Team, 2001

2) Gross Regional Domestic Product (GRDP)

Gross regional domestic products (GRDP) by province in Mongolia is not dealt with in the statistics; therefore, future provincial GRDP for 2000, 2005, 2010 and 2015 were distributed from the projected national GDP based on the provincial shares of projected population. Furthermore, the GRDPs are subdivided into the three industry sectors of primary, secondary and tertiary.

According to statistics of GDP by sector during the past 5 years, the sector shares range as follows; primary sector 50-52%, secondary sector 11-15%, tertiary sector 35-37%. These values are stable. In 1999, the secondary sector accounted for only a small share of the total GDP, while the ratio of tertiary sector to primary sector is roughly 2:3.

The growth rates of GDP by sector were calculated by using logarithmic regression formula for each sector: namely, primary sector at 4.7%, secondary sector at 1.7%, and tertiary sector at 1.8%. Taking into consideration Mongolian government plans to develop industrial activity in the Western and Eastern regions, in the year 2015, the share accounted for by the primary sector is assumed to remain unchanged, whereas the secondary and tertiary sectors ratios are assumed to rise gradually.

In this context, 1.7% and 1.8% of the growth rates for secondary and tertiary sectors were applied for estimates of future provincial sector GRDP. When the population of urban areas increases, the general tendency is for the tertiary sector GDP to increase at a faster pace than the secondary sector GDP.

Table 3-2-9 shows future provincial GRDPs by sector. In the western region, the growth rates in Zavkhan, Uvs and Govi-Altai provinces are comparatively high, while in the eastern region, Govisumber, Dornod, Sukhbaatar and Khentii provinces show high growth rates.

Table 3-2-9 Future Provincial GRDP by Sector (1)

Unit: Million Tg.

Provinces & Capital City		2000				2005			
		Pri.	Sec.	Terti.	Total	Pri.	Sec.	Terti.	Total
Total Mongolia		**332,315.7**	**71,713.6**	**236,270.7**	**640,300.0**	**403,415.5**	**94,969.0**	**313,316.7**	**811,701.2**
1	Arkhangai	13,627.1	2,940.7	9,688.6	26,256.5	16,654.2	3,920.6	12,934.6	33,509.4
2	Bayan-Ulgii	12,664.1	2,732.9	9,004.0	24,401.0	14,758.9	3,474.4	11,462.7	29,696.0
3	Bayankhongor	11,965.0	2,582.0	8,506.9	23,053.9	15,020.6	3,536.0	11,665.9	30,222.5
4	Bulgan	8,527.3	1,840.2	6,062.7	16,430.2	9,574.4	2,253.9	7,436.1	19,264.4
5	Govi-Altai	9,094.8	1,962.7	6,466.2	17,523.7	12,113.1	2,851.6	9,407.8	24,372.5
6	Dornogovi	7,060.4	1,523.6	5,019.8	13,603.8	8,383.2	1,973.5	6,510.9	16,867.6
7	Dornod	10,861.2	2,343.8	7,722.1	20,927.2	15,122.0	3,559.9	11,744.7	30,426.6
8	Dundgovi	7,219.0	1,557.8	5,132.5	13,909.3	8,770.1	2,064.6	6,811.4	17,646.1
9	Zavkhan	13,117.1	2,830.7	9,326.0	25,273.7	19,364.5	4,558.6	15,039.6	38,962.7
10	Uvurkhangai	15,878.4	3,426.5	11,289.3	30,594.2	20,970.5	4,936.7	16,286.9	42,194.1
11	Umnugovi	6,590.4	1,422.2	4,685.7	12,698.2	8,105.8	1,908.2	6,295.5	16,309.5
12	Sukhbaatar	7,941.8	1,713.8	5,646.5	15,302.0	10,046.5	2,365.1	7,802.7	20,214.3
13	Selenge	14,012.4	3,023.9	9,962.6	26,998.9	16,993.4	4,000.4	13,198.1	34,191.9
14	Tuv	13,932.0	3,006.5	9,905.4	26,844.0	17,003.3	4,002.8	13,205.8	34,212.0
15	Uvs	12,981.4	2,801.4	9,229.5	25,012.3	18,193.3	4,282.9	14,130.0	36,606.2
16	Khovd	12,384.4	2,672.6	8,805.1	23,862.1	16,438.2	3,869.8	12,766.9	33,074.8
17	Khuvsgul	16,591.2	3,580.4	11,796.0	31,967.6	19,621.1	4,619.1	15,238.9	39,479.1
18	Khentii	10,104.6	2,180.6	7,184.2	19,469.4	13,244.3	3,117.9	10,286.3	26,648.5
19	Darkhan-Uul	11,731.0	2,531.5	8,340.5	22,603.1	14,587.6	3,434.1	11,329.6	29,351.4
20	Ulaanbaatar	104,081.7	22,460.8	74,000.3	200,542.9	112,483.8	26,480.1	87,361.7	226,325.6
21	Orkhon	10,125.1	2,185.0	7,198.8	19,508.9	12,943.8	3,047.1	10,053.0	26,043.9
22	Govi-sumber	1,819.8	392.7	1,293.8	3,506.3	3,016.7	710.2	2,342.9	6,069.8

Source: JICA Study Team, 2001

Table 3-2-10 Future Provincial GRDP by Sector (2)

Unit: Million Tg.

Provinces & Capital City		2010				2015			
		Pri.	Sec.	Terti.	Total	Pri.	Sec.	Terti.	Total
Total Mongolia		**555,919.9**	**133,330.4**	**440,668.2**	**1,129,918.4**	**815,601.6**	**196,811.8**	**655,483.5**	**1,667,897.0**
1	Arkhangai	22,888.7	5,489.6	18,143.5	46,521.8	33,154.0	8,000.3	26,645.2	67,799.5
2	Bayan-Ulgii	19,342.6	4,639.1	15,332.5	39,314.2	26,717.1	6,447.1	21,472.0	54,636.2
3	Bayankhongor	21,205.2	5,085.8	16,809.0	43,100.0	31,551.0	7,613.5	25,356.9	64,521.4
4	Bulgan	12,089.1	2,899.4	9,582.8	24,571.4	16,087.6	3,882.1	12,929.3	32,899.0
5	Govi-Altai	18,142.6	4,351.3	14,381.3	36,875.2	28,639.1	6,910.9	23,016.7	58,566.6
6	Dornogovi	11,193.6	2,684.6	8,873.0	22,751.3	15,752.4	3,801.2	12,659.9	32,213.5
7	Dornod	23,676.7	5,678.6	18,768.1	48,123.5	39,070.5	9,428.1	31,400.2	79,898.8
8	Dundgovi	11,981.6	2,873.6	9,497.6	24,352.9	17,252.1	4,163.1	13,865.2	35,280.5
9	Zavkhan	32,148.1	7,710.3	25,483.2	65,341.6	56,249.6	13,573.5	45,206.7	115,029.8
10	Uvurkhangai	31,145.1	7,469.8	24,688.2	63,303.1	48,751.4	11,764.1	39,180.6	99,696.1
11	Umnugovi	11,211.5	2,688.9	8,887.2	22,787.7	16,343.6	3,943.8	13,135.0	33,422.4
12	Sukhbaatar	14,292.0	3,427.8	11,329.0	29,048.8	21,428.3	5,170.8	17,221.5	43,820.6
13	Selenge	23,175.3	5,558.3	18,370.6	47,104.2	33,310.8	8,038.2	26,771.3	68,120.3
14	Tuv	23,336.5	5,597.0	18,498.4	47,431.8	33,756.0	8,145.6	27,129.0	69,030.6
15	Uvs	28,673.6	6,877.0	22,729.1	58,279.6	47,628.5	11,493.2	38,278.2	97,399.9
16	Khovd	24,536.4	5,884.7	19,449.6	49,870.8	38,599.7	9,314.4	31,021.8	78,936.0
17	Khuvsgul	26,094.6	6,258.5	20,684.7	53,037.7	36,575.6	8,826.0	29,395.1	74,796.8
18	Khentii	19,521.7	4,682.0	15,474.5	39,678.2	30,326.4	7,318.0	24,372.7	62,017.1
19	Darkhan-Uul	20,399.2	4,892.5	16,170.1	41,461.9	30,064.8	7,254.9	24,162.5	61,482.3
20	Ulaanbaatar	136,705.4	32,787.1	108,364.1	277,856.5	175,104.2	42,254.2	140,727.9	358,086.3
21	Orkhon	18,608.3	4,463.0	14,750.5	37,821.7	28,194.5	6,803.6	22,659.4	57,657.5
22	Govi-sumber	5,623.7	1,348.8	4,457.8	11,430.2	11,049.0	2,666.2	8,879.9	22,595.2

Source: JICA Study Team, 2001

3.3 Distribution of Traffic Zones

3.3.1 Distribution of Traffic Zones

The study area covers 22 provinces including Ulaanbaatar, and the outer study area covers neighbouring nations such as China, Russia and Kazakhstan. The Study Area can be divided into 66 traffic zones. The boundaries are borders of provinces or municipalities in the Study Area. Tuv and Khentii provinces were divided by Sum. Major road networks and geographic features are considered for the zoning. Details are shown in Table 3-3-1 and Figure 3-3-1 and Figure 3-3-2.

Table 3-3-1 Zoning System

Nation	Traffic Zone	Name	
		Province	Sum
Mongolia	1	Arkhangai	-
	2	Bayan-Ulgii	-
	3	Bayankhongor	-
	4	Bulgan	-
	5	Govi-Altai	-
	6	Dornogovi	-
	7	Dornod	
	8	Dundgovi	-
	9	Zavkhan	-
	10	Uvurkhangai	-
	11	Umnugovi	-
	12	Sukhbaatar	
	13	Selenge	-
	14	Tuv	Altanbulag
	15		Arkhust
	16		Argalant
	17		Batsumber
	18		Bayanchandmani
	19		Bayantsogt
	20		Bayankhangai
	21		Bayandelger
	22		Bayanjargalan
	23		Bayan
	24		Bayantsagaan
	25		Bayan-Unjuul
	26		Buren
	27		Bornuur
	28		Delgerkhangai
	29		Erdenesant
	30		Erdene
	31		Jargalant
	32		Lun
	33		Mungunmorit
	34		Sergelen
	35		Tseel
	36		Sumber
	37		Undurshireet
	38		Ugtaaltsaidam
	39		Ulaanbaatar
	40		Zaamar
	41	Uvs	-
	42	Khovd	-
	43	Khuvsgul	-
	44	Khentii	Batshireet
	45		Binder
	46		Bayan-Adarga
	47		Bayan-Ovoo
	48		Batnorov
	49		Bayankhutag
	50		Bayanmunkh
	51		Darkhan
	52		Delgerkhaan
	53		Dadal
	54		Galshar
	55		Jargaltkhaan
	56		Kherlen
	57		Tsenkhermandal
	58		Murun
	59		Norovlin
	60		Umnudelger
	61	Darkhan-Uul	-
	62	Orkhon	-
	63	Govi-sumber	-
Russia	64		-
China	65		-
Kazakhstan	66		-

Source: JICA Study Team, 2001.

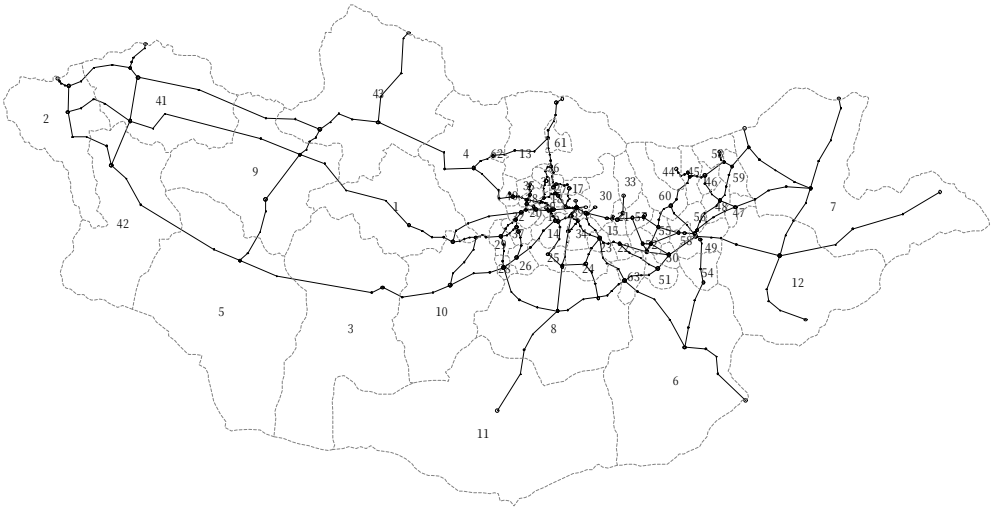


Figure 3-3-1 Zoning Map by Province

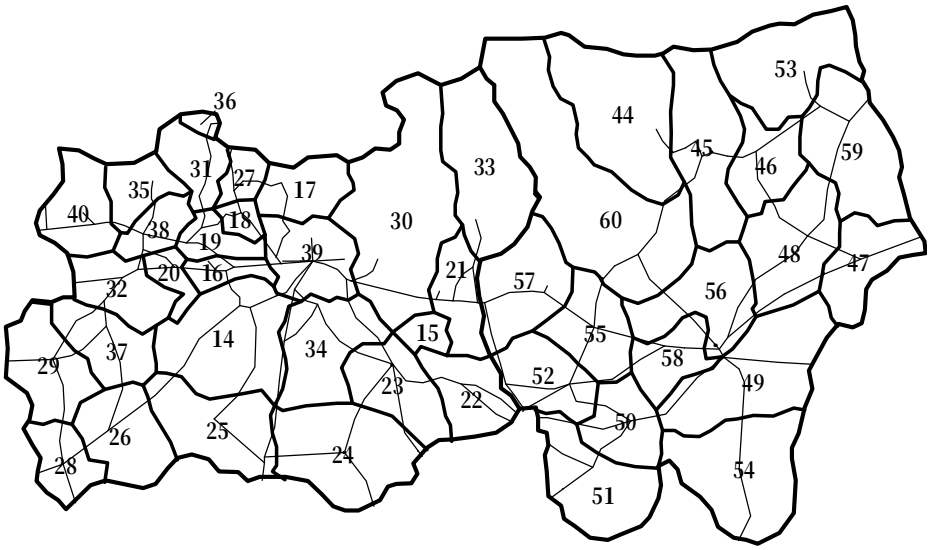


Figure 3-3-2 Zoning Map by Sum in Tuv and Khentii

3.3.2 Future Socioeconomic Frame by Traffic Zones

Socioeconomic frameworks by traffic zones in 2005, 2010 and 2015 are summarized in Table 3-3-2, 3-3-3 and 3-3-4 respectively, showing population, employed population and gross regional domestic product (GRDP).

Table 3-3-2 Future Socioeconomic Frame in 2005

Provinces & Capital City		Traffic Zones	Population	Employed Population	GRDPs (Million Tg)			
					Pri.	Sec.	Terti.	Total
Total Mongolia		**-**	**2,732,300**	**948,335**	**403,415.5**	**94,969.0**	**313,316.7**	**811,701.2**
1	Arkhangai	1	112,797	44,288	16,654.2	3,920.6	12,934.6	33,509.4
2	Bayan-Ulgii	2	99,961	33,932	14,758.9	3,474.4	11,462.7	29,696.0
3	Bayankhongor	3	101,733	41,042	15,020.6	3,536.0	11,665.9	30,222.5
4	Bulgan	4	64,847	23,839	9,574.4	2,253.9	7,436.1	19,264.4
5	Govi-Altai	5	82,041	38,678	12,113.1	2,851.6	9,407.8	24,372.5
6	Dornogovi	6	56,779	19,258	8,383.2	1,973.5	6,510.9	16,867.6
7	Dornod	7	102,420	23,080	15,122.0	3,559.9	11,744.7	30,426.6
8	Dundgovi	8	59,399	25,531	8,770.1	2,064.6	6,811.4	17,646.1
9	Zavkhan	9	131,154	60,758	19,364.5	4,558.6	15,039.6	38,962.7
10	Uvurkhangai	10	142,031	63,138	20,970.5	4,936.7	16,286.9	42,194.1
11	Umnugovi	11	54,900	23,378	8,105.8	1,908.2	6,295.5	16,309.5
12	Sukhbaatar	12	68,044	26,242	10,046.5	2,365.1	7,802.7	20,214.3
13	Selenge	13	115,095	36,543	16,993.4	4,000.4	13,198.1	34,191.9
14	Tuv	-	115,162	41,560	17,003.3	4,002.8	13,205.8	34,212.0
	Altanbulag	14	4,036	1,457	595.8	140.3	462.7	1,198.7
	Arkhust	15	2,426	876	358.1	84.3	278.1	720.5
	Argalant	16	2,323	839	342.9	80.7	266.3	690.0
	Batsumber	17	7,256	2,619	1,071.0	252.1	831.8	2,155.0
	Bayanchandmani	18	4,001	1,444	590.6	139.0	458.7	1,188.3
	Bayantsogt	19	3,304	1,192	487.7	114.8	378.8	981.3
	Bayankhangai	20	2,013	726	297.0	69.9	230.7	597.7
	Bayandelger	21	2,144	774	316.4	74.5	245.7	636.6
	Bayanjargalan	22	2,096	756	309.3	72.8	240.2	622.4
	Bayan	23	2,818	1,017	415.9	97.9	323.0	836.8
	Bayantsagaan	24	3,216	1,161	474.7	111.8	368.7	955.2
	Bayan-Unjuul	25	3,224	1,164	475.9	112.0	369.6	957.6
	Buren	26	4,211	1,520	621.5	146.3	482.7	1,250.5
	Bornuur	27	4,952	1,787	730.9	172.1	567.7	1,470.7
	Delgerkhangai	28	2,911	1,051	429.7	101.2	333.7	864.6
	Erdenesant	29	6,611	2,386	975.7	229.7	757.8	1,963.2
	Erdene	30	3,901	1,408	575.8	135.5	447.2	1,158.5
	Jargalant	31	6,887	2,486	1,016.6	239.3	789.5	2,045.4
	Lun	32	3,651	1,318	539.0	126.9	418.6	1,084.4
	Mungunmorit	33	2,495	901	368.3	86.7	286.1	741.1
	Sergelen	34	19,893	7,179	2,936.2	691.2	2,280.4	5,907.8
	Tseel	35	4,318	1,558	642.4	151.2	498.9	1,292.6
	Sumber	36	2,526	912	372.9	87.8	289.6	750.2
	Undurshireet	37	2,949	1,064	435.2	102.5	338.0	875.7
	Ugtaaltsaidam	38	4,558	1,645	672.8	158.4	522.5	1,353.7
	Ulaanbaatar	39	761,844	210,319	112,483.8	26,480.1	87,361.7	226,325.6
	Zaamar	40	6,441	2,324	950.7	223.8	738.3	1,912.8
15	Uvs	40	123,222	42,869	18,193.3	4,282.9	14,130.0	36,606.2
16	Khovd	41	111,334	42,104	16,438.2	3,869.8	12,766.9	33,074.8
17	Khuvsgul	42	132,892	51,990	19,621.1	4,619.1	15,238.9	39,479.1
18	Khentii	43	89,703	28,888	13,244.3	3,117.9	10,286.3	26,648.5
	Batshireet	44	2,927	943	432.2	101.8	335.7	869.7
	Binder	45	4,805	1,547	709.5	167.0	551.0	1,427.5
	Bayan-Adarga	46	3,008	969	444.1	104.6	345.0	893.7
	Bayan-Ovoo	47	2,178	701	321.5	75.7	249.7	646.9
	Batnorov	48	8,722	2,809	1,287.8	303.2	1,000.2	2,591.1
	Bayankhutag	49	2,767	891	408.6	96.2	317.4	822.2
	Bayanmunkh	50	2,209	711	326.2	76.8	253.3	656.3
	Darkhan	51	10,509	3,384	1,551.6	365.3	1,205.1	3,122.0
	Delgerkhaan	52	4,588	1,478	677.5	159.5	526.2	1,363.1
	Dadal	53	3,245	1,045	479.1	112.8	372.1	964.0
	Galshar	54	3,522	1,134	520.1	122.4	403.9	1,046.4
	Jargaltkhaan	55	2,588	834	382.2	90.0	296.8	769.0
	Kherlen	56	22,128	7,126	3,267.2	769.1	2,537.5	6,573.9
	Tsenkhermandal	57	2,583	832	381.4	89.8	296.3	767.5
	Murun	58	3,151	1,015	465.2	109.5	361.3	936.0
	Norovlin	59	3,605	1,161	532.3	125.3	413.5	1,071.1
	Umnudelger	60	7,166	2,308	1,058.0	249.1	821.7	2,128.8
19	Darkhan-Uul	61	98,801	32,290	14,587.6	3,434.1	11,329.6	29,351.4
20	Orkhon	62	87,667	32,692	12,943.8	3,047.1	10,053.0	26,043.9
21	Govi-sumber	63	20,432	5,917	3,016.7	710.2	2,342.9	6,069.8

Source: JICA Study Team, 2001.

Table 3-3-3 Future Socioeconomic Frame in 2010

Provinces & Capital City		Traffic Zones	Population	Employed Population	GRDPs (Million Tg)			
					Pri.	Sec.	Terti.	Total
Total Mongolia		**-**	**3,104,000**	**1,088,317**	**555,919.9**	**133,330.4**	**440,668.2**	**1,129,918.4**
1	Arkhangai	1	127,800	50,179	22,888.7	5,489.6	18,143.5	46,521.8
2	Bayan-Ulgii	2	108,000	36,661	19,342.6	4,639.1	15,332.5	39,314.2
3	Bayankhongor	3	118,400	47,766	21,205.2	5,085.8	16,809.0	43,100.0
4	Bulgan	4	67,500	24,814	12,089.1	2,899.4	9,582.8	24,571.4
5	Govi-Altai	5	101,300	47,757	18,142.6	4,351.3	14,381.3	36,875.2
6	Dornogovi	6	62,500	21,198	11,193.6	2,684.6	8,873.0	22,751.3
7	Dornod	7	132,200	29,791	23,676.7	5,678.6	18,768.1	48,123.5
8	Dundgovi	8	66,900	28,755	11,981.6	2,873.6	9,497.6	24,352.9
9	Zavkhan	9	179,500	83,154	32,148.1	7,710.3	25,483.2	65,341.6
10	Uvurkhangai	10	173,900	77,304	31,145.1	7,469.8	24,688.2	63,303.1
11	Umnugovi	11	62,600	26,656	11,211.5	2,688.9	8,887.2	22,787.7
12	Sukhbaatar	12	79,800	30,776	14,292.0	3,427.8	11,329.0	29,048.8
13	Selenge	13	129,400	41,085	23,175.3	5,558.3	18,370.6	47,104.2
14	Tuv	-	130,300	47,023	23,336.5	5,597.0	18,498.4	47,431.8
	Altanbulag	14	4,567	1,648	817.9	196.2	648.4	1,662.5
	Arkhust	15	2,745	991	491.6	117.9	389.7	999.2
	Argalant	16	2,629	949	470.8	112.9	373.2	957.0
	Batsumber	17	8,210	2,963	1,470.4	352.7	1,165.6	2,988.6
	Bayanchandmani	18	4,527	1,634	810.8	194.5	642.7	1,648.0
	Bayantsogt	19	3,738	1,349	669.5	160.6	530.7	1,360.9
	Bayankhangai	20	2,277	822	407.8	97.8	323.3	828.9
	Bayandelger	21	2,425	875	434.4	104.2	344.3	882.8
	Bayanjargalan	22	2,371	856	424.7	101.9	336.6	863.1
	Bayan	23	3,188	1,151	571.0	136.9	452.6	1,160.6
	Bayantsagaan	24	3,639	1,313	651.8	156.3	516.6	1,324.7
	Bayan-Unjuul	25	3,648	1,317	653.4	156.7	517.9	1,328.0
	Buren	26	4,764	1,719	853.3	204.6	676.4	1,734.3
	Bornuur	27	5,603	2,022	1,003.5	240.7	795.5	2,039.7
	Delgerkhangai	28	3,294	1,189	589.9	141.5	467.6	1,199.0
	Erdenesant	29	7,479	2,699	1,339.6	321.3	1,061.8	2,722.7
	Erdene	30	4,414	1,593	790.5	189.6	626.6	1,606.7
	Jargalant	31	7,793	2,812	1,395.6	334.7	1,106.3	2,836.7
	Lun	32	4,131	1,491	739.9	177.5	586.5	1,503.9
	Mungunmorit	33	2,823	1,019	505.7	121.3	400.8	1,027.8
	Sergelen	34	22,508	8,123	4,031.1	966.8	3,195.4	8,193.3
	Tseel	35	4,885	1,763	875.0	209.8	693.6	1,778.4
	Sumber	36	2,858	1,032	511.9	122.8	405.8	1,040.5
	Undurshireet	37	3,336	1,204	597.5	143.3	473.7	1,214.5
	Ugtaaltsaidam	38	5,157	1,861	923.7	221.5	732.2	1,877.3
	Ulaanbaatar	39	763,300	210,721	136,705.4	32,787.1	108,364.1	277,856.5
	Zaamar	40	7,287	2,630	1,305.2	313.0	1,034.6	2,652.8
15	Uvs	40	160,100	55,699	28,673.6	6,877.0	22,729.1	58,279.6
16	Khovd	41	137,000	51,811	24,536.4	5,884.7	19,449.6	49,870.8
17	Khuvsgul	42	145,700	57,001	26,094.6	6,258.5	20,684.7	53,037.7
18	Khentii	43	109,000	35,103	19,521.7	4,682.0	15,474.5	39,678.2
	Batshireet	44	3,557	1,146	637.1	152.8	505.0	1,294.9
	Binder	45	5,839	1,880	1,045.7	250.8	828.9	2,125.5
	Bayan-Adarga	46	3,655	1,177	654.6	157.0	518.9	1,330.6
	Bayan-Ovoo	47	2,646	852	473.9	113.7	375.7	963.2
	Batnorov	48	10,598	3,413	1,898.1	455.2	1,504.6	3,858.0
	Bayankhutag	49	3,363	1,083	602.3	144.4	477.4	1,224.1
	Bayanmunkh	50	2,684	864	480.8	115.3	381.1	977.2
	Darkhan	51	12,770	4,112	2,287.0	548.5	1,812.9	4,648.4
	Delgerkhaan	52	5,575	1,796	998.6	239.5	791.5	2,029.6
	Dadal	53	3,943	1,270	706.2	169.4	559.8	1,435.4
	Galshar	54	4,280	1,378	766.5	183.8	607.6	1,558.0
	Jargaltkhaan	55	3,145	1,013	563.3	135.1	446.5	1,145.0
	Kherlen	56	26,888	8,659	4,815.6	1,155.0	3,817.3	9,787.9
	Tsenkhermandal	57	3,139	1,011	562.2	134.8	445.7	1,142.7
	Murun	58	3,828	1,233	685.6	164.4	543.5	1,393.6
	Norovlin	59	4,381	1,411	784.6	188.2	622.0	1,594.8
	Umnudelger	60	8,707	2,804	1,559.4	374.0	1,236.1	3,169.5
19	Darkhan-Uul	61	113,900	37,225	20,399.2	4,892.5	16,170.1	41,461.9
20	Orkhon	62	103,900	38,745	18,608.3	4,463.0	14,750.5	37,821.7
21	Govi-sumber	63	31,400	9,093	5,623.7	1,348.8	4,457.8	11,430.2

Source: JICA Study Team, 2001.

Table 3-3-4 Future Socioeconomic Frame in 2015

Provinces & Capital City		Traffic Zones	Population	Employed Population	GRDPs (Million Tg)			
					Pri.	Sec.	Terti.	Total
Total Mongolia		**-**	**3,562,100**	**1,260,567**	**815,601.6**	**196,811.8**	**655,483.5**	**1,667,897.0**
1	Arkhangai	1	144,798	56,853	33,154.0	8,000.3	26,645.2	67,799.5
2	Bayan-Ulgii	2	116,686	39,609	26,717.1	6,447.1	21,472.0	54,636.2
3	Bayankhongor	3	137,797	55,592	31,551.0	7,613.5	25,356.9	64,521.4
4	Bulgan	4	70,262	25,830	16,087.6	3,882.1	12,929.3	32,899.0
5	Govi-Altai	5	125,080	58,968	28,639.1	6,910.9	23,016.7	58,566.6
6	Dornogovi	6	68,798	23,334	15,752.4	3,801.2	12,659.9	32,213.5
7	Dornod	7	170,638	38,452	39,070.5	9,428.1	31,400.2	79,898.8
8	Dundgovi	8	75,348	32,386	17,252.1	4,163.1	13,865.2	35,280.5
9	Zavkhan	9	245,667	113,807	56,249.6	13,573.5	45,206.7	115,029.8
10	Uvurkhangai	10	212,919	94,650	48,751.4	11,764.1	39,180.6	99,696.1
11	Umnugovi	11	71,380	30,395	16,343.6	3,943.8	13,135.0	33,422.4
12	Sukhbaatar	12	93,587	36,093	21,428.3	5,170.8	17,221.5	43,820.6
13	Selenge	13	145,483	46,191	33,310.8	8,038.2	26,771.3	68,120.3
14	Tuv	-	147,428	53,205	33,756.0	8,145.6	27,129.0	69,030.6
	Altanbulag	14	5,167	1,865	1,183.4	285.6	951.1	2,420.0
	Arkhust	15	3,106	1,121	711.2	171.6	571.6	1,454.5
	Argalant	16	2,974	1,073	681.2	164.4	547.4	1,393.0
	Batsumber	17	9,289	3,352	2,127.3	513.3	1,709.7	4,350.4
	Bayanchandmani	18	5,122	1,849	1,173.0	283.1	942.7	2,398.8
	Bayantsogt	19	4,230	1,526	968.7	233.7	778.5	1,980.9
	Bayankhangai	20	2,576	930	590.0	142.4	474.2	1,206.6
	Bayandelger	21	2,744	990	628.4	151.6	505.0	1,285.1
	Bayanjargalan	22	2,683	968	614.4	148.3	493.8	1,256.4
	Bayan	23	3,607	1,302	826.1	199.3	663.9	1,689.4
	Bayantsagaan	24	4,118	1,486	943.0	227.5	757.8	1,928.3
	Bayan-Unjuul	25	4,128	1,490	945.3	228.1	759.7	1,933.1
	Buren	26	5,390	1,945	1,234.5	297.9	992.1	2,524.5
	Bornuur	27	6,340	2,288	1,451.8	350.3	1,166.8	2,969.0
	Delgerkhangai	28	3,727	1,345	853.5	206.0	685.9	1,745.3
	Erdenesant	29	8,463	3,054	1,938.0	467.7	1,557.5	3,963.2
	Erdene	30	4,994	1,802	1,143.6	276.0	919.1	2,338.7
	Jargalant	31	8,817	3,182	2,019.2	487.2	1,622.8	4,129.1
	Lun	32	4,675	1,687	1,070.5	258.3	860.4	2,189.2
	Mungunmorit	33	3,195	1,153	731.6	176.5	588.0	1,496.1
	Sergelen	34	25,467	9,191	5,832.1	1,407.3	4,687.1	11,926.5
	Tseel	35	5,528	1,995	1,265.9	305.5	1,017.3	2,588.7
	Sumber	36	3,234	1,167	733.9	177.1	589.8	1,500.7
	Undurshireet	37	3,775	1,362	864.5	208.6	694.8	1,767.9
	Ugtaaltsaidam	38	5,835	2,106	1,336.3	322.5	1,074.0	2,732.7
	Ulaanbaatar	39	764,759	211,124	175,104.2	42,254.2	140,727.9	358,086.3
	Zaamar	40	8,245	2,976	1,888.3	455.7	1,517.6	3,861.5
15	Uvs	40	208,015	72,369	47,628.5	11,493.2	38,278.2	97,399.9
16	Khovd	41	168,582	63,754	38,599.7	9,314.4	31,021.8	78,936.0
17	Khuvsgul	42	159,742	62,494	36,575.6	8,826.0	29,395.1	74,796.8
18	Khentii	43	132,449	42,654	30,326.4	7,318.0	24,372.7	62,017.1
	Batshireet	44	4,322	1,392	990.1	238.9	795.7	2,024.7
	Binder	45	7,095	2,285	1,625.1	392.2	1,306.1	3,323.3
	Bayan-Adarga	46	4,442	1,430	1,017.3	245.5	817.6	2,080.5
	Bayan-Ovoo	47	3,215	1,035	736.5	177.7	591.9	1,506.1
	Batnorov	48	12,878	4,147	2,949.8	711.8	2,370.7	6,032.2
	Bayankhutag	49	4,086	1,316	935.9	225.9	752.2	1,914.0
	Bayanmunkh	50	3,262	1,050	747.1	180.3	600.5	1,527.9
	Darkhan	51	15,517	4,997	3,554.1	857.6	2,856.4	7,268.1
	Delgerkhaan	52	6,775	2,182	1,551.8	374.5	1,247.2	3,173.4
	Dadal	53	4,791	1,543	1,097.5	264.8	882.0	2,244.3
	Galshar	54	5,201	1,675	1,191.2	287.5	957.4	2,436.1
	Jargaltkhaan	55	3,822	1,231	875.4	211.2	703.6	1,790.2
	Kherlen	56	32,673	10,522	7,471.6	1,803.0	6,004.8	15,279.3
	Tsenkhermandal	57	3,815	1,228	873.7	210.8	702.2	1,786.7
	Murun	58	4,652	1,498	1,065.5	257.1	856.3	2,179.0
	Norovlin	59	5,324	1,714	1,219.4	294.2	980.0	2,493.6
	Umnudelger	60	10,580	3,407	2,423.4	584.8	1,947.6	4,955.8
19	Darkhan-Uul	61	131,307	42,913	30,064.8	7,254.9	24,162.5	61,482.3
20	Orkhon	62	123,138	45,919	28,194.5	6,803.6	22,659.4	57,657.5
21	Govi-sumber	63	48,256	13,974	11,049.0	2,666.2	8,879.9	22,595.2

Source: JICA Study Team, 2001.

3.4 Methodology for Traffic Demand Forecast

Future traffic demand forecast in this study has been carried out as illustrated in Figure 3-4-1. The basic procedure for the traffic demand forecast is summarized as follows:

(1) Formulation of Present Origin and Destination Tables (OD Tables)

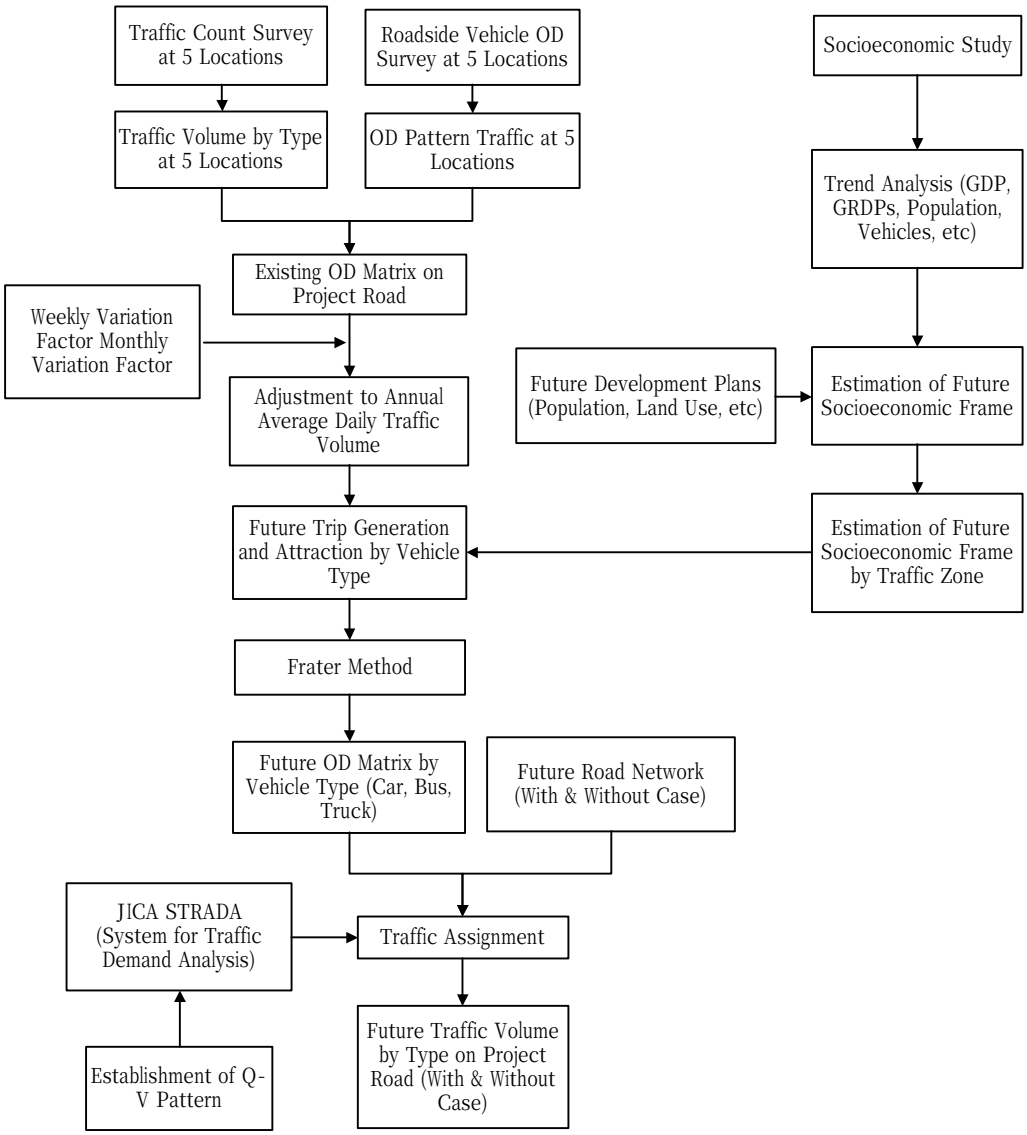
The existing Origin-Destination Matrices (hereinafter referred to 'OD Tables') by type of vehicles were made based on the traffic survey in the Study Area. In order to convert existing OD tables into the annual average daily conditions, the OD tables were adjusted by weekly variation and monthly variation factors. The traffic model analysis regarding socioeconomic indicators was executed after the adjustment of the existing OD tables. Socioeconomic indicators of population, employed population and GRDP by sector were applied to the traffic model analysis. Since the existing OD is an incomplete OD table, the effective traffic model has not been formulated in this study. Therefore, future OD tables were estimated mainly by using the socioeconomic indicators of GRDPs and population by traffic zone. Induced traffic was not estimated separately.

(2) Future OD Tables

Future OD tables will be formulated from the present OD tables and future socioeconomic indicators by traffic zone. The adjusted OD matrices were calculated by Frater's method. The future OD tables were projected for five types of vehicles: cars, buses, small trucks, medium trucks and large trucks.

(3) Traffic Assignment

Future traffic volumes were assigned upon the future road network. The future road network for assignment consists of mainly state road and local road in the Study Area. Passenger car unit (PCU) is adopted based on Table 3-4-1. The length and number of lanes for each link are specified using road information. Then, traffic variables of capacity (Q) and velocity (V) for each link were arranged in a Q-V pattern as shown in Table 3-4-2 and Figure 3-4-2. The traffic assignment was implemented using the software package 'JICA STRADA'. Future traffic volumes on the project road were forecast based on the traffic assignment results.



Source: JICA Study Team

Figure 3-4-1 General Flow Chart of Traffic Demand Forecast

Table 3-4-1 Passenger Car Unit (PCU)

Vehicle Type	Type of Terrain		
	Level	Rolling	Mountainous
Medium bus	1.5	3.0	5.0
Large bus	2.0	4.0	6.0
Small single truck	1.5	3.0	5.0
Medium single truck	2.0	4.0	6.0
Truck with trailer	2.5	5.0	8.0

Source: Feasibility Study for Erdent-Bulgan-Moron Road Project, Kuwait Fund TA No.186, 2001

Table 3-4-2 Q-V Pattern

Q-V Pattern	No. of Lanes	Topographic Condition	Possible Traffic Capacity (Q1)	Free Flow Traffic Volume (Q2)	Free Flow Speed (V1) (km/h)	Minimum Speed (V2) (km/h)	Critical Speed (V3) (km/h)
					(km/h)	(km/h)	(km/h)
1	2	Flat	19,700	12,800	40	20	10
2	2	Mountain	17,200	11,200	40	20	10
3	2	Flat	29,400	22,100	80	40	20
4	2	Hill	26,000	16,900	60	30	15

Source: JICA Study Team

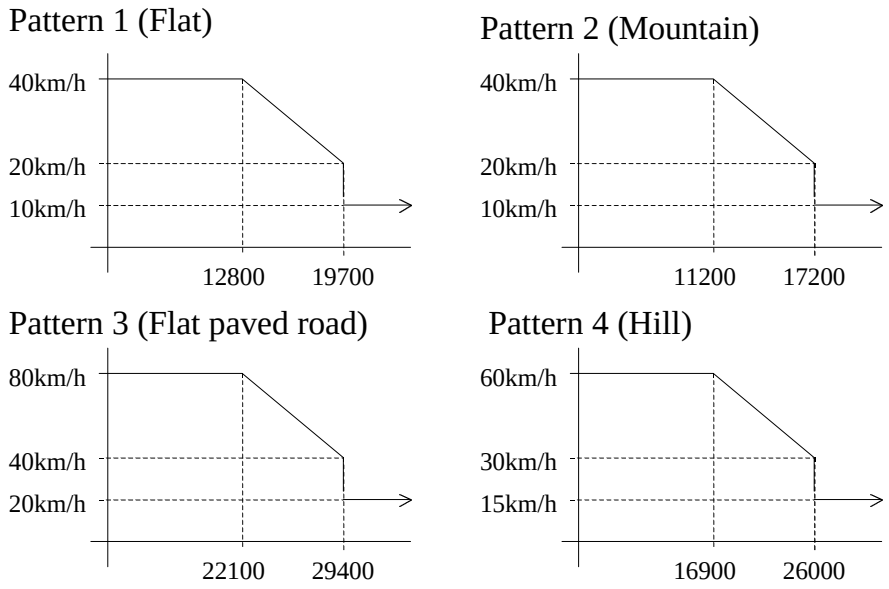


Figure 3-4-2 Q-V Curve (Traffic Volume and Velocity)

3.5 Future Traffic Demand

(1) Traffic Volume

Table 3-4-3 shows the results of the traffic demand forecast based on the future OD tables. Traffic volumes in 2005, 2010 and 2015 are projected as 453-835 vehicles/day, 656-1,063 vehicles/day and 994-1,417 vehicles/day, respectively. Figure 3-4-3 shows the desire line of traffic demand in 2015. Figure 3-4-4 (1)-(3) shows the traffic demand by 2005, 2010 and 2015.

(2) Vehicle Kilometers and Vehicle Hours

Table 3-4-4 shows the results of the vehicle kilometers and vehicle hours between the existing road and the future project road. The difference of the total vehicle

kilometers by year is as follows: existing roads in 2000 with 238,500 vehicle kilometers, and future project roads with 702,600 vehicle kilometers. While, the difference of the total vehicle hours by year is as follows: existing roads in 2000 with 5,300 vehicle hours, and future project roads in 2015 with 10,900 vehicle hours.

Table 3-4-3 Traffic Demand Forecast by Year

Year	Section	Vehicle Type (Vehicle per Day)						Passenger
		Car	Bus	Small Truck	Medium Truck	Large Truck	Total	Car Unit
2000	Erdene - Baganuur	357	155	14	123	40	689	957
	Baganuur - Jargaltkhaan	216	72	11	95	32	426	611
	Jargaltkhaan - Murun	144	57	9	82	24	316	467
	Murun - Undurkhaan	156	57	9	86	24	332	487
2005	Erdene - Baganuur	430	187	18	150	50	835	1,163
	Baganuur - Jargaltkhaan	308	113	20	140	49	630	910
	Jargaltkhaan - Murun	201	84	14	119	35	453	674
	Murun - Undurkhaan	222	84	14	125	35	480	707
2010	Erdene - Baganuur	548	237	25	188	65	1,063	1,480
	Baganuur - Jargaltkhaan	437	168	30	204	68	907	1,312
	Jargaltkhaan - Murun	286	127	21	174	48	656	976
	Murun - Undurkhaan	324	127	21	184	48	704	1,034
2015	Erdene - Baganuur	716	325	33	250	93	1,417	1,986
	Baganuur - Jargaltkhaan	640	256	41	317	98	1,352	1,965
	Jargaltkhaan - Murun	428	192	30	275	69	994	1,484
	Murun - Undurkhaan	496	192	30	289	69	1,076	1,580

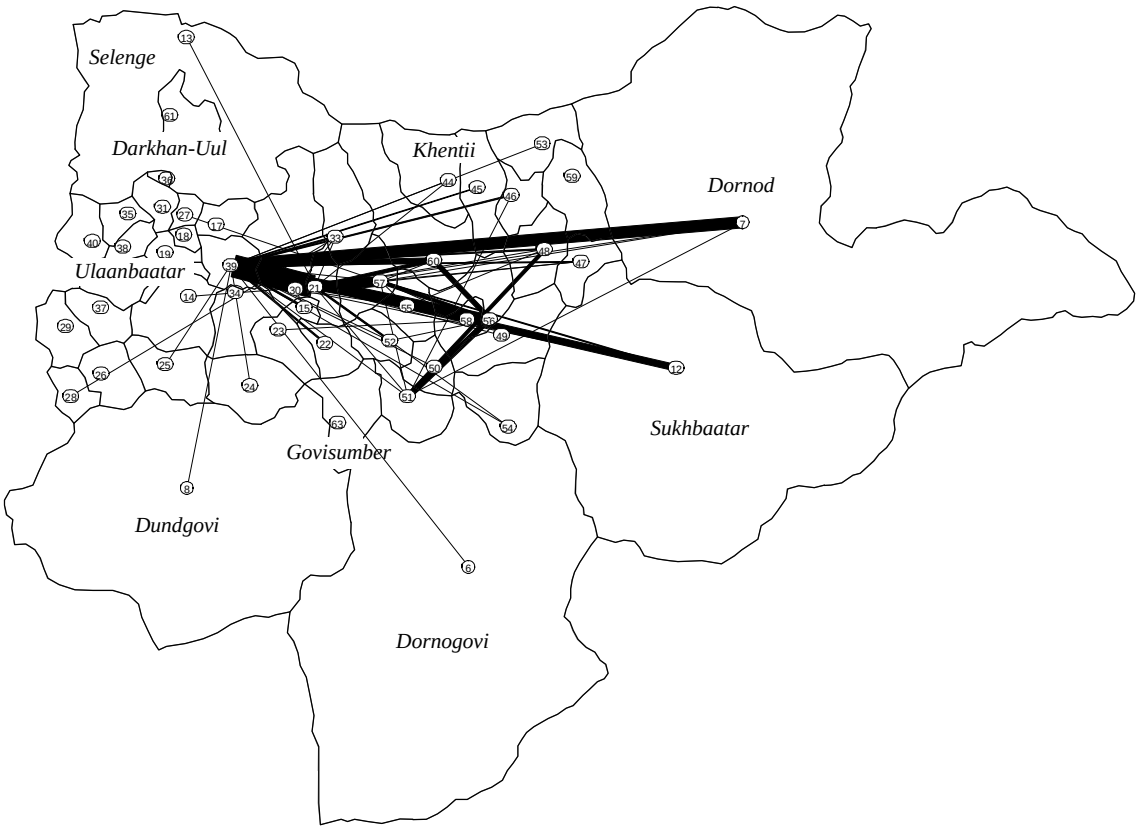


Figure 3-4-3 Desire Line of Traffic Demand in 2015

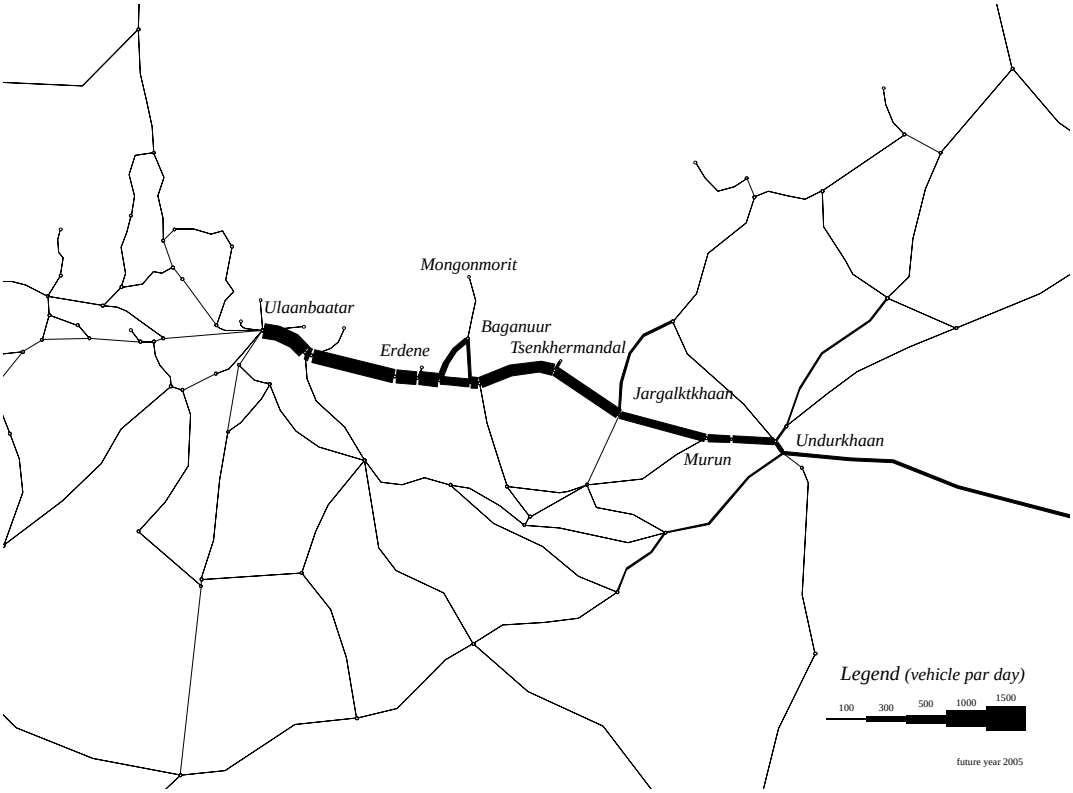


Figure 3-4-4 (1) Traffic Demand in 2005

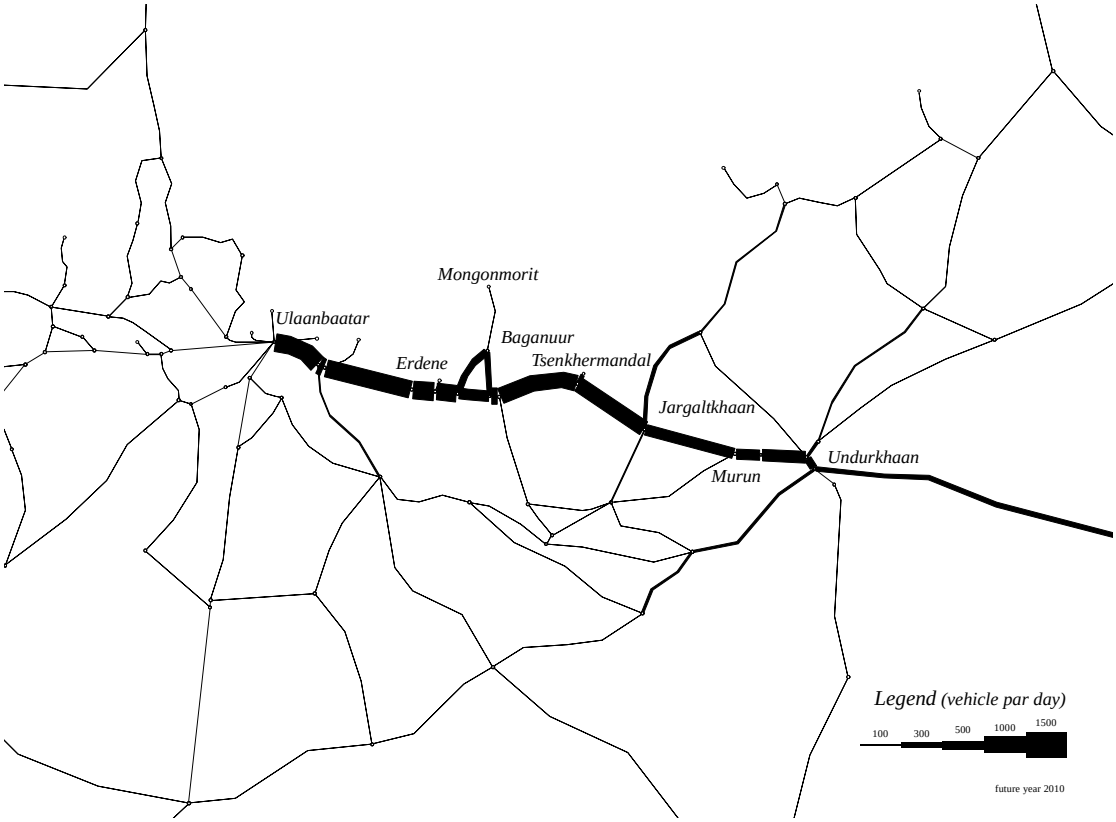


Figure 3-4-4 (2) Traffic Demand in 2010

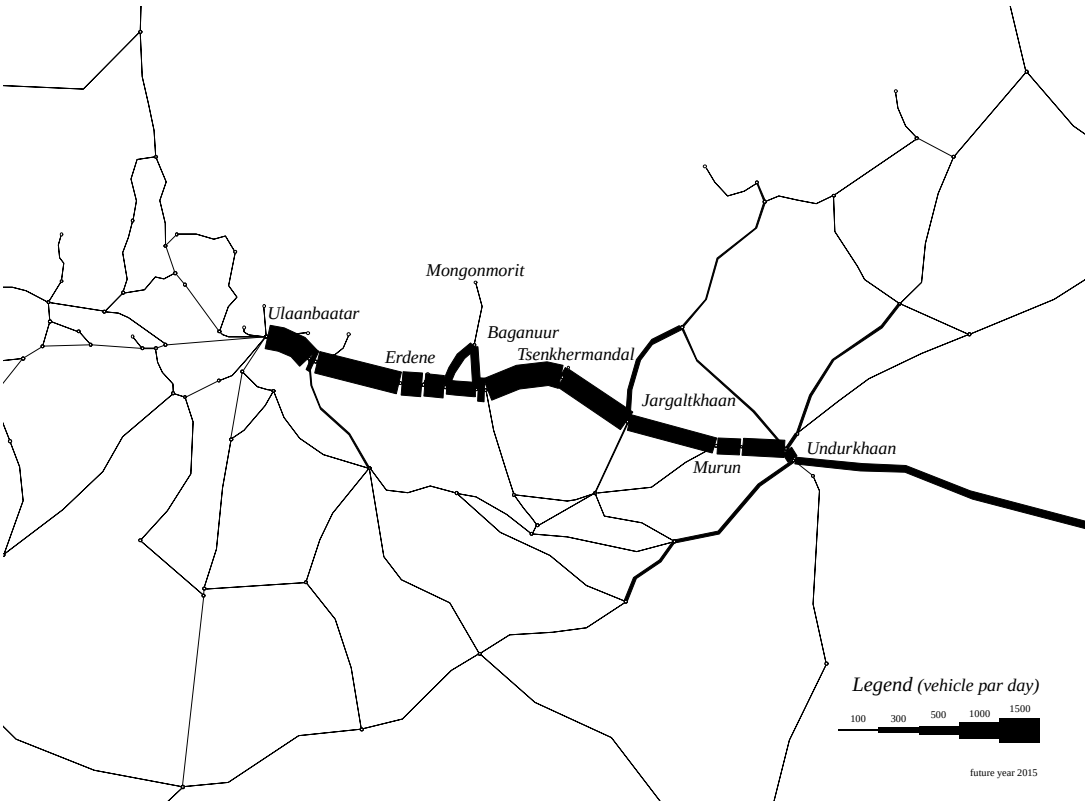


Figure 3-4-4 (3) Traffic Demand in 2015

Table 3-4-4 Vehicle Kilometers and Vehicle Hours

2000

		Vehicle Kilometers						Vehicle Hours					
		ALL	Car	Bus	S-Truck	M-Truck	L-Truck	ALL	Car	Bus	S-Truck	M-Truck	L-Truck
Section	Erdene - Baganuur	22,465	11,637	5,067	446	3,995	1,320	561.6	290.9	126.7	11.2	99.9	33.0
	Baganuur - Jargaltkhaan	19,596	9,936	3,312	506	4,370	1,472	489.9	248.4	82.8	12.7	109.3	36.8
	Jargaltkhaan - Murun	18,012	8,208	3,249	513	4,674	1,368	450.3	205.2	81.2	12.8	116.9	34.2
	Murun - Undurkhaan	21,670	10,092	3,765	603	5,602	1,608	541.8	252.3	94.1	15.1	140.1	40.2
Total Section		81743	39873	15393	2068	18641	5768	2,043.6	996.8	384.8	51.7	466.0	144.2
Whole Study Area		238,051	113,879	45,687	6,036	53,338	19,111	5,258.6	2,483.8	982.4	136.9	1,216.9	438.6

2005

		Vehicle Kilometers						Vehicle Hours					
		ALL	Car	Bus	S-Truck	M-Truck	L-Truck	ALL	Car	Bus	S-Truck	M-Truck	L-Truck
Section	Erdene - Baganuur	27,187	14,014	6,107	562	4,854	1,650	394.0	203.1	88.5	8.1	70.3	24.0
	Baganuur - Jargaltkhaan	28,980	14,168	5,198	920	6,440	2,254	362.3	177.1	65.0	11.5	80.5	28.2
	Jargaltkhaan - Murun	25,821	11,457	4,788	798	6,783	1,995	322.8	143.2	59.9	10.0	84.8	24.9
	Murun - Undurkhaan	31,026	14,034	5,574	938	8,135	2,345	387.8	175.4	69.7	11.7	101.7	29.3
Total Section		113014	53673	21667	3218	26212	8244	1,466.8	698.8	283.0	41.3	337.3	106.4
Whole Study Area		337,548	154,957	67,122	10,021	76,509	28,939	5,099.3	2,305.1	1,000.5	144.7	1,171.8	477.1

2010

		Vehicle Kilometers						Vehicle Hours					
		ALL	Car	Bus	S-Truck	M-Truck	L-Truck	ALL	Car	Bus	S-Truck	M-Truck	L-Truck
Section	Erdene - Baganuur	34,631	17,892	7,725	793	6,076	2,145	501.9	259.4	112.0	11.4	88.0	31.1
	Baganuur - Jargaltkhaan	41,722	20,102	7,728	1,380	9,384	3,128	521.5	251.3	96.6	17.3	117.3	39.1
	Jargaltkhaan - Murun	37,392	16,302	7,239	1,197	9,918	2,736	467.4	203.8	90.5	15.0	124.0	34.2
	Murun - Undurkhaan	45,194	20,188	8,455	1,407	11,928	3,216	564.9	252.4	105.7	17.6	149.1	40.2
Total Section		158939	74484	31147	4777	37306	11225	2,055.7	966.8	404.7	61.2	478.3	144.6
Whole Study Area		477,107	216,262	96,633	13,710	109,291	41,211	7,307.7	3,260.0	1,456.4	199.1	1,701.6	690.7

2015 with

		Vehicle Kilometers						Vehicle Hours					
		ALL	Car	Bus	S-Truck	M-Truck	L-Truck	ALL	Car	Bus	S-Truck	M-Truck	L-Truck
Section	Erdene - Baganuur	46,153	23,404	10,581	1,041	8,058	3,069	668.8	339.4	153.3	15.0	116.6	44.6
	Baganuur - Jargaltkhaan	62,192	29,440	11,776	1,886	14,582	4,508	777.4	368.0	147.2	23.6	182.3	56.4
	Jargaltkhaan - Murun	56,658	24,396	10,944	1,710	15,675	3,933	708.2	305.0	136.8	21.4	195.9	49.2
	Murun - Undurkhaan	68,812	30,512	12,864	2,010	18,803	4,623	860.2	381.4	160.8	25.1	235.0	57.8
Total Section		233815	107752	46165	6647	57118	16133	3,014.6	1,393.7	598.1	85.1	729.8	207.9
Whole Study Area		702,601	314,109	144,353	18,678	164,840	60,621	10,864.3	4,794.2	2,192.1	270.2	2,581.7	1,026.0

2015 with out

		Vehicle Kilometers						Vehicle Hours					
		ALL	Car	Bus	S-Truck	M-Truck	L-Truck	ALL	Car	Bus	S-Truck	M-Truck	L-Truck
Section	Erdene - Baganuur	45,328	22,942	10,449	1,041	7,827	3,069	837.4	424.4	193.0	19.0	144.0	57.0
	Baganuur - Jargaltkhaan	59,156	27,922	10,948	1,702	14,076	4,508	1,478.9	698.1	273.7	42.6	351.9	112.7
	Jargaltkhaan - Murun	55,062	23,199	10,944	1,710	15,276	3,933	1,376.6	580.0	273.6	42.8	381.9	98.3
	Murun - Undurkhaan	68,008	30,177	12,864	2,010	18,334	4,623	1,700.2	754.4	321.6	50.3	458.4	115.6
Total Section		227554	104240	45205	6463	55513	16133	5,393.1	2,456.8	1,061.9	154.6	1,336.2	383.6
Whole Study Area		675,511	306,481	134,916	18,622	157,794	57,698	15,044.1	6,736.3	2,958.8	390.4	3,622.6	1,336.1