社会開発調査部報告書

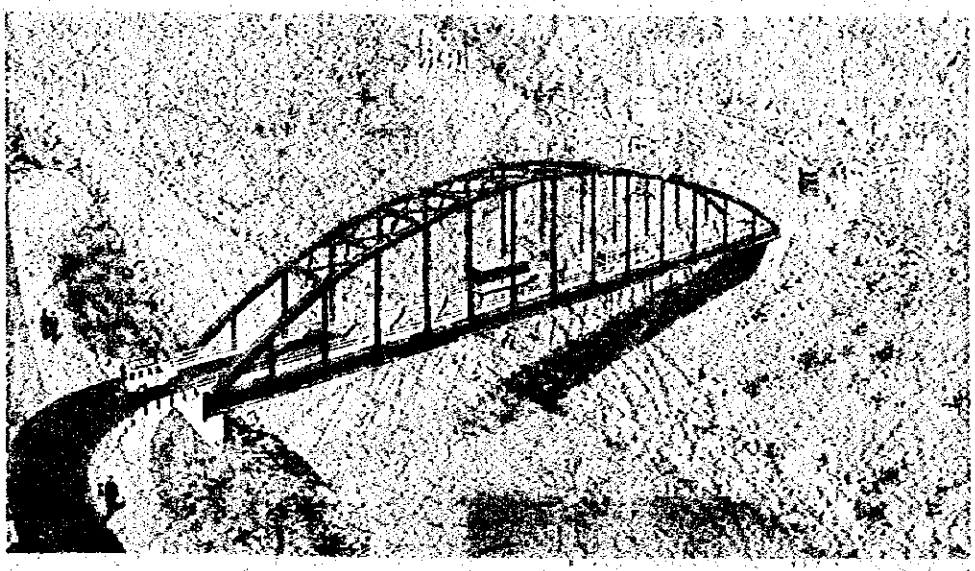
No. 2

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF COMMUNICATIONS,
THE ROYAL GOVERNMENT OF BHUTAN

THE STUDY
ON
NATIONAL HIGHWAY BRIDGE CONSTRUCTION
IN
THE KINGDOM OF BHUTAN

FINAL REPORT
VOLUME 2
MAIN TEXT



JULY 1998

PACIFIC CONSULTANTS INTERNATIONAL
HOKKAIDO ENGINEERING CONSULTANTS Co., Ltd.

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NOTE

The following exchange rate was adopted through this report.

US$ 1.00 = Nu. 38.6 (March 1998)

PREFACE

In response to a request from the Government of Bhutan the Government of Japan decided to conduct a Study, and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent a study team to Bhutan between August 1997 and June 1998. The study team was headed by Mr. Hiroyuki ENDO and composed of members of Pacific Consultants International and Hokkaido Engineering Consultants Co., Ltd.

The team held discussions with the officials concerned of the Royal Government of Bhutan, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Royal Government of Bhutan for their close cooperation extended to the team.

July 1998

Kimio Fujita
President
Japan International Cooperation Agency

July 1998

Mr. Kimio FUJITA
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

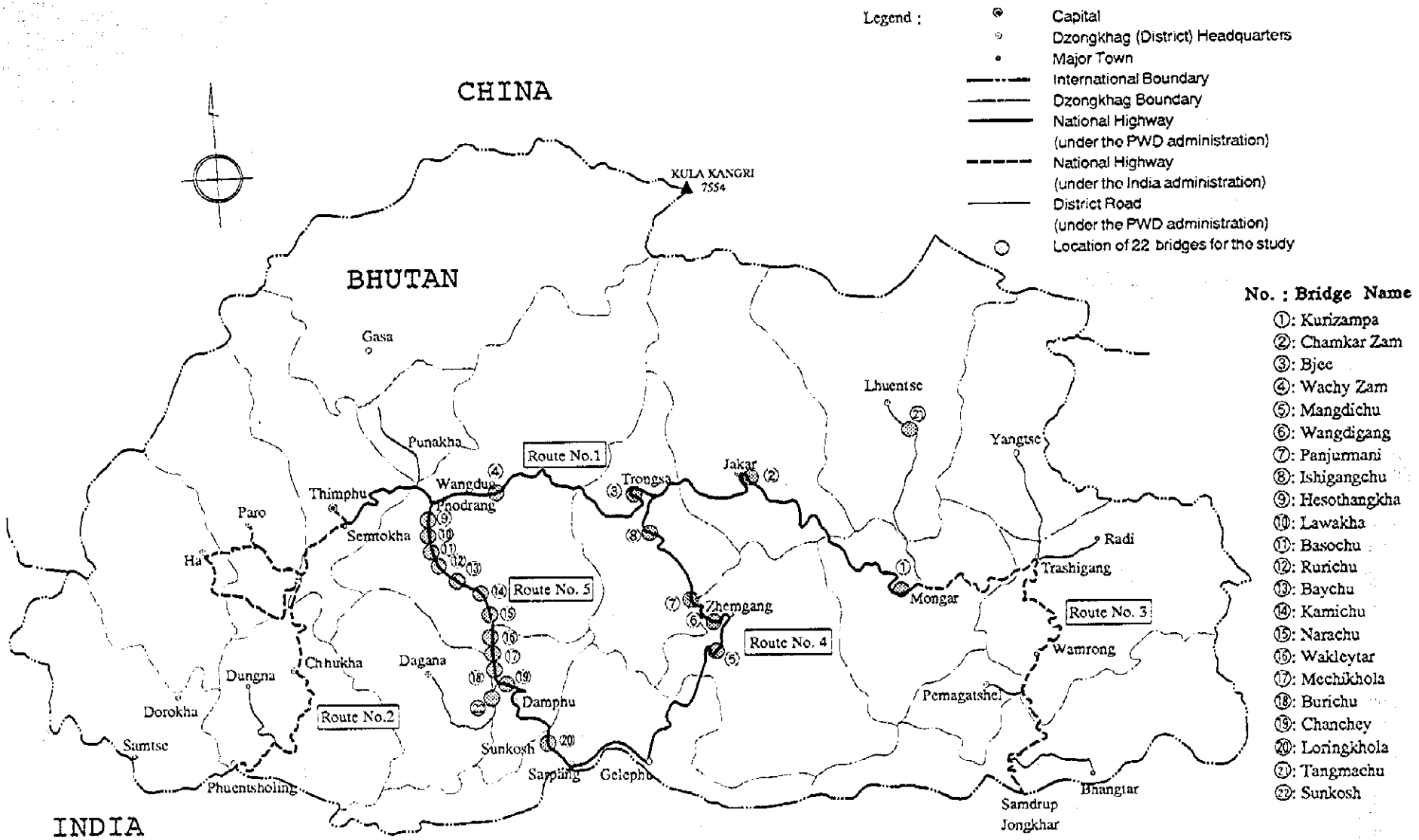
We are pleased to submit to you the report on the Study. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the comments made by the Ministry of Communications, Public Works Division and the authorities concerned in Bhutan. The report consists of three volumes; a Summary, a Main Text, and an Appendix. This report presents the Study on National Highway Bridge in the Kingdom of Bhutan.

We believe that this project will contribute greatly to upgrade the transport system in Bhutan.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Construction. We also wish to express our deep gratitude to the Ministry of Communications and the Governmental Agencies concerned in Bhutan, the Japanese Embassy in India for the close cooperation and assistance extended to us during our study. We hope this report will contribute to construct bridges.

Very truly yours,

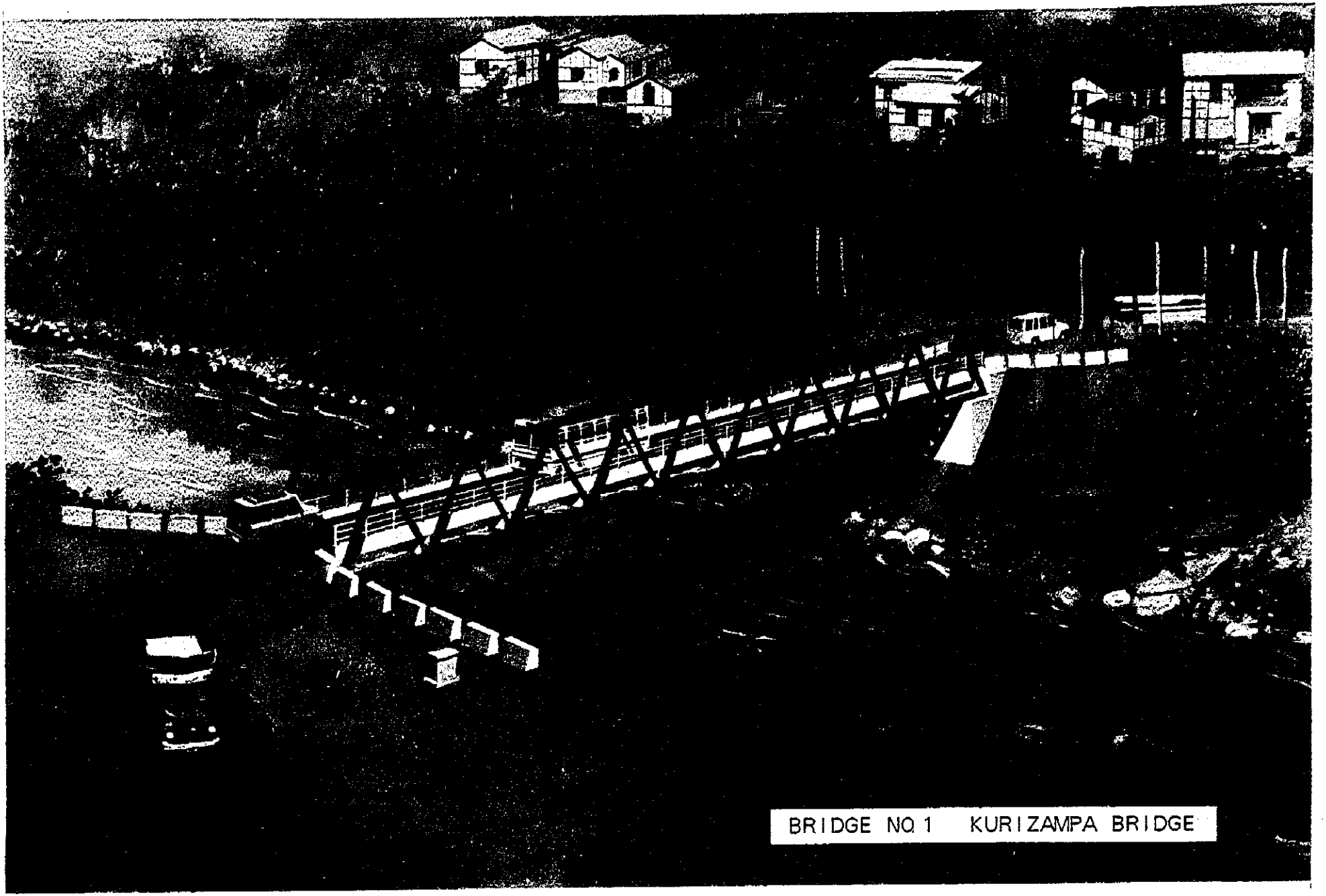
Mr. Hiroyuki Endo
Team Leader



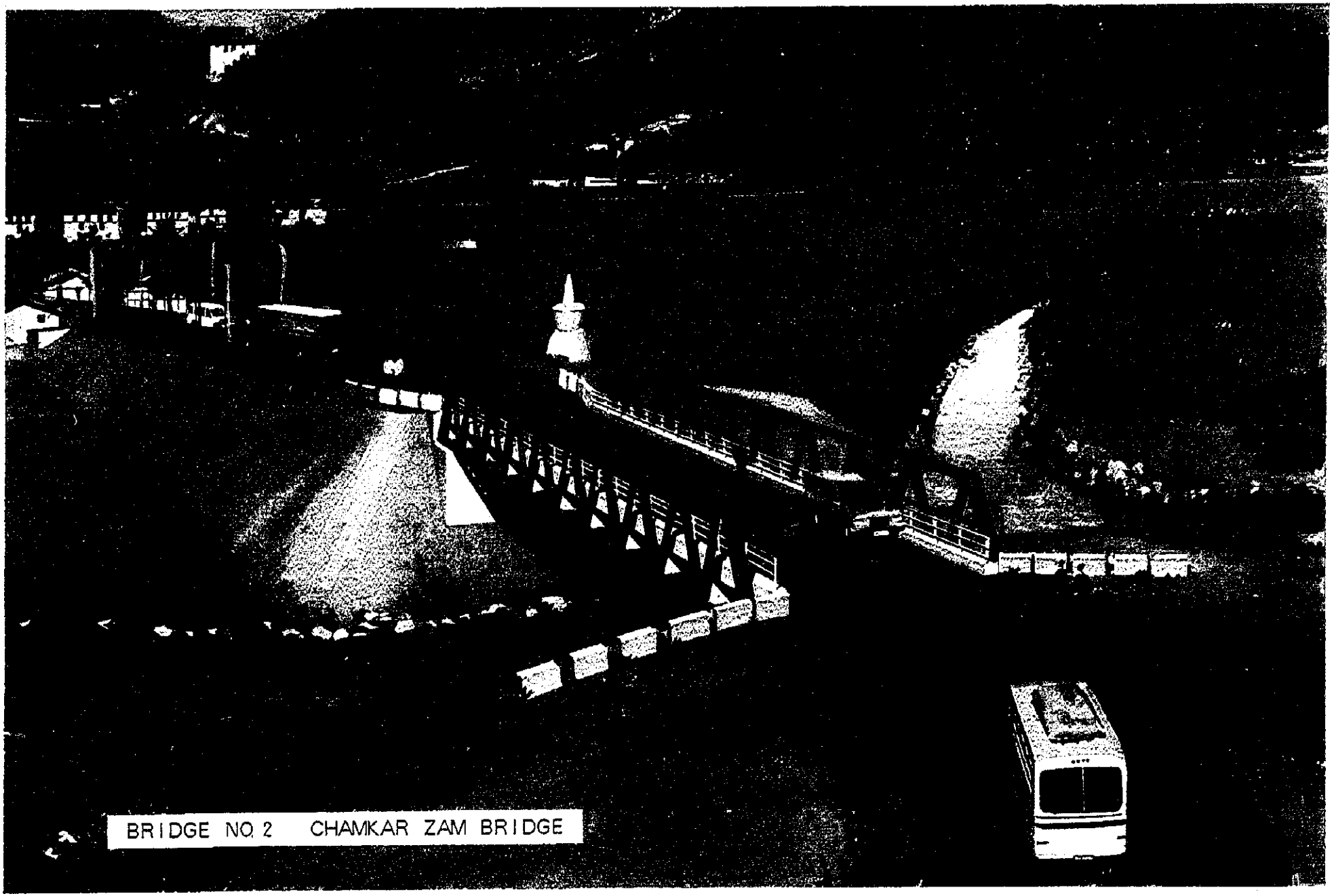
No. : Bridge Name

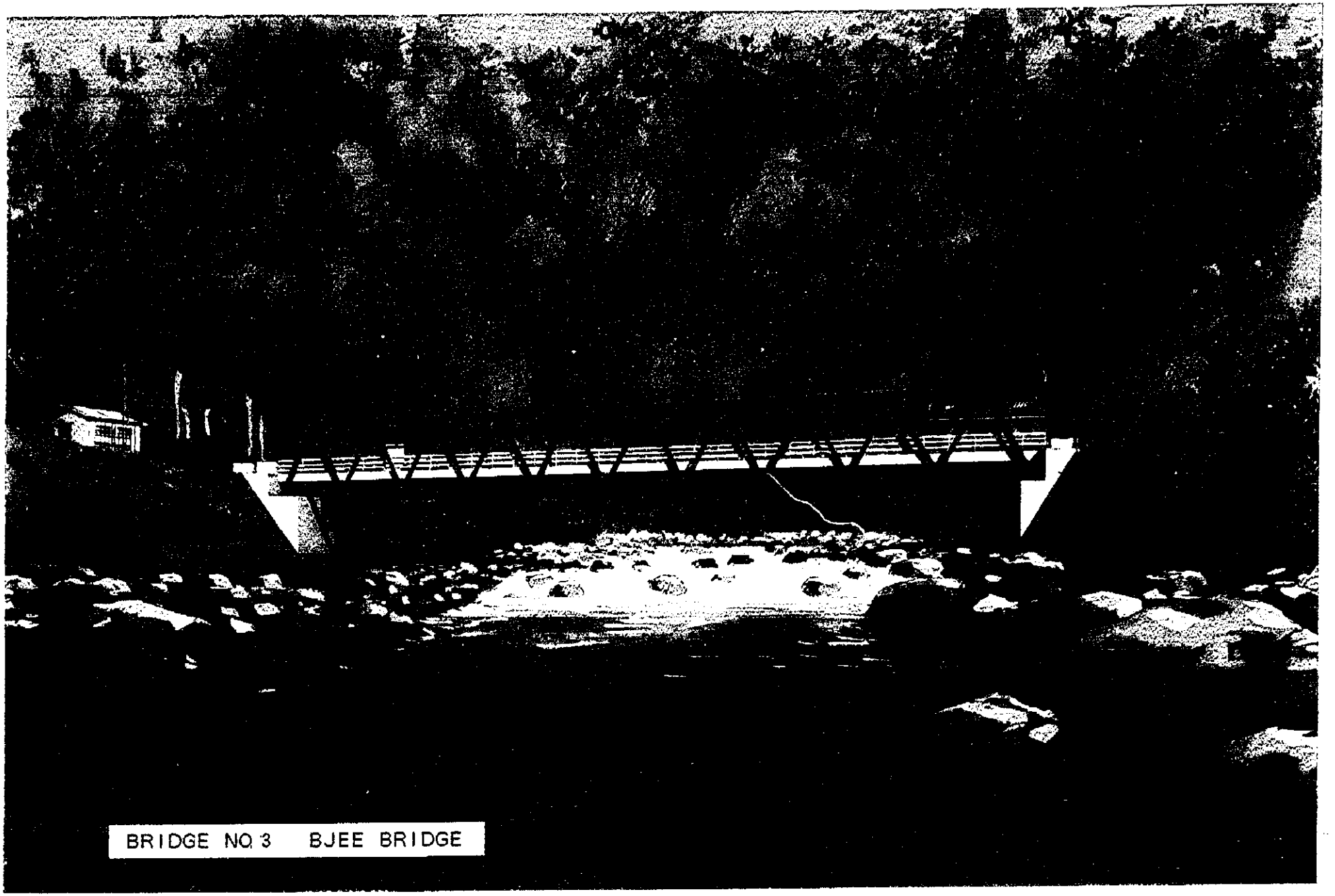
① : Kurizampa
② : Chamkar Zam
③ : Bjee
④ : Wachy Zam
⑤ : Mangdichu
⑥ : Wangdigang
⑦ : Panjurmani
⑧ : Ishigangchu
⑨ : Hesothangkha
⑩ : Lawakha
⑪ : Basochu
⑫ : Rurichu
⑬ : Baychu
⑭ : Kamichu
⑮ : Narachu
⑯ : Wakleytar
⑰ : Mechikhola
⑱ : Burichu
⑲ : Chanchey
⑳ : Loringkhola
㉑ : Tangmachu
㉒ : Sunkosh

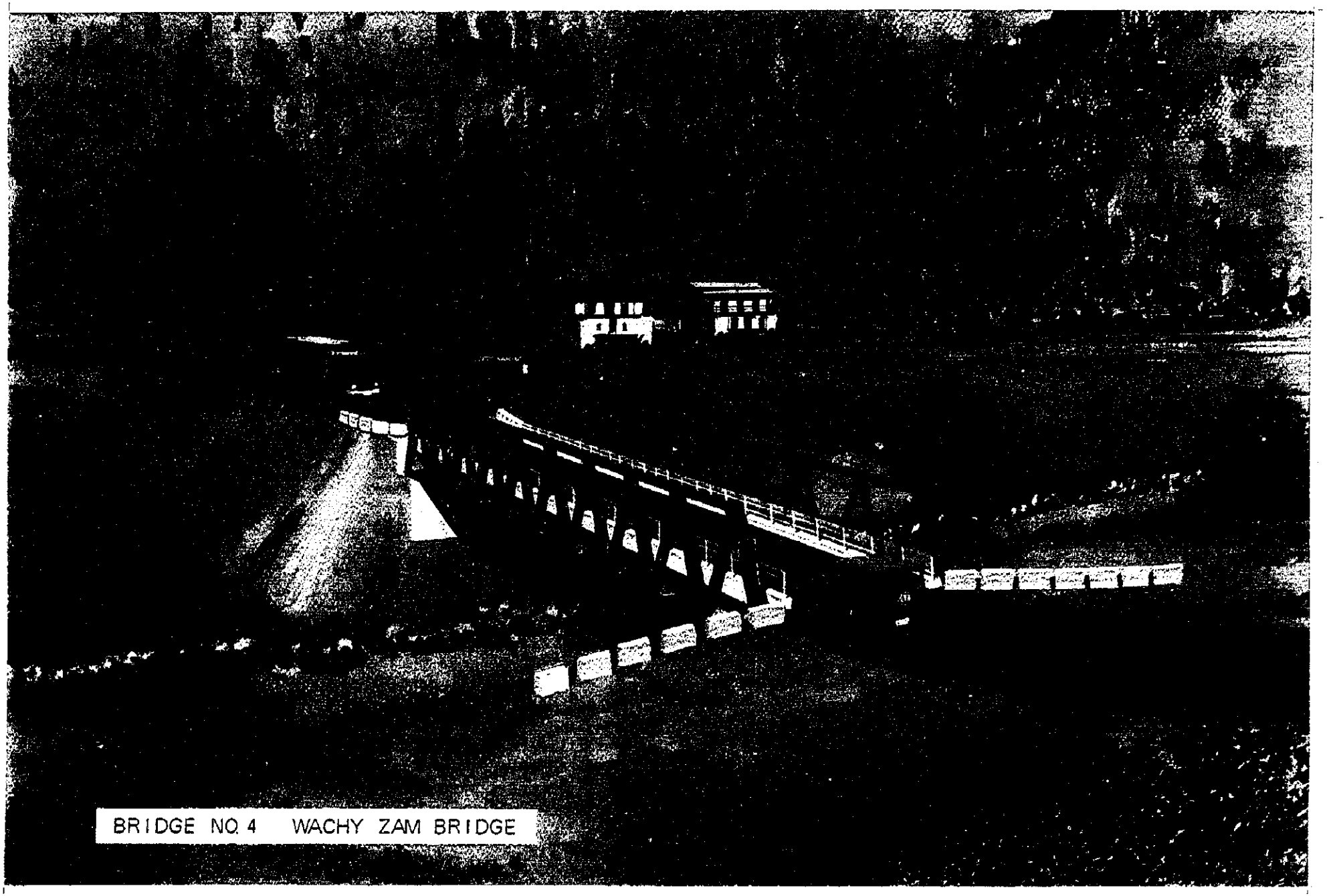
Location Map of Bridges for the Study



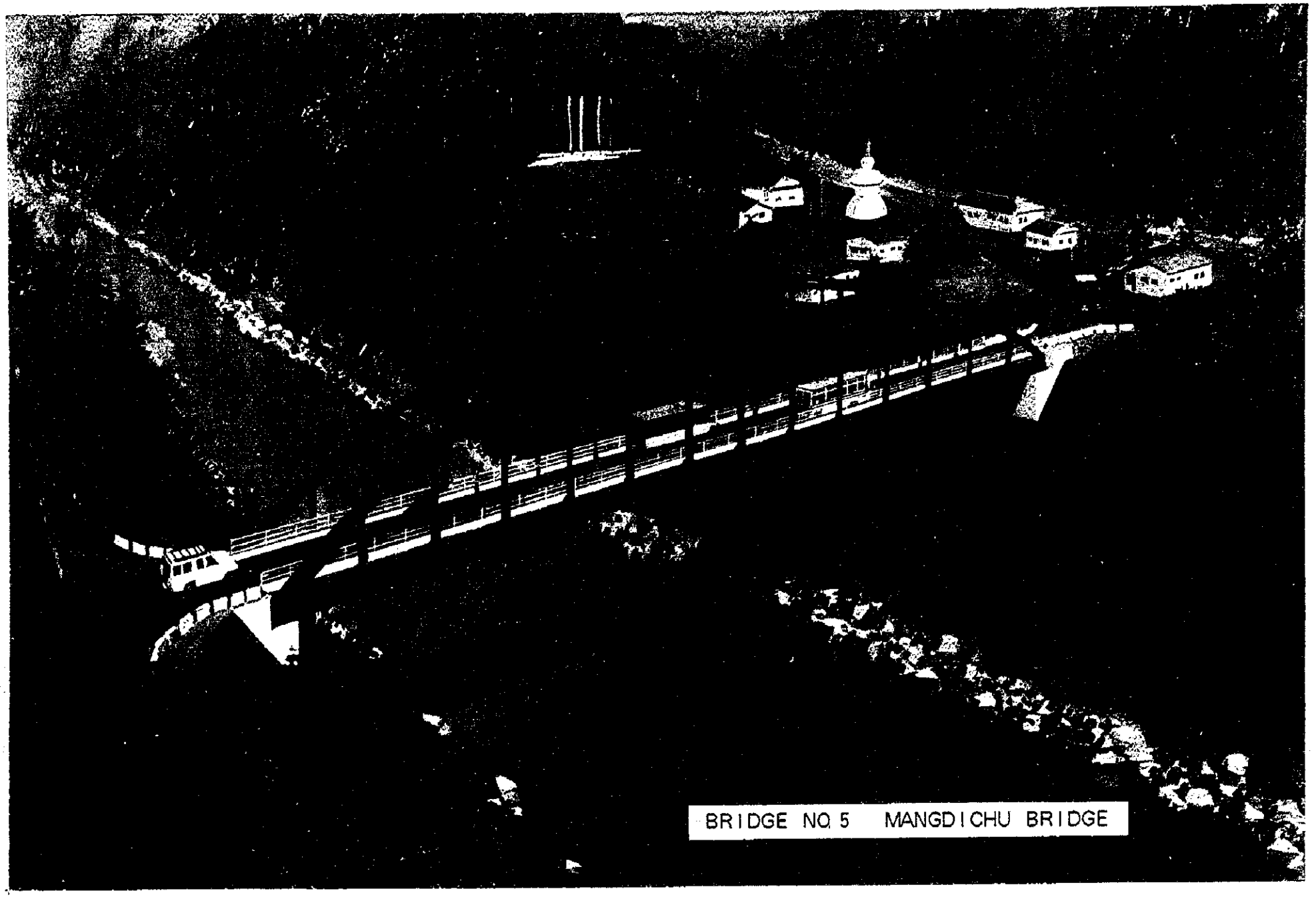
BRIDGE NO 1 KURIZAMPA BRIDGE


BRIDGE NO 2 CHAMKAR ZAM BRIDGE


BRIDGE NO 3 BJEE BRIDGE



BRIDGE NO. 4 WACHY ZAM BRIDGE



BRIDGE NO. 5 MANGDICHU BRIDGE

ABBREVIATION

AC	Asphaltic Concrete
ADB	Asian Development Bank
ADT	Average Daily Traffic Volume
AM	Ante Meridiem
ASL	Above Sea Level
BSR	Bhutan Schedule of Rate
CBR	Cost Benefit Ratio (B/C)
CBR	California Bearing Ratio
CO	Carbon Monoxide
DANTAK	A Division of the General Reserve Engineering Force of the Border Roads Organization of the Indian Army
dB	decibel
dB(A)	decibel (A-weighted)
D/D	Detailed Design
EIA	Environmental Impact Assessment
ESCAP	Economic and Social Commission for Asia and the Pacific
FT	Freight Ton
FYP	Five Year Plan
GDP	Gross Domestic Product
GH	Ground Height
HWL	High Water Level
Hz	Hertz
IEE	Initial Environmental Evaluation
IRC	The Indian Road Congress
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
JIS	Japan Industry Standards
kgf	kilogram force
kW	kilo Watt
LUPP	Land Use Planning Projects
LWL	Low Water Level
mg/L	milligram/liter
MOC	Ministry of Communications
Mpa	Mega Pascal
MT	Metric Ton

MTI	Ministry of Trade & Industry
MW	Mega-watt
NBACD	National Budget and Aid Coordination Division
NCS	Nature Conservation Section
NEC	National Environment Commission
NH Rte. No.	National Highway Route Number
No. Nos.	Number, Numbers
NOx	Nitrogen Oxide
NPV	Net Present Value
Nu.	Ngultrum
OD, O-D	Origin Destination
PC	Prestressed Concrete
PM	Post Meridiem
PWD	Public Works Division
RCM	Road Construction Manual
RGOB	Royal Government of Bhutan
RNR	Renewable Natural Resources
sp.	species
sq.	square
SV	Supervision
t	ton
TDS	Total Dissolved Solids
t/H	ton/Hour
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
Veh.	Vehicle
VOC	Vehicle Operation Cost
WFP	World Food Programs

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CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background for the Study

Bhutan is a land-locked country, and its socioeconomic development depends largely on an efficient and reliable road network. However, the lack of a well-developed transport network has been identified as one of the major constraints to the development of more remote areas of the country. Road infrastructure development has therefore been given priority in all the past five year plans.

The national highway network in Bhutan provides links between districts (Dzongkhags) and the capital, and between the district capitals. Some of the national highways carry international traffic to India, such as National Highway No. 2 (Thimphu-Phuentsholing) and National Highway No. 3 (Tashigang-Samdrup Jongkhar). These highways are narrow with winding horizontal alignments with many hairpin bends, and are prone to landslides and subsidence.

The construction and maintenance of the roads in Bhutan is technically difficult due to the fragility of the ground and the risk of landslides during the monsoon period. The terrain in which the roads are located require that they are aligned along the sides of mountainous valleys and cut into hillside, making road construction more demanding in terms of technology and finance and therefore costlier than those located in the plains.

Most of the bridges along the national highways were built as temporary structures (Bailey bridges with stone masonry substructures) and have passed their design life. Due to such conditions, the restrictions on vehicle loads become tighter each year. Within a few years they will not be passable by any form of transport, much less heavy vehicles. Therefore, it is absolutely necessary to replace them with permanent bridges in order to maintain normal road transportation.

Recently, the road network has been developed under the Seventh Five-Year Plan (1991-1996). Its objective was to construct and maintain the road network and bridges in order to facilitate efficient movement of cargo and passengers. An adequate road network in Bhutan is a prerequisite for the socioeconomic development of the country. In the Eighth Five-Year Plan (1997-2002) the programs for highway improvements and permanent bridge construction are again given high priority.

National Highway Route No. 1 is the only a trunk highway which connects the west of the country with the east, and has an important role in maintaining the well-balanced development of the country.

In taking account of these conditions, the Royal Government of Bhutan through the Public Works Division, intends to implement a Study on National Highway Bridge Replacement Project with the assistance of the Government of Japan.

1.2 Objective and Scope of Study

Objective of the Study is to carry out a feasibility study for the reconstruction of selected bridges on national highways in order to facilitate the efficient movement of cargo and passengers in the country. Scope of the Study includes:

1) Preliminary survey of 22 candidate bridges:
2) Identification of bridges which need replacement, selection of priority projects (up to five) among these bridges and implementation of a feasibility study for the priority projects
3) Technology transfer on bridge construction planning through the Study

1.3 Study Area

The study area comprises 22 bridge sites, as shown in the Location Map of Bridges for the Study.

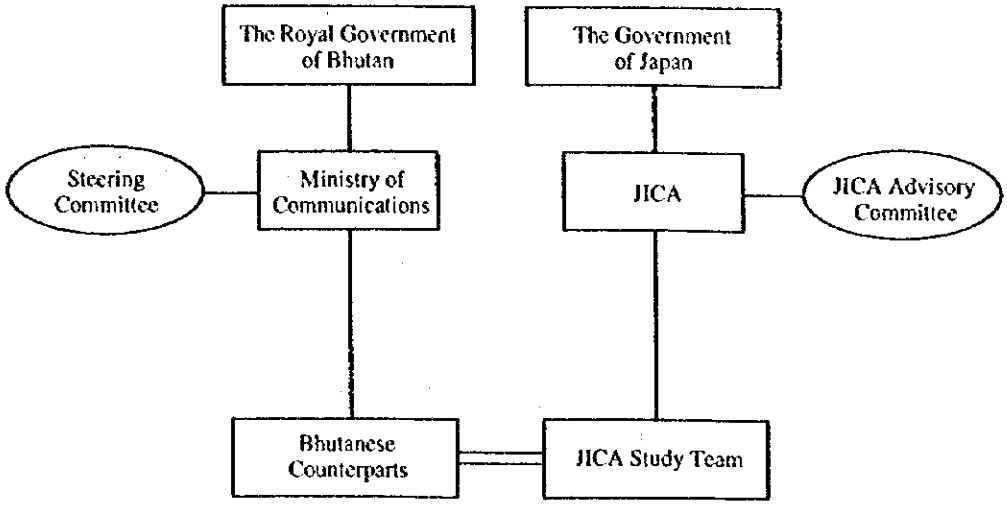
Four (4) bridges are on National Highway Route 1 (Semtokha-Tashigang, 546 km), four (4) bridges on National Highway Route 4 (Trongsa-Geylephug-Sarpang, 244 km), twelve (12) bridges on National Highway Route 5 (Wangdue-Sarpang, 187 km), one (1) bridge on district highway between Mongar-Lhuntshi, 64 km and one (1) bridge on district highway between Sunkosh and Daga, 87 km.

1.4 Study Organization and Implementation

The Study was carried out by the JICA Study Team. The Study Team was closely collaborate with the Bhutanese counterpart personnel, who are organized by the Bhutanese Government. The following committees was set up for the duration of the Study:

- Steering Committee of the Bhutanese Government, and
- JICA Advisory Committee

The Study organization is shown as follows:



The study was conducted in Japan and Bhutan from August 1997 to June 1998. Several reports were submitted to report the progress of the Study. They are the Inception Report (September 1997), Progress Report (1) (November 1997), Interim Report (December 1997), Progress Report (2) (March 1998) and the Draft Final Report (June 1998). The Draft Final Report comprises three volumes:

Volume 1 : Summary
Volume 2 : Main Text
Volume 3 : Appendix

The flow chart is shown in Figure 1.1. The chart gives the various clarification of the Study, the submission of reports and their scheduled timing, and a descriptions of the Study performed.

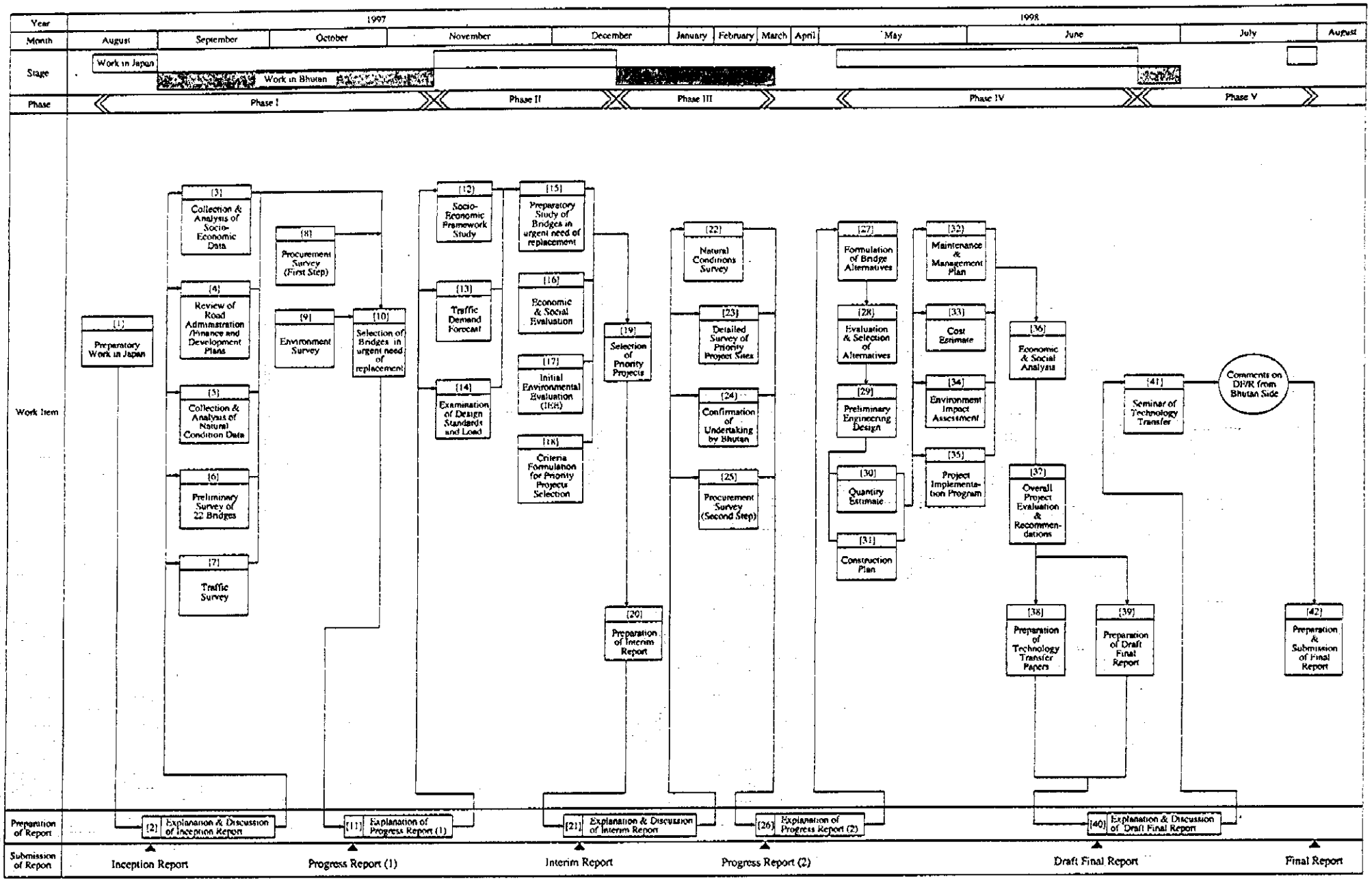


Figure 1.1 General Work Diagram

1.5 Participants of the Study

Participants of the Study are:

(1) Bhutanese Side:

- Ministry of Communications -

Dasho Leki Dorji	Deputy Minister
Dasho Dorji Tenzing	Secretary, Public Works Division (PWD)
Mr. Tshering Dorji	Director, PWD
Mr. Phuntsho Wangdi	Superintending Engineer, PWD
Mr. Sangay Tenzin	Executive Engineer, PWD
Mr. Migma Dorji	Superintending Engineer, PWD
Mr. Kunzang Wangdi	Superintending Engineer, Design and Planning Cell, PWD
Mr. Bachu Phub Dorji	Sr. Planning Officer, Policy and Planning Division
Mr. Karma Tenzin	Technical Officer, PWD

- Ministry of Finance -

Mr. Pema Chewang	Senior Programme Officer, National Budget and Aid Coordination Division (NBACD)
Mr. Nim Dorji	Senior Programme Officer, National Budget and Aid Coordination Division (NBACD)

- Ministry of Trade and Industry -

Mr. Dorji Wangda	Head, Division of Geology and Mines

- National Environment Commission -

Mr. Karma C Nyedrup	Head, EIA Division, NEC
Mr. Nedup Tshering	EIA Officer, NEC

- Survey of Bhutan -

Mr. Choeki Khorlo	Superintending Engineer, Topographical Division

(2) Japanese Side:

- JICA Advisory Committee Member -

Mr. Minoru Arita	Leader of Committee Member
Mr. Shouichi Yamashita	Committee Member

- JICA Headquarter -	
Mr. Keiichi Okitsu	Coordinator
- JICA India Office -	
Mr. Hidekazu Kumano	Resident Representative
Mr. Toshiaki Tanaka	Deputy Resident Representative
- JICA/JOCV Bhutan Office -	
Mr. Seiji Komatsu	Resident Representative
Ms. Kayo Torii	Associate Specialist
Mr. Hiroyuki Ueda	Coordinator
- JICA Study Team -	
Mr. Hiroyuki Endo	Team Leader/Bridge Planner
Mr. Tsutomu Kudo	Transport Analyst/Economist
Mr. Yasuo Furukawa	Bridge Designer
Mr. Takenobu Suzuki	Natural Condition/Environment Specialist
Mr. Akihiko Kitayama	Topographic/Geotechnical Surveyor
Mr. Kazuo Mizukoshi	Construction Planner/Cost Estimator

CHAPTER 2
SOCIOECONOMIC CONDITIONS

CHAPTER 2 SOCIOECONOMIC CONDITIONS

2.1 Current Socioeconomic Conditions

2.1.1 Social Conditions

(1) Physical Characteristics

The Kingdom of Bhutan covers an approximate area of 46,500 Km^2: roughly 150 Km north to south and 300 Km east to west. The terrain is among the most rugged and mountainous in the world, as most of the country includes part of the Himalayan ranges. The land rises from an elevation of about 100 m above sea level in the south to more than 7,550 m above sea level in the north. The variations in climate are correspondingly extreme.

(2) History

The history of Bhutan is known only from the 7th century onwards. Bhutan has been an independent nation throughout its history. However, it was not until the 17th century that Shabdrung Ngawang Namgyal (1594-1652) unified the country into one state, and brought Bhutan under one rule. He established a theocracy in 1652 and gave Bhutan an administrative system and a code of law. The theocracy established by Shabdrung ended in 1907 when Ugyen Wangchuk (1862-1926) was elected as the first king of Bhutan by popular consensus. Since the establishment of the monarchy in 1907, there have been four hereditary kings.

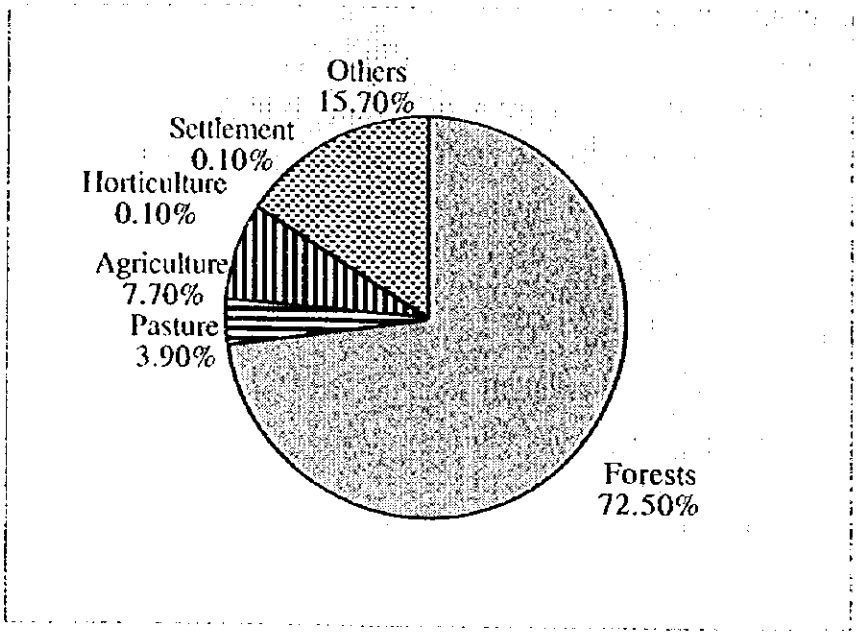
Bhutan was fairly isolated from the outside world until the 1960s when the third King opened links with other countries and initiated the development of a modern economy. His Majesty the late King introduced many social, legal and constitutional reforms, which have produced far-reaching effects.

(3) Religion

Buddhism was introduced in Bhutan in the 7th century by Guru Padma Sambhava. The majority of the Bhutanese are Buddhists. Hinduism is another religion, practiced particularly in Southern Bhutan. Buddhism has a significant influence on the values of the Bhutanese and has shaped institutions, organizations, arts, drama, architecture, literature and the social structure. Bhutan's culture, as in other societies, is continually adapting itself in the face of development.

(4) Land Use

The conditions of land use in Bhutan show that forest accounts for over 72% of land area (64.4% forest tree cover, and 8.1% scrub forest), while cultivated areas account for 7.8%, pasture areas for 3.9% and non-agricultural areas for 15.8% (0.1% settlement areas, and 15.7% others). In the arable areas, virtually all accessible and moderately sloped land is being utilized. Around 18% of farm households own less than one hectare(ha). Households with insufficient land of their own enter into tenancy contracts and sharecropping arrangements to get additional land for food production.



Source : Statistical Yearbook of Bhutan 1994

Figure 2.1 Composition of Land Use in 1994

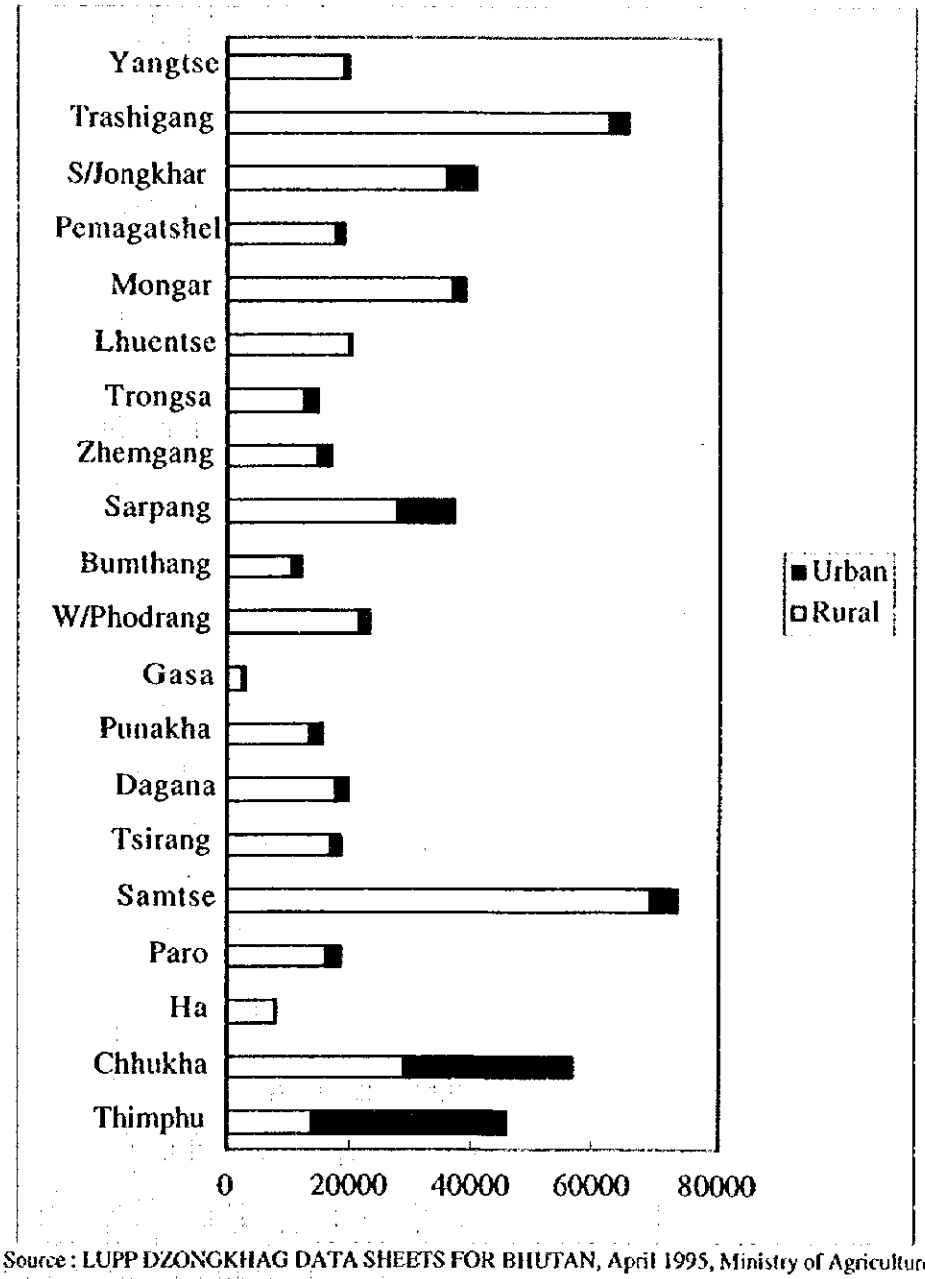
(5) Population

Bhutan is one of the least populated countries in South Asia. Most of the population is concentrated in the valleys, while large areas at higher altitudes in the north of the country are virtually empty except for nomadic herders. Most Bhutanese still live in villages in an extended family system or maintain strong links with their rural families.

Population censuses were undertaken in Bhutan in 1969 and 1980. In Bhutan, the vital registration system does not currently provide the full coverage of births and deaths, and so it has been necessary to carry out a special sample survey (in 1984) to obtain the important demographic information. From the census in 1980, the population of Bhutan was estimated at 1,165,000. At present, however, it is officially estimated at 600,000 in 1996.

The number of houses per village varies from 2 to 100 with an average of 43. Thimphu in Western Bhutan is the capital with an estimated population of 30,000 - 40,000. The other main urban settlements are Gelephu, Phuntsholing and Samdrup Jongkhar, all of them in the south. Towns are developing in all the 20 dzongkhag (district) headquarters.

Population distribution by dzongkhag in 1995 is as shown in Figure 2.2 and Figure 2.3. The dzonkhags with higher population distribution ratio are Samtse (12.9%), Chhukha (10.0%) and Thimphu(8.0%) in the western part of Bhutan, and Trashigang(11.6%), Samdrup Jongkhar(7.2%) and Mongar(6.9%) in the east.



Source : LUPP DZONGKHAG DATA SHEETS FOR BHUTAN, April 1995, Ministry of Agriculture

Figure 2.2 Estimated Urban and Rural Population by Dzongkhag in 1995

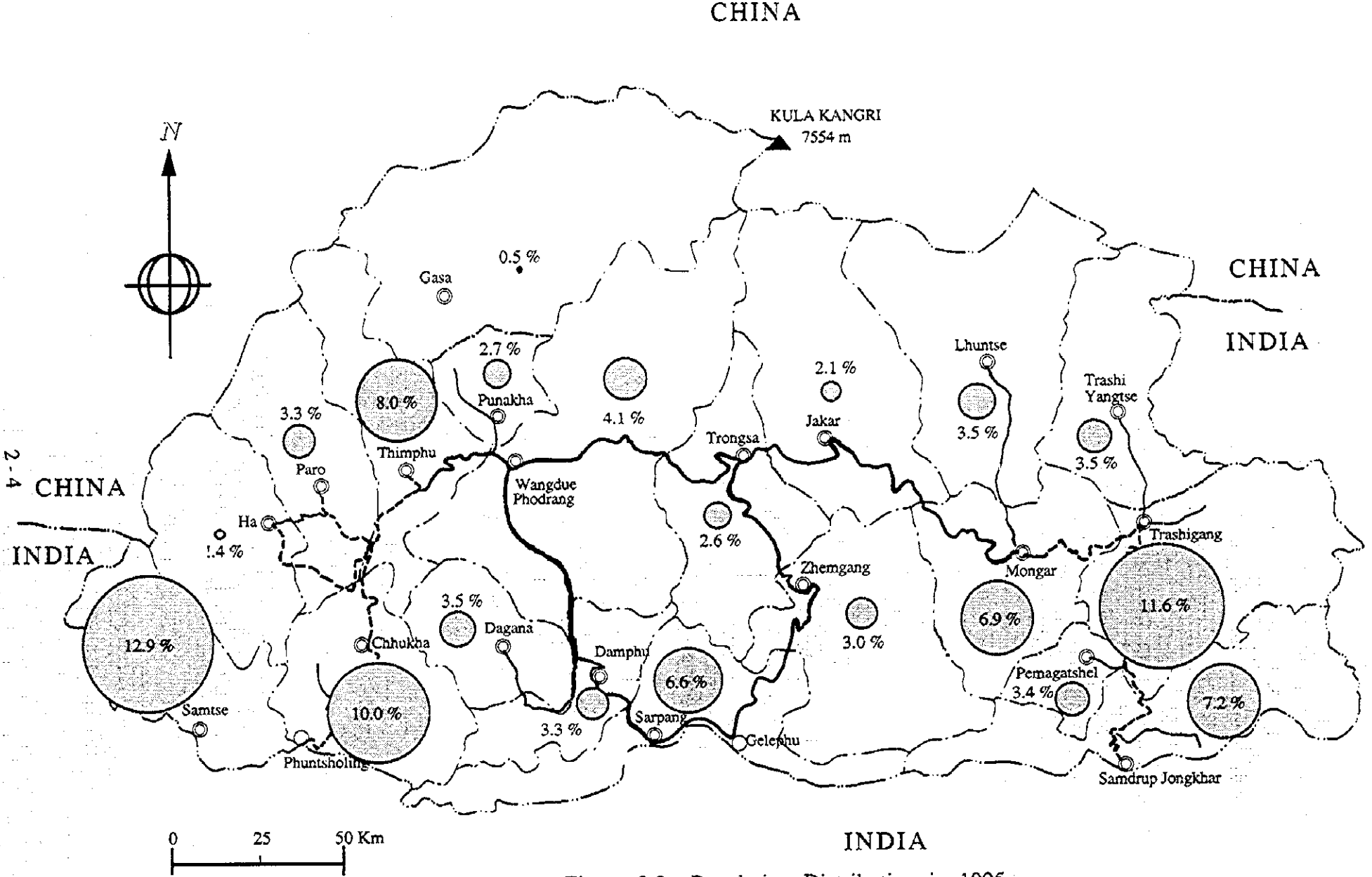


Figure 2.3 Population Distribution in 1995

(6) Employment

Although significant economic progress has taken place since the 1960s, the majority of the population remain dependent on agriculture for income and employment. At present, 85% of the population derive their living from agriculture and other traditional activities in the rural sector. By 1995, Bhutan had achieved 65% self-sufficiency in food grains.

Employment in the modern sectors of the economy is limited, apart from public services of various kinds, and small-scale trade in the urban areas. Industrial development is as yet limited and does not provide significant employment. The Government has been responsible for the establishment of several productive enterprises, and the private sector is being encouraged to take over these activities. Unlike many other developing counties, unemployment is not yet a major problem. The working population of Bhutan is estimated at 336,000 in 1997.

2.1.2 Economic Conditions

(1) Outline of Economic Activities

1) Agriculture

Bhutan is predominantly an agricultural country with agriculture being the main subsistence occupation of the majority of Bhutanese people. For this reason, the programs to increase and improve both the quantity and quality of agricultural products and for the country to achieve self sufficiency in food grains and to have a marketable surpluses for sale, are of paramount importance in government planning.

Bhutan's mountainous environment produces a wide range of agro-climate conditions, reflecting differences in soil, rainfall, temperature and slope. This allows a considerable variety of different crops to be grown. Crop production, livestock and forestry activities are closely interrelated and interdependent. Agriculture derives organic material, fuel, timber, feed, bedding materials and other basic resources from the forest. Livestock provides the draft power and organic nutrients required for food production and in turn utilize feed and fodder from crops. The forests provide over 90% of domestic fuel in the rural areas as well as the timber used in rural housing and farm buildings. They are also a source of supplementary food supplies in the form of edible roots, tubers, fungi and leaves of certain plants. Lemon grass, other essential oils and medical herb provide a significant source of cash income to some rural communities.

The main crop production in Bhutan (see Table 2.1) is of rice and maize, which are the principal food crops. The production of rice, maize and wheat increased greatly from 1988 to 1995. Moreover, the crops which production volumes was better in 1995 are as follows; 107,877 tons for rice, 77,031 tons for orange, 75,380 tons for maize and 43,325 tons for potato. The main producing districts for rice are Wandue Phodrang, Punakha and Samtse, those for orange are Sarpang and Samtse, and those for maize are Trashigang, Dagana and Sarpang.

Table 2.1 Production of Major Crops by Dzongkhag

(Unit : Tons)

Dzongkhag	1988				1995			
	Rice	Wheat	Maize	Total	Rice	Wheat	Maize	Total
Thimphu	1850	260	10	2120	4869	607	56	5532
Chhukha	950	220	680	1850	5474	543	1807	7824
Ha	80	230	40	350	338	399	223	960
Paro	2400	650	n.a	n.a	8194	1435	145	9774
Samtse	5740	130	2490	8360	9680	326	6447	16453
Tsirang	4510	170	2910	7590	4749	453	5029	10231
Dagana	1070	40	890	2000	5999	177	8715	14891
Punakha	4290	230	60	4580	11745	755	116	12616
Gasa	-	-	-	-	326	74	2	402
Wandgdhu Phodrang	n.a	n.a	n.a	n.a	13744	1212	152	15108
Bumthang	0	150	20	170	0	572	20	592
Sarpang	7120	400	2650	10170	8141	357	8184	16682
Zhemgang	900	150	1250	2300	3845	576	3905	8326
Trongsa	820	180	270	1270	5239	347	964	6550
Lhuentse	1640	170	2480	4290	4662	331	2586	7579
Mongar	470	60	4530	5060	2071	457	7465	9993
Pemagatshel	110	100	920	1130	104	337	3148	3589
Samdrup Jongkhar	2910	30	2650	5590	5722	384	7846	13952
Trashigang	4930	460	9230	14620	6580	1183	14842	22605
Yangtse	-	-	-	-	6395	222	3728	10345
Total	43140	4080	31130	78350	107877	10747	75380	194004

Source : Statistical Yearbook of Bhutan 1990, 1994

For livestock production, cattle predominate and are owned by 90% of the households. Meat and livestock products are mostly retained for home consumption and consequently marketed surpluses are small. Cattle have a crucial role in the farming system as providers of draft power and manure.

Forest products consist of timber and firewood supplied to domestic markets and the export of sawed timber and unsawed logs to India. In recent years, there has been a downward trend of forest production reflecting the Government's concern to place forest utilization on a sustainable basis.

The agricultural sector has continued to contribute a significant positive trade balance. Imports, primarily of rice, wheat, livestock products and edible oils are more than offset by exports mainly of cardamom, oranges, apples, timber and logs.

2) Mining and quarrying

Due to lack of adequate geological information, lack of expertise and the Government's policy of sustainable use of resources and environmental conservation, the mining and quarrying sector's contribution to economical activities in Bhutan is negligible.

Bhutan has significant deposits of a number of mineral resources, such as limestone, coal, graphite, gypsum, slate and dolomite. Most mining activities are limited to relatively small operations, mainly in the mining of dolomite, gypsum, limestone, slate, coal, marbles, quartzite and talc.

3) Manufacturing industry

The manufacturing industry is dominated by a small number of major operations such as the Penden Cement Authority Ltd., Bhutan Board Products Ltd. and Bhutan Carbide and Chemicals Ltd. which is the first chemical plant established in 1988. Besides Bhutan Agro Industries Ltd., there are a number of other small manufacturing plants concentrated in the food processing sector.

4) Construction

The share of the construction sector to GDP was high during the period 1983-84 as numerous major construction works were undertaken such as the Chhukha Power Project. After completion of the Chuukha Power Project, no major projects were undertaken and its contribution to GDP declined and remained low until the early 1990s. The contribution of this sector increased since 1992 with the starting of major projects such as Kurichu and Basochu power projects, expansion of Penden Cement Plant, Punakha Dzong renovation, Telecommunications, Flood protection at Punakha, Thimphu and Phuntsholing Sewerage projects, etc. The share of this sector is expected to increase in the 8th Five Year Plan (8FYP) with the start of some major projects such as Dungsum Cement Plant, Tala Hydro Power Project, etc.

5) Wholesale and retail trade, restaurants and hotels

Although the share of these sectors to GDP have increased over the years, these sectors experienced one of the slowest growth rates during the decade. This low growth was due to slow growth of service industries. Further, to avoid unwanted side effects of the excess influx of tourists in the country, the Government adopted a policy

of high value low volume tourism, restricting the number of tourists by charging a high tariff.

6) Transport and communications

This sector experienced one of the most rapid growth rates during the decade. The achievement of this sector was the outcome of the Government's act of privatizing the bus services in the 1980s for efficient management and better return on investment. With the purchase of an additional aircraft in the air sector and with the setting up of a satellite communication system, further growth is expected.

(2) Gross Domestic Product (GDP)

Gross domestic product (GDP) reflects the end result of all economic activities that has taken place in an economy during an accounting period. GDP represents the money value of all goods and services that have been produced within the territorial limits of the country and are available for final uses such as consumption, gross capital formation and net exports.

During the decade (1985-95), the Bhutanese economy experienced a growth rate of 6.8% per annum, doubling the real GDP to Nu. 2,946 m. from Nu. 1,519.8 m. This was largely due to the commissioning of Chhukha Power Project in 1987/88 and its forward linkages to other sectors, particularly manufacturing.

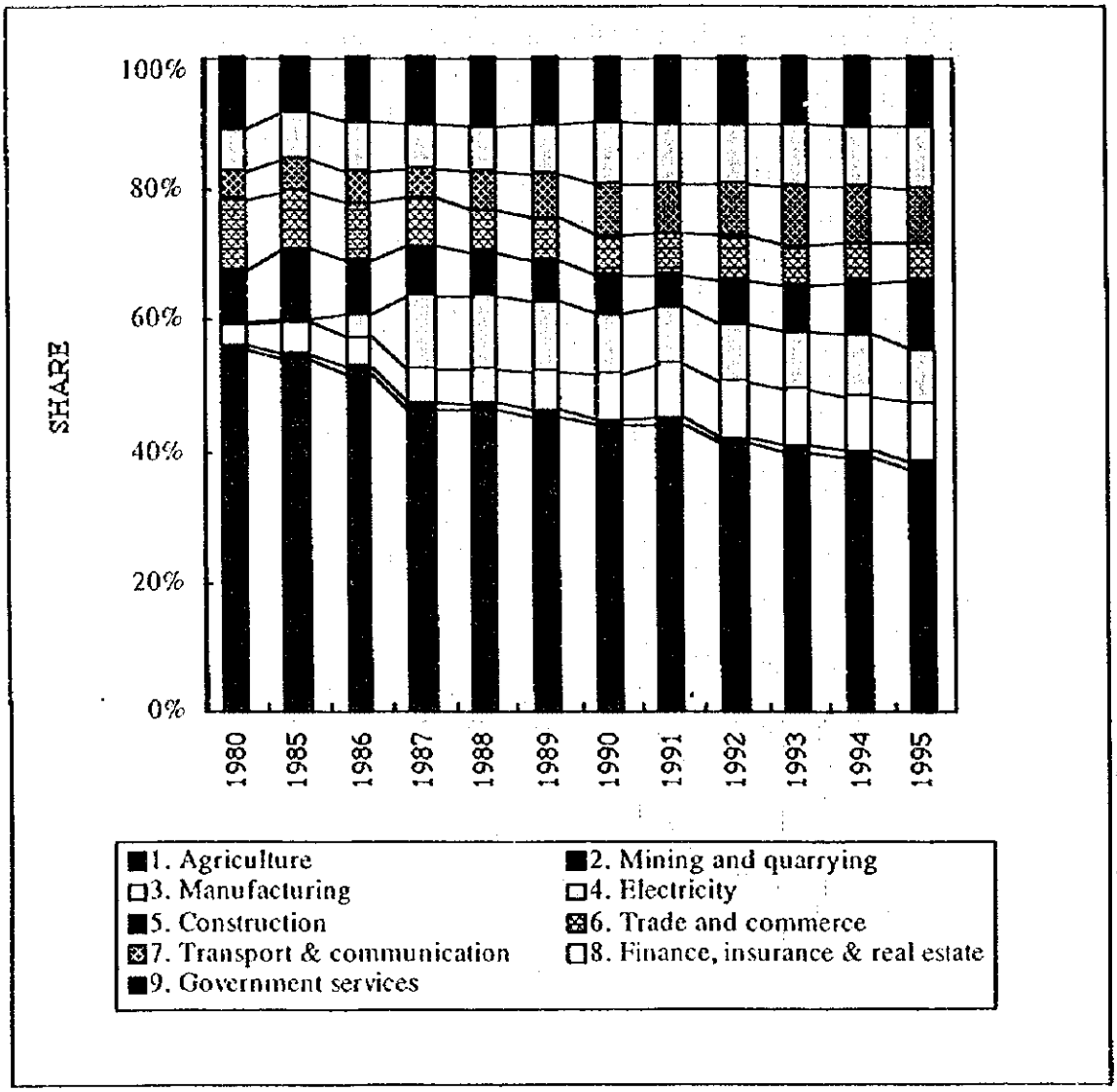
As mentioned above, the Bhutanese economy is still dominated by agriculture and the vast majority of Bhutanese depend on agriculture for their livelihood. During the decade, nevertheless, the composition of GDP changed substantially with agriculture sector's share declining from 55% to 38%, while the contribution of modern sectors like manufacturing, electricity, transport & communication increased significantly (see Table 2.2 and Figure 2.4).

Table 2.2 Gross Domestic Product (GDP) by Sector in 1980 Prices

(Unit : Millions Nu.)

Sector	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995(Proj.)
1. Agriculture	621.4	833.9	881.0	925.8	939.7	962.9	992.8	1,024.6	1,004.0	1,040.2	1,081.2	1119
1.1 Agricultural proper	309.9	411.6	436.3	458.1	485.6	514.7	530.9	544.8	555.6	563.9	578.7	601
1.2 Livestock production	139.2	168.6	177.4	184.5	191.5	201.7	212.2	221.3	201.6	226.1	227.6	246
1.3 Forestry and logging	172.3	253.7	267.3	283.2	262.6	246.5	249.7	258.5	246.8	250.2	274.9	271
2. Mining and quarrying	6.8	12.6	22.2	21.6	19.0	21.7	19.3	27.4	23.5	26.2	32.7	38
3. Manufacturing	35.8	75.4	71.0	105.0	110.3	129.2	158.1	186.7	208.8	218.9	233.0	268
4. Electricity	2.5	6.0	60.4	229.0	225.1	222.3	204.1	200.4	210.0	232.0	258.8	245
5. Construction	88.5	169.0	141.8	152.3	129.0	136.2	136.8	116.2	168.5	178.0	221.5	317
6. Trade and commerce	121.5	132.4	143.4	142.4	129.2	133.6	134.7	145.1	160.7	163.8	170.2	178
7. Transport & communication	47.9	79.4	83.9	91.3	122.1	142.4	172.1	182.0	192.3	234.6	241.5	242
8. Finance, insurance & real estate	70.4	110.1	126.2	135.7	141.0	162.9	212.2	208.8	215.4	238.1	245.4	281
9. Government services	120.4	126.0	168.6	200.0	210.0	217.0	223.3	233.2	251.6	266.5	293.0	322
Less: Imputed bank service charges	-20.0	-25.0	-24.0	-30.0	-31.8	-41.1	-28.8	-21.0	-28.1	-45.0	-61.2	-63
Gross domestic product	1,095.0	1,519.8	1,674.5	1,973.1	1,993.6	2,087.1	2,224.6	2,303.4	2,406.6	2,553.3	2,716.1	2946
Annual growth rate (%)	-	3.7	10.2	17.8	1.0	4.7	6.6	3.5	4.5	6.1	6.4	8.5

Source : Statistical Yearbook of Bhutan 1994
Eighth Five Year Plan (1997-2002) Vol. I Main Document



Source : Statistical Yearbook of Bhutan 1994
Eighth Five Year Plan (1997 - 2002) Vol.1 Main Document

Figure 2.4 Change of GDP Share by Sector

2.1.3 Transport Conditions

(1) Transport System

Bhutan's total road network measures about 3,200 Km (as of 1996) and the main routes consists of an east-west highway and four north-south highways. The road network connects all dzongkhags (districts) and 16 dungkhags (sub-districts) (see Figure 2.5). Major towns and villages are also connected by motor roads. However, some areas can only be reached by mule tracks, foot trails and pedestrian suspension bridges. Although horses are the main animals of burden, yaks and oxen are also used for transportation in some parts of Bhutan.

A bus transport system, which is the public transport service in Bhutan, connects main towns and villages throughout country. The vehicles used for bus services are large buses, medium buses(coaster) and trucks. Taxi transport as another public transport service is beginning to develop in Bhutan.

The only airport, at Paro, is in regular use. The national airline, Druk Air, provides services to Yangon, Dhaka, Kathmandu, Delhi, Calcutta and Bangkok.

Table 2.3 Length of Roads by Type

(Unit : Km)

Type of Road	1990	1991	1992	1993	1994
National Highway	1,453	1,489	1,491	1,527	1,527
District Roads	496	443	443	443	443
Feeder Roads	387	487	427	598	1,067
Black topped	1,801	1,913	1,897	1,914	1,981
National	1,399	1,419	1,404	1,418	1,467
District	256	351	299	299	299
Feeder	146	143	193	197	215
Non-black topped	535	506	565	654	1,056
National	54	70	87	109	60
District	240	92	144	144	144
Feeder	241	344	334	401	852
All Roads	2,336	2,419	2,462	2,568	3,037

Source : Statistical Yearbook in Bhutan 1994

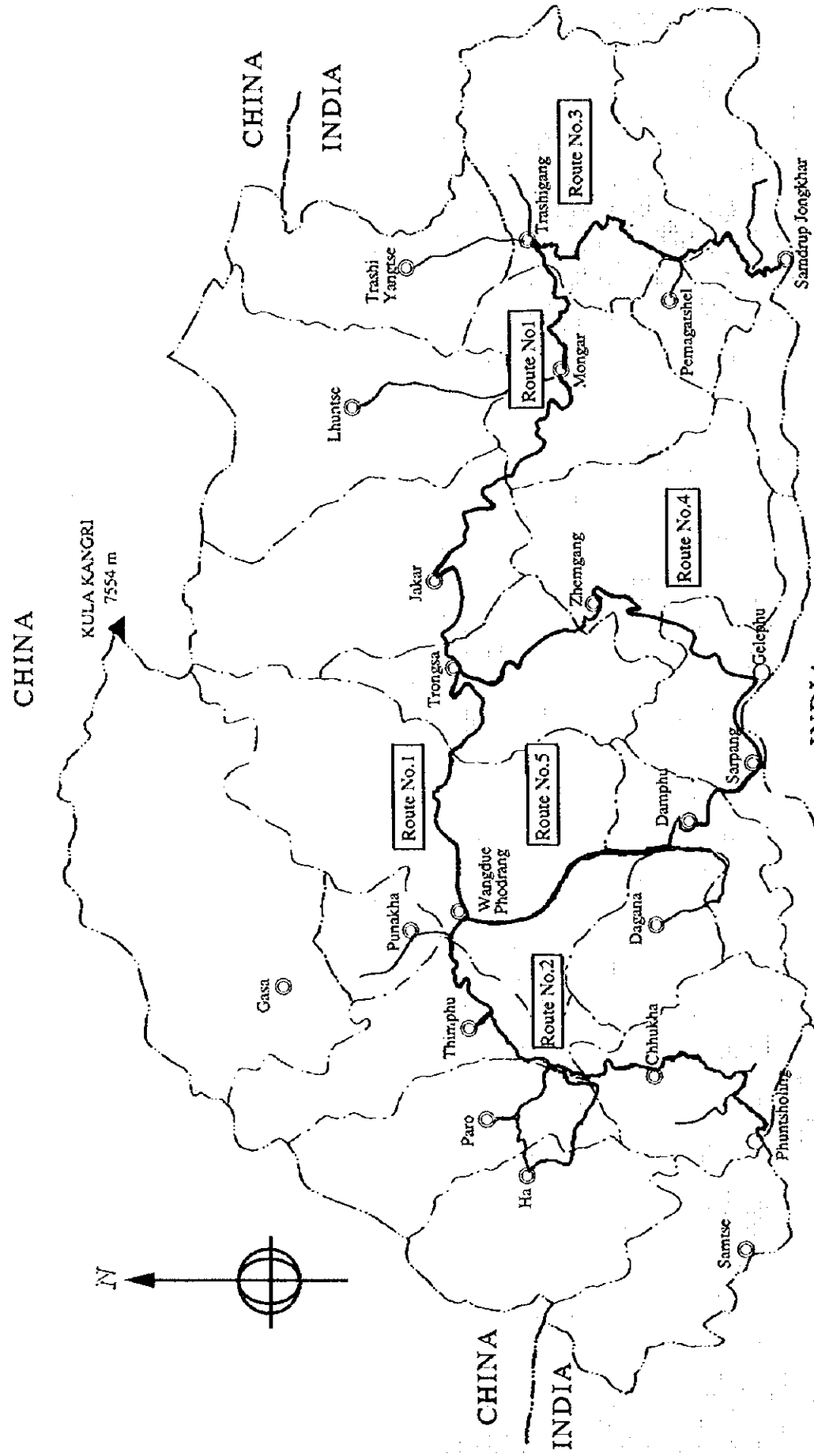


Figure 2.5 Trunk Road Network in Bhutan

(2) Vehicle Ownership, Traffic Volumes and Traffic Accidents

(Vehicle Ownership)

The changes in the number of registered vehicles from 1980 to 1997 are shown in Table 2.4. It can be seen from the table that although the number of registered vehicles increased smoothly until 1992, a decrease occurred from 1993 to 1994. This reason is attributed to changes in the definition of registration system since 1993 which registers only vehicles in running condition. The growth of number of registered vehicles between 1980 and 1997 is 18.4 times with an estimated annual growth rate of 18.7%.

The total number of registered vehicles as of 1997 is 12,899, and the compositions by vehicle types are; 45.2% two wheelers, 33.9% light vehicles, 4.3% taxis and the remaining 16.6% heavy vehicles(see Figure 2.6).

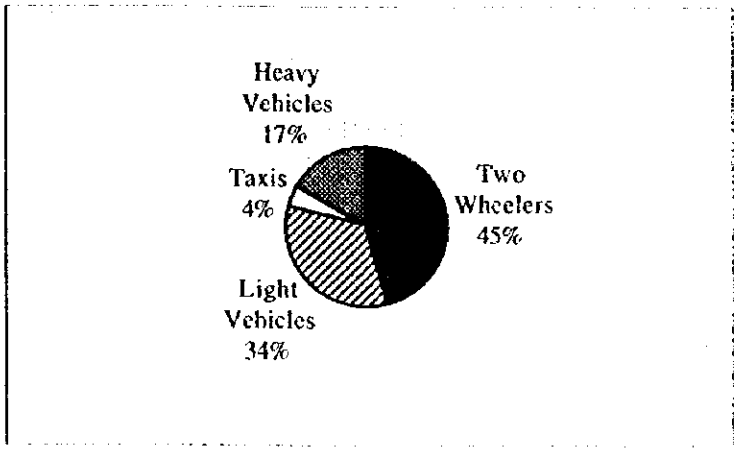


Figure 2.6 Composition of Vehicle Type in 1997

Table 2.4 Number of Registered Vehicles by Type

Year	Two Wheelers	Light	Taxis	Heavy	Total
1980	299	213	23	165	700
1981	455	371	39	347	1,212
1982	707	618	55	460	1,840
1983	946	806	60	533	2,345
1984	1,200	1,125	78	719	3,122
1985	1,513	1,458	117	892	3,980
1986	1,883	1,802	153	1,043	4,881
1987	2,281	2,043	213	1,184	5,721
1988	2,882	2,411	250	1,459	7,002
1989(a)	3,222	2,518	291	1,633	7,664
1990	4,100	4,372	385	3,059	11,916
1991	4,681	4,857	447	3,259	13,244
1992	5,028	5,282	534	3,424	14,268
1993(b)	4,046	3,082	289	1,557	8,974
1994	3,001	2,246	172	655	6,074
1995					
1996					
1997	5,834	4,368	557	2,140	12,899

Source: - Data in 1980-1994 from Statistical Yearbook of Bhutan
- Data in 1997 from PWD

Notes: (a) Figure includes up to Sept. 1989
(b) - Includes figure from first few months of 1994.
- The decrease since 1993 is due to change in definitions of registration system since the year. Unlike previous years the figure reflect only vehicles in running condition.

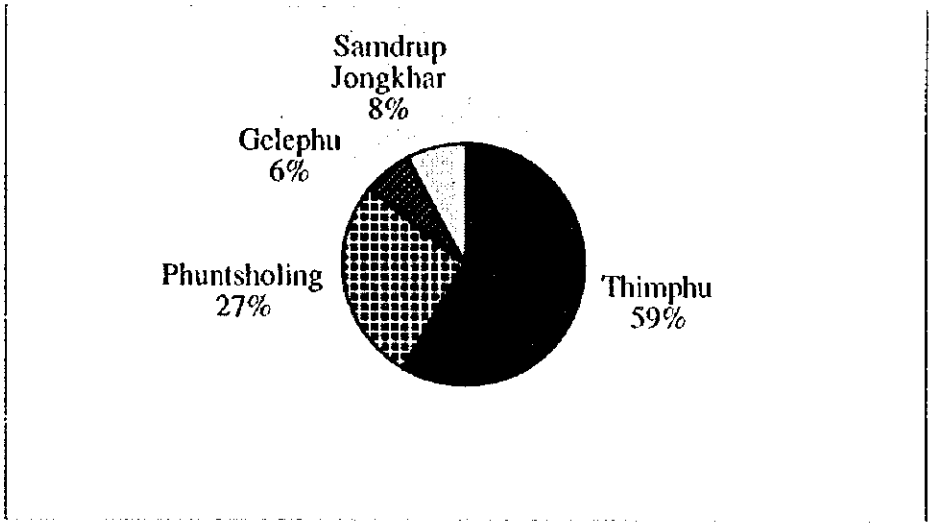
Moreover, the number of registered vehicles by region as of August 1997 is shown in Figure 2.7. The share of registered vehicles in Thimphu region is 59%. Each region includes the following districts(Dzongkhags):

Thimphu region ---------- Thimphu, Paro, Haa, Punakha, Wangdue Phodrang, Gasa

Phuntsholing region ---------- Chhukha, Samtse

Gelephu region ---------- Sarpang, Zhemgang, Trongsa, Bumthang, Tsirang, Dagana

Samdrup Jongkhar region --- Samdrup Jongkhar, Trashigang, Mongar, Yangtse, Lhuntse, Pemagatshel



Source : PWD

Figure 2.7 Composition of Registered Vehicles by Region

(Traffic Volumes)

The average daily traffic volumes by station on arterial roads as counted by PWD during 16 hours (6:00-22:00) are as shown in Table 2.5.

Traffic volumes on the national highway route No. 1, which is the east-west highway, are as follows: around 200-800 vehicles on Semtokha-Wangdue Phodrang section, around 20-80 vehicles on Wangdue Phodrang-Trashigang section. Those on the route No. 2 are counted at about 1,500-2,400 vehicles between Thimphu and Chhuzom and about 280-560 vehicles on Chhuzom-Phuntsholing. Khiri station nearby Trashigang and a station nearby Samdrup Jongkhar on the route No. 3 are counted to about 210-230 and 1,300 vehicles, respectively. Traffic volumes on the route No. 4 and No. 5 are as low as 70 vehicles or even less.

According to the report from Royal Bhutan Police(RBP) in Phuntsholing, the number of vehicles which used the Indian national highway from Phuntsholing main gate to Samdrup Jongkhar and Gelephu at middle of January 1998 were about 100 on the average during five weekday mornings(7:00 ~ 9:00). The ratio of heavy vehicles to the total traffic volumes was around 85%.

Table 2.5 Average Daily Traffic Volume (Traffic Count Data during 16 Hours)

Location		1994					1995				
Highway No.	Station	Scooter L.	Vehicle	Bus	Truck	Total	Scooter L.	Vehicle	Bus	Truck	Total
Route No.1 (1)	Semtokha-Hongtsho	39	104	6	79	228	48	148	18	80	294
Route No.1 (2)	Hongtsho C/P	27	112	13	68	220	29	124	15	76	244
Route No.1 (3)	Wangdue C/P	116	135	13	100	364	132	241	9	105	487
Route No.1 (4)	Trongsa-Wangdue Road	1	13	5	9	28	1	13	2	10	26
Route No.1 (5)	East of Trongsa	1	7	0	11	19	2	11	1	9	23
Route No.1 (6)	Bumthang-Mongar Road	1	7	0	11	19	6	10	1	10	27
Route No.1 (7)	Gaytsa-Bumthang Road	3	5	0	5	13	2	6	2	12	22
Route No.1 (8)	Limithang, West of Mongar						6	13	1	11	31
Route No.1 (9)	Mongar-Trashigang						20	29	5	23	77
Route No.1 (10)	Chazam	7	33	2	32	74	14	25	4	24	67
Route No.2 (1)	Thimphu-Semtokha	282	710	44	316	1352	338	887	48	284	1557
Route No.2 (2)	Semtokha-Chhuzom	226	616	39	307	1188	237	647	37	322	1243
Route No.2 (3)	Thimphu-Chhuzom	9	68	21	80	178					
Route No.2 (4)	Chhukha C/P	33	173	38	181	425					
Route No.2 (5)	Chhuzom-P/ling	18	102	31	129	280	23	73	20	88	204
Route No.2 (6)	P/ling-Thimphu						81	123	30	126	360
Route No.3 (1)	Khiri	73	86	9	64	232	7	12	2	15	36
Route No.3 (2)	Samdrup Jongkhar Road										
Route No.4 (1)	Trongsa south	6	10	1	4	21	4	6	1	3	14
Route No.4 (2)	Zhemgang- Gelephu	5	15	2	20	42	36	26	2	2	66
Route No.4 (3)	Gelephu-Sarpang (C/P)	9	16	11	15	51	15	20	6	27	68
Route No.5 (1)	Sarpang-Tsirang	3	9	2	8	22	10	13	3	14	40
Route No.5 (2)	Sunkosh-Dagana	1	3	1	2	7	1	4	1	5	11
	Autso, Mongar-Lhuntse Road						1	4	1	6	12
	Chhuzom-Paro	3	11	3	27	44	24	150	9	28	211

Location		1996					1997				
Highway No.	Station	Scooter L.	Vehicle	Bus	Truck	Total	Scooter L.	Vehicle	Bus	Truck	Total
Route No.1 (1)	Semtokha-Hongtsho	164	419	38	160	781	73	203	14	88	378
Route No.1 (2)	Hongtsho C/P	39	145	12	64	260	50	123	18	74	265
Route No.1 (3)	Wangdue C/P	192	307	10	119	628	159	240	9	117	525
Route No.1 (4)	Trongsa-Wangdue Road	2	21	2	15	40	11	36	2	19	68
Route No.1 (5)	East of Trongsa	4	19	1	14	38	7	19	1	15	42
Route No.1 (6)	Bumthang-Mongar Road	5	16	1	3	25	138	163	1	88	390
Route No.1 (7)	Gaytsa-Bumthang Road	2	19	2	9	32					
Route No.1 (8)	Limithang, West of Mongar	16	29	1	17	63	12	19	1	17	49
Route No.1 (9)	Mongar-Trashigang	24	28	0	19	71	21	26	1	19	67
Route No.1 (10)	Chazam	9	20	2	16	47	7	33	2	32	74
Route No.2 (1)	Thimphu-Semtokha	734	1484	54	131	2403					
Route No.2 (2)	Semtokha-Chhuzom	313	850	52	289	1504					
Route No.2 (3)	Thimphu-Chhuzom	55	343	36	125	559					
Route No.2 (4)	Chhukha C/P	12	126	28	109	275					
Route No.2 (5)	Chhuzom-P/ling	12	136	24	116	288					
Route No.2 (6)	P/ling-Thimphu	53	143	54	284	534	26	172	24	198	420
Route No.3 (1)	Khiri	64	78	6	62	210	10	23	3	24	60
Route No.3 (2)	Samdrup Jongkhar Road	538	454	14	301	1307	193	202	11	230	636
Route No.4 (1)	Trongsa south										
Route No.4 (2)	Zhemgang- Gelephu	26	26	1	11	64					
Route No.4 (3)	Gelephu-Sarpang (C/P)						25	19	6	7	57
Route No.5 (1)	Sarpang-Tsirang						7	9	1	5	22
Route No.5 (2)	Sunkosh-Dagana						2	2	0	2	6
	Autso, Mongar-Lhuntse Road	4	10	0	9	23	11	19	2	19	51
	Chhuzom-Paro	46	217	20	61	344					

Source : PWD

(Traffic Accidents)

The total number of traffic accidents involving motor vehicles from 1987 to 1994 have been reported to be about 200-300 accidents throughout the whole country. Out of the total accidents, the majority of the accidents have occurred in the jurisdiction of Thimphu traffic division, Royal Bhutan Police. Traffic accidents under Thimphu traffic division in 1994 was 207, occupying about 66% of total accidents. The causes of accidents which occurred in the whole country in 1994 were as follows: 51.9% by unknown causes, 17.6% by mechanical fault, 12.2% by bad weather, 9.3% by unexperienced drivers and 9.0% by drunk driving.

(3) Bus Transport

Bus transport in Bhutan at present is run by 18 operators. There are 74 service routes that serve the main settlements in the country. The number of passengers carried by buses was 1.0 million in 1990, 1.2 million in 1991, 1.3 million in 1992, 1.0 million in 1993, 1.0 million in 1994 and 1.1 million in 1995. Since 1990, the number of passengers has not fluctuated greatly remaining around 1.0 million a year.

(4) Air Transport

Druk Air (Royal Bhutan Airlines), the national carrier of the Royal Government of Bhutan, operates seven stations including six cities in five countries. The airlines operates two BAe 146-100 series with seating capacity of 72.

The total number of passengers carried has been increasing continuously, since its inception in 1989. The annual growth rate from 1989 to 1994 was 12.7%.

2.2 Future Socioeconomic Framework

2.2.1 Review of Existing Framework

It is important that there should be a long term assessment of the macroeconomics variables (framework) that are expected to influence the realization of the country's vision of the future. The document of the 8th Five Year Plan(8FYP) includes a longer 20 years perspective and a macroeconomics outlook for the five years of the Plan itself. In the document, only the GDP and the population parameters are considered. The following is a summary of these variables and Table 2.6 presents a forecast of the national income and population from the beginning of the 8th to 11th Five Year Plan.

The population growth is projected to decline from 2.43% in 2002/03 to 1.63% in 2011/12 and to 1.31% in 2016/17. On the basis of these figures, the population is expected to reach about 931,700 in 2016/17 from 600,000 in 1996. The assumed decline in the population growth rate will in turn depend primarily upon the successful implementation of family planning programs.

The estimate of national income by 2016/17 is based on the accumulated performance of the economy from the current plan until the end of the 11th Five Year Plan. The method used to forecast GDP is based on the assumption that the economy will have an underlying average growth rate of about 5% per annum until year 2005/06, and about 4.5% thereafter. The underlying growth rate is then boosted upwards by large projects coming on stream, especially in the power sector. This rate assumes steadily growing private, financial and horticultural sectors, the latter growing in accordance with its master plan projections.

The per capita income, in real terms(1980 prices) is envisaged to reach Nu. 11,800 by 2016/17. This means that the per capita income of Nu. 5,181 at the end of the 7th Five Year Plan, is expected to more than double by the end of the 11th Five Year Plan.

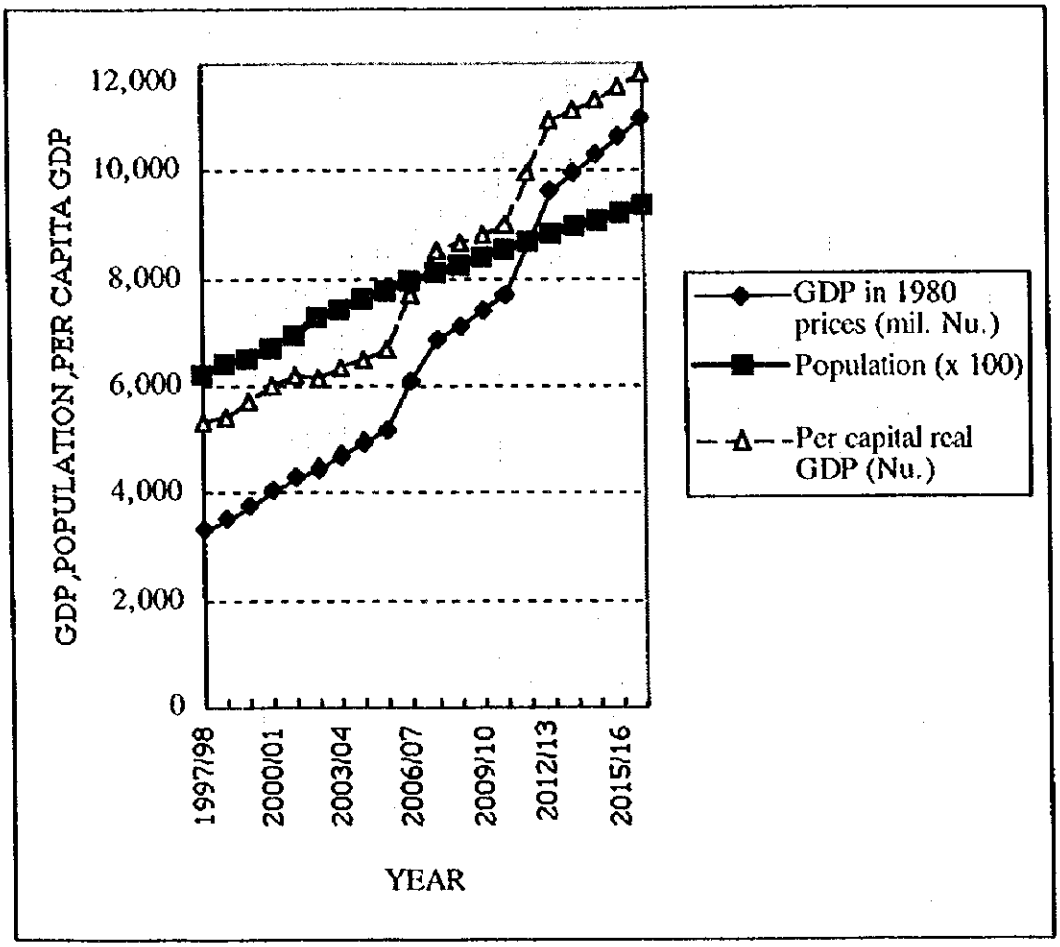
Table 2.6 Forecast of National Income and Population

	7FYP Compound Growth (%)
GDP in 1980 prices (mil. Nu.)	5.88
GDP growth rate (%)	
Population (Million)	2.78
Population growth rate (%)	
Per capita real GDP (Nu.)	2.79

	8FYP					8FYP	9FYP					9FYP
	1997/98	1998/99	999/2000	2000/01	2001/02	Compound Growth (%)	2002/03	2003/04	2004/05	2005/06	2006/07	Compound Growth (%)
GDP in 1980 prices (mil. Nu.)	3,286	3,462	3,714	4,016	4,262	6.7	4,466	4,689	4,923	5,169	6,106	7.5
GDP growth rate (%)	5.7	5.3	7.3	8.1	6.1		5.0	5.0	5.0	5.0	18.1	
Population (Million)	0.62	0.64	0.65	0.67	0.69	2.7	0.725	0.742	0.759	0.775	0.792	2.2
Population growth rate (%)	2.9	2.8	2.7	2.7	2.6		2.4	2.4	2.3	2.2	2.1	
Per capita real GDP (Nu.)	5,300	5,409	5,713	5,994	6,177	3.9	6,159	6,319	6,486	6,670	7,709	4.5

	10FYP					10FYP	11FYP					11FYP
	2007/08	2008/09	2009/10	2010/11	2011/12	Compound Growth (%)	2012/13	2013/14	2014/15	2015/16	2016/17	Compound Growth (%)
GDP in 1980 prices (mil. Nu.)	6,873	7,127	7,393	7,670	8,650	7.2	9,643	9,960	10,290	10,636	10,997	4.9
GDP growth rate (%)	12.6	3.7	3.7	3.8	12.8		11.5	3.3	3.3	3.4	3.4	
Population (Million)	0.808	0.823	0.838	0.853	0.867	1.8	0.881	0.894	0.907	0.92	0.932	1.4
Population growth rate (%)	2.0	1.9	1.8	1.7	1.6		1.6	1.5	1.4	1.4	1.3	
Per capita real GDP (Nu.)	8,507	8,660	8,822	8,992	9,977	5.2	10,946	11,140	11,346	11,561	11,800	3.4

Source : Eighth Five Year Plan (1997-2002) Vol.I Main Document, Ministry of Planning



Source : The 8FYP

Note : The underlying growth rate is boosted upwards by larger projects coming on stream, especially in the power sector; Tala, Wangdue Hydro Power Project, etc.

Figure 2.8 Changes of Future GDP, Population and Per Capita GDP

2.2.2 Establishment of Future Framework

The study of future socioeconomic framework aims to make the fundamental preconditions for the traffic demand forecast. The future socioeconomic framework(target year 2020) which will be used in this Study should be established taking into account the long term development outlook in the above mentioned document.

The following three cases for the estimate of future GDP in this Study are considered:

(1) Case (1)

A case of the estimate of future GDP based on the basic thinking of the long term development outlook by the Bhutanese government.

- The estimate of GDP for 2020 applies to the underlying economic growth rate of about 5.0% per annum until 2006/07(end of the 9FYP) and about 4.5% per annum from 2006/07 to 2020/2021.

(2) Case (2)

A case of the estimate of future GDP based on the following assumptions:

- The underlying economic growth rate in the long term development outlook will achieve 50% of target by the end of the 9FYP, and 100% of it after 2006/07.
- Tala Hydro Power Project, Dungsum Cement Project, for which implementation has already been decided, and Wangdue Phodrang Hydro Project, for which feasibility study will be carried out during the 8FYP, will be finished on schedule.

(3) Case (3)

A case of the estimate of future GDP based on the following assumptions:

- The underlying economic growth rate in the long term development outlook will achieve 50% of target due to influenced economic crisis in Asia.
- The projects for which implementation has already been decided will be finished on schedule.

The future population figures are established in accordance with the basic thinking of the long term development outlook:

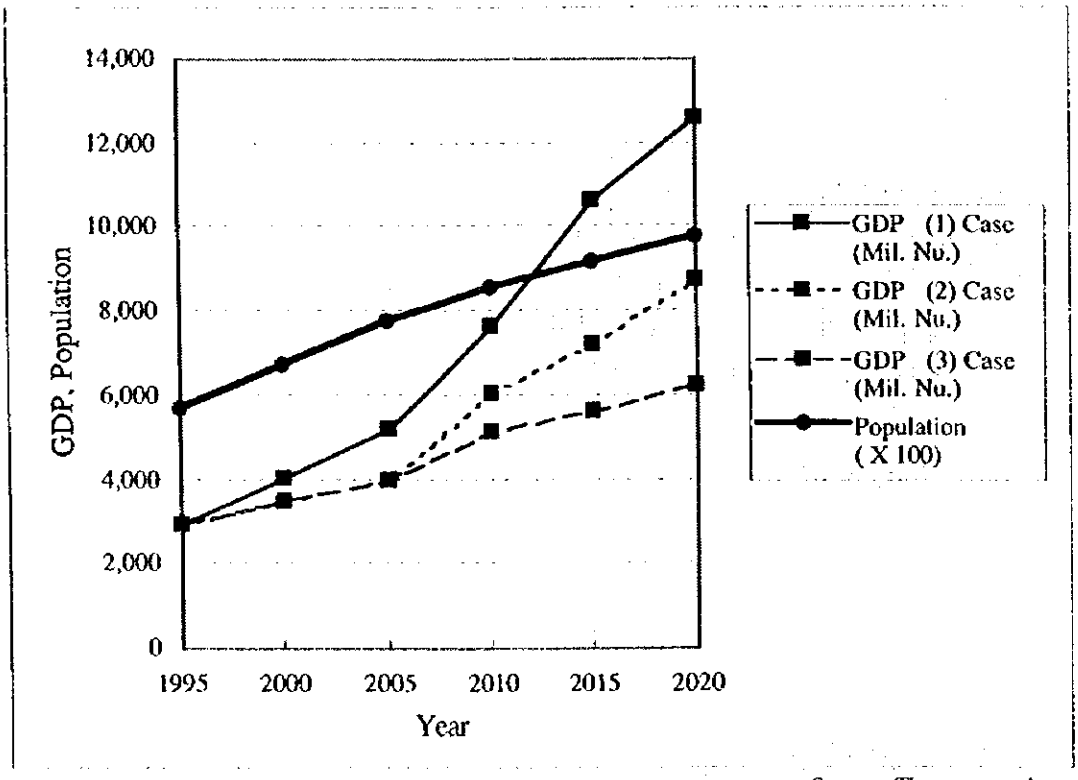
- The population growth is projected to decline gradually from 2.92% in 1997/98 to 2.56% in 2001/02(end of the 8FYP), to 1.63% in 2011/12(end of the 10FYP) and to 1.31% in 2016/17 and 2020/21.

The future framework which will be used in this Study is shown in Table 2.7 and Figure 2.8.

Table 2.7 Future Framework

	1995	2000	2005	2010	2015	2020
GDP in 1980 prices(Mil. Nu.)						
Case (1)	2,946	4,007	5,169	7,670	10,636	12,612
Case (2)	2,946	3,462	3,946	6,052	7,239	8,719
Case (3)	2,946	3,462	3,946	5,126	5,646	6,227
Annual growth rate(%)						
Case (1)		6.3	5.2	8.2	6.8	3.5
Case (2)		3.3	2.7	8.9	3.6	3.8
Case (3)		3.3	2.7	5.4	2.0	2.0
Growth to 1995						
Case (1)	1.00	1.36	1.75	2.60	3.61	4.28
Case (2)	1.00	1.18	1.32	2.05	2.46	2.96
Case (3)	1.00	1.18	1.32	1.68	1.93	2.08
Population (Million)	0.567	0.670	0.775	0.853	0.920	0.981
Annual growth rate (%)		3.4	3.0	1.9	1.5	1.3
Growth to 1995	1.00	1.18	1.37	1.50	1.62	1.73
Per capita GDP (Nu.)						
Case (1)	5,195	5,981	6,670	8,992	11,561	12,856
Case (2)	5,195	5,167	5,091	7,095	7,868	8,887
Case (3)	5,195	5,167	5,091	6,009	6,134	6,348
Annual growth rate (%)						
Case (1)		2.9	2.2	6.2	5.2	2.1
Case (2)		0	-0.3	6.9	2.1	2.5
Case (3)		0.0	-0.3	3.4	0.4	0.7

Source : - The 8FYP from 1995 to 2015. - Estimated values in 2020 by Study Team.



Source : The same as above

Figure 2.9 Change of Future Framework

2.2.3 Forecast of Vehicle Ownership

The vehicle ownership by type is forecasted by the method of regression analysis based on the trend data of registered vehicles and GDPs. The trend data of registered vehicles decreased largely due to the change of registration system in 1993. Moreover, the import of new vehicles only has been permitted since January 1997. Its influence on the number of registered vehicles is unknown at present.

The results of vehicle ownership forecast, taking the constraints of registered vehicle data into consideration, are as shown in Table 2.8. From the results of forecast of vehicle ownership, the estimated results of Case 2 using regression formula "Y = aX + b" in Table 2.8 are proper for the following reasons:

- Correlation coefficient(r) of Case 2 based on the regression analysis is high enough (r=0.90~0.97 respectively).
- Taking account of the changes of future industrial structure and future development of the trunk road network, level of vehicles/1000 persons in future is appropriate.
- Although the growth rate of vehicle ownership will decline sometime in the future, it is expected to increase at least until 2020, if there is no stagnancy of economic activities.

Table 2.8 Forecast of Vehicle Ownership by Type

	1980	1985	1990	1995	1997	2000	2005	2010	2015	2020
Two Wheelers (Case 1)	299	1,513	4,100	3,700	5,834	9,900~11,900	11,700~15,200	15,100~20,400	16,400~24,800	17,700~27,000
Growth to 1995				1.0	1.6	2.68~3.22	3.16~4.11	4.08~5.51	4.43~6.70	4.78~7.30
(Case 2)						7,400~9,000	8,800~12,300	12,200~19,600	13,700~28,200	15,400~33,900
Growth to 1995				1.0	1.6	2.00~2.43	2.38~3.32	3.30~5.30	3.70~7.62	4.16~9.16
Light Vehicles (Case 1)	213	1,458	4,372	2,800	4,368	11,700~14,200	14,000~18,800	18,500~25,400	20,100~31,000	21,800~33,900
Growth to 1995				1.0	1.6	4.18~5.07	5.00~6.71	6.61~9.07	7.18~11.07	7.79~12.11
(Case 2)						6,000~7,100	7,000~9,500	9,400~14,500	10,500~20,500	11,600~24,500
Growth to 1995				1.0	1.6	2.14~2.53	2.50~3.39	3.36~5.18	3.75~7.32	4.14~8.75
Taxis (Case 1)	23	117	385	300	557	1,100~1,300	1,300~1,700	1,700~2,300	1,800~2,800	2,000~3,000
Growth to 1995				1.0	1.9	3.67~4.33	4.33~5.67	5.67~7.67	6.00~9.33	6.67~10.00
(Case 2)						700~900	900~1,200	1,200~2,000	1,400~2,900	1,600~3,500
Growth to 1995				1.0	1.9	2.33~3.00	3.00~4.00	4.00~6.67	4.67~9.67	5.33~11.67
Heavy Vehicles(Case 1)	165	892	3,059	1,000	2,140	8,100~9,900	9,700~13,000	12,900~17,800	14,100~21,800	15,300~23,900
Growth to 1995				1.0	2.1	8.10~9.90	9.70~13.00	12.90~17.80	14.10~21.80	15.30~23.90
(Case 2)						3,200~3,600	3,600~4,500	4,500~6,400	4,900~8,700	5,300~10,200
Growth to 1995				1.0	2.1	3.20~3.60	3.60~4.50	4.50~6.40	4.90~8.70	5.30~10.20
Total (Case 1)	700	3,980	11,916	7,800	12,899	30,800~37,300	36,700~48,700	48,200~65,900	52,400~80,400	56,800~87,800
Growth to 1995				1.0	1.7	3.94~4.78	4.71~6.24	6.18~8.44	6.71~10.30	7.28~11.26
(Case 2)						17,300~20,600	20,300~27,500	27,300~42,500	30,500~60,300	33,900~72,100
Growth to 1995				1.0	1.7	2.21~2.64	2.60~3.53	3.50~5.45	3.91~7.73	4.35~9.24
Vehicles/1000 (Case 1)				13.8		46.0~55.7	47.4~62.8	56.5~77.3	57.0~87.4	57.9~89.5
Persons (Case 2)						25.8~30.7	26.2~34.8	32.0~49.8	33.2~65.5	34.6~73.5

Note : (1) Number of registered vehicles in 1980, 1985, 1990 and 1997 is the existing value, and number in 1995 is estimated by the Study Team.
(2) Future values in (Case 1) : regression formula Y= a Ln(X) + b (trend data from 1985 to 1992)
Future values in (Case 2) : regression formula Y= a X + b (trend data from 1985 to 1997)

CHAPTER 3
NATIONAL DEVELOPMENT PLAN

CHAPTER 3 NATIONAL DEVELOPMENT PLAN

3.1 National Development Plan

The Bhutanese Government has recognized that Bhutan's economic future is linked to its neighbors and to the world economy since the inception of the first development plan in 1961. Having abandoned a strategy of self-imposed isolation, Bhutan has looked forward to increased economic interaction with other countries as an avenue for development.

Since the 1960s, Bhutan has made considerable progress in overcoming many constraints, particularly in terms of infrastructure. However, the development of Bhutanese economy is still constrained by several factors. The constraints as given in the document of the 8th Five Year Plan (1997-2002) are as follows:

- Bhutan, as a landlocked country, is geographically isolated from other countries in the region and is as far as 800 Km from the nearest sea port in Calcutta, India. This isolation substantially increases the costs of transport of goods into and from Bhutan.
- Because of the extremely mountainous terrain, the area of land suitable for agricultural production is very limited. This restricts the potential for increasing output from the agricultural sector and increases the risk of environmental degradation.
- The population is distributed in remote scattered settlements, to take advantage of the limited land suitable for agricultural production.
- The above factors have made the provision of roads and communication networks difficult, and the delivery of health and education services costly.
- Unlike most developing countries, Bhutan has a relatively small population and the supply of manpower is a major constraint. The fairly recent introduction of modern education has not been able to make good the shortage of manpower with the necessary skills for a developing economy.
- As most of the population have been subsistence farmers until recently, the level of monetization has remained low. This has restricted the government's ability to raise domestic revenues, and Bhutan has relied on external assistance for the funding of development programs.

Although the development of Bhutan economy is constrained by several factors as mentioned above, Bhutan will continue the efforts to offset the limitations imposed by these constraints in the 8th Five Year Plan.

Accordingly, there are many new projects/programs and continuation/ongoing programs which are to be implemented in the next five years. The development projects will influence largely traffic, and will cause to generate new traffic demand. Moreover, improvement of traffic conditions will cause to generate latent traffic demand. Out of many projects/programs in the 8th Five Year PLan, the projects/programs which will relate to the traffic generation and the improvement of traffic conditions are as follows :

=== New Projects/Programs ===

- Project RNR02 : Irrigation Program Strengthening Project (Location : Nationwide)
- Project RNR06 : Lhuntse-Mongar Sustainable Integrated Area Development Project (Location : Lhuntse and Mongar Districts)
- Project RNR07 : Sub-tropical Integrated Area Development (Location : Tsirang, Samtse, Dagana and Sarpang Districts)
- Project MOC04 : Strengthening of Paro Airport (Location : Paro Airport)
- Project MOC05 : New Roads Construction (Location : Nationwide) -- Expansion of district and feeder road network
- Project MOC06 : Improvement National Highway (Location : Nationwide) -- widening, geometric improvement, permanent works, resurfacing, etc.
- Project MOC07 : Realignment of Roads (Location : Chhukha)
- Project MOC10 : Construction of Permanent Bridges (Location : Nationwide)
- Project MOC11 : Urban Development Program (Location : Thimphu and Phuntsholing)
- Project MOC12 : Urban Development Program (Location : District towns)
- Project TI08 : Development of Gedu Industrial Estate (Location : Chhukha)

=== Cotinuation/Ongoing Programs ===

- Gasa/Punakha/Wangdue Phodrang Watershed Development
- Development of Gidakom Industrial Estate
- Kurichu Hydro Power Project (45 MW)
- Basochu Hydro Power Project (60.8 MW)

Projects expected after the 8FYP are as follows:

- Tala Hydro Power Project (1,020 MW)

- Wangdue Phodrang Hydro Power Project (stage 1 and stage 2) (1,410 MW)
- Mangdechu Hydro Power Project (265 MW)

The places of projects mentioned above are shown in Figure 3.1.

Figure 3.2 shows the existing mining projects in Bhutan. In the 8FYP, the government aims to explore opportunities for the expantion of mineral-based industries consistent with Bhutan's comparative advantage, and to increase government revenue from this sub-sector.

The government intends in the netional development plan that the long term objective of the health service is to promote the health of the whole population so as to enable every citizen to lead a socially and economically prodictive life and, whithin the broader framework of overall national development enhance the quality of life of the people through better health care in the spirit of social justice and equity. The existing main health facilities which have been developed until the 7FYP are as shown in Figure 3.3.

In Bhutan, the broad objectives for education sector are in line with national objectives of improving the quality of life, developing human resources, facilitating the meaningful participation of the population in the country's development activities, and preserving and strengthening the county's culture. The existing main education facilities are as shown in Figure 3.4.

The efficient socioeconomic activities in Bhutan such as the expansion of mineral-based industries and the delivery of health and education services are made difficult and costly for the present because of the insufficient provision of roads and communication networks.

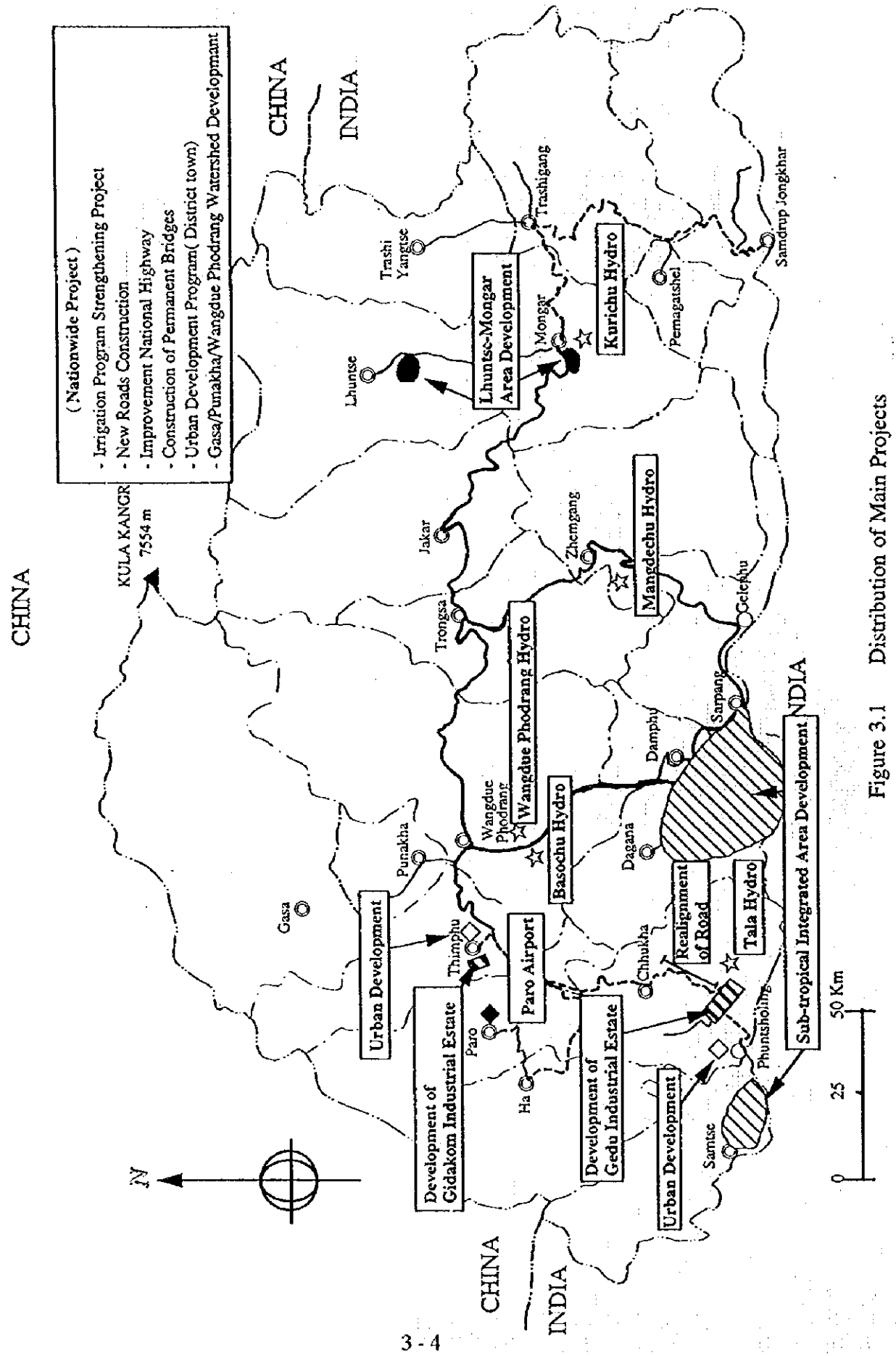


Figure 3.1 Distribution of Main Projects

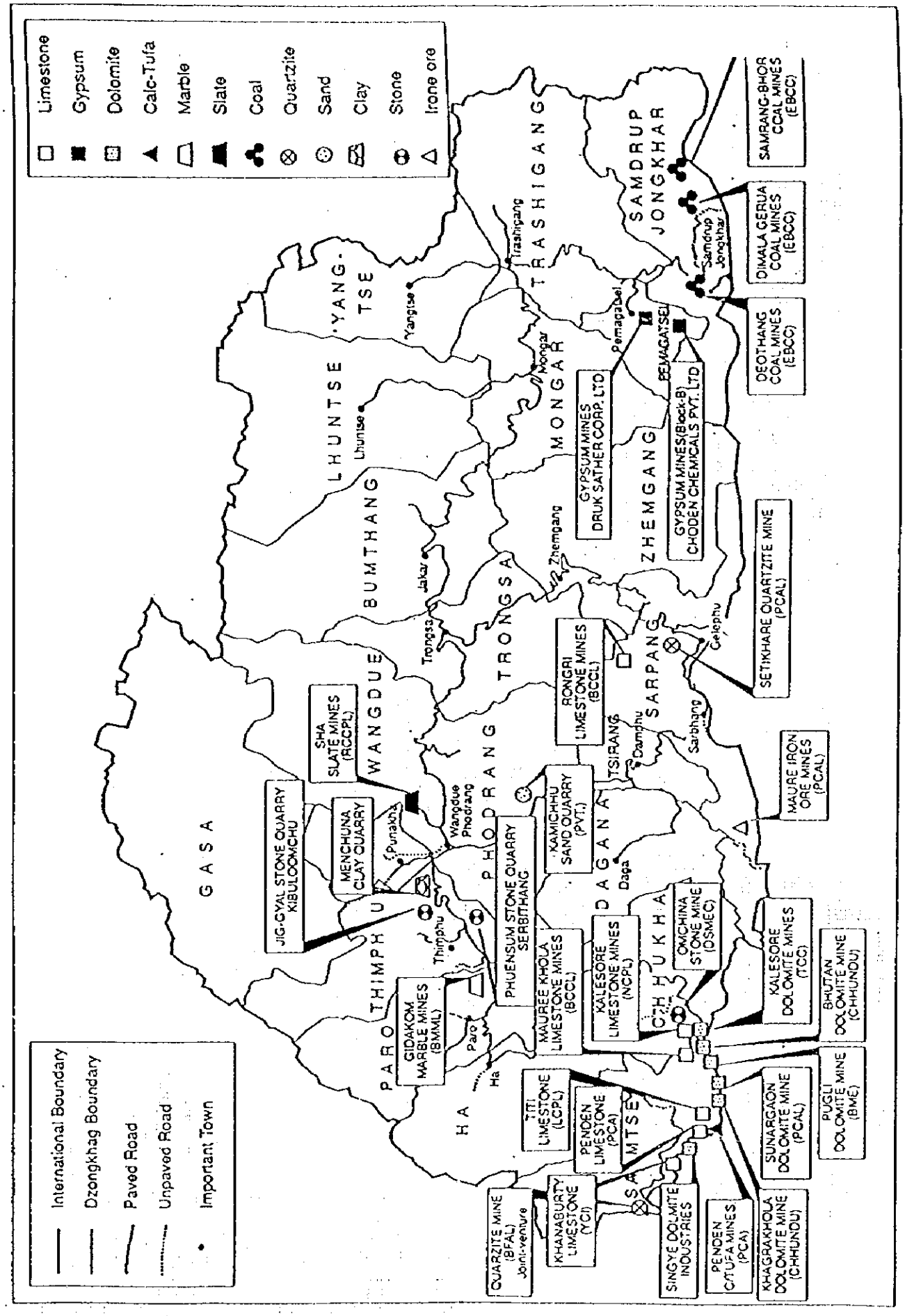


Figure 3.2 Mining Projects

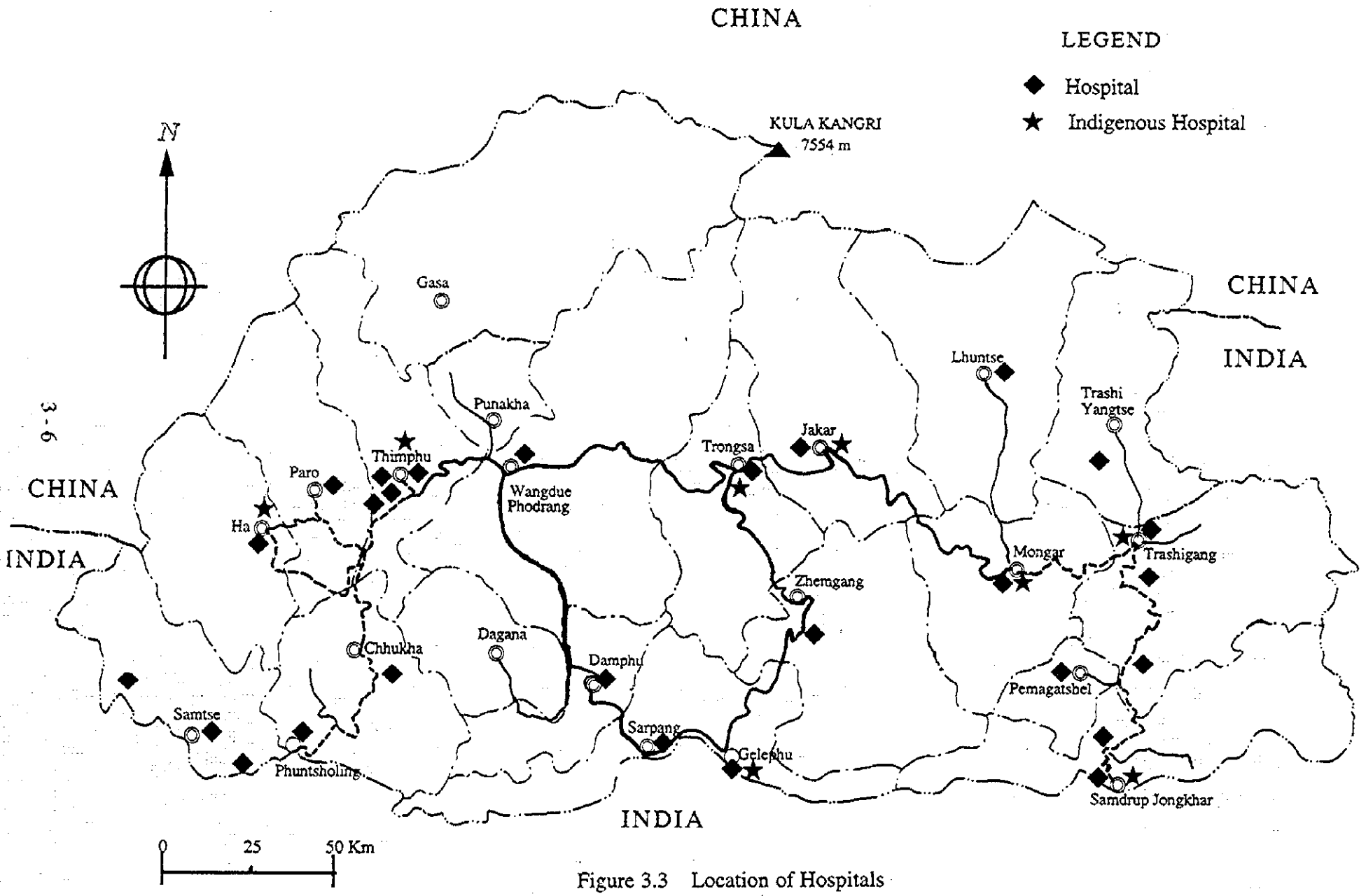


Figure 3.3 Location of Hospitals

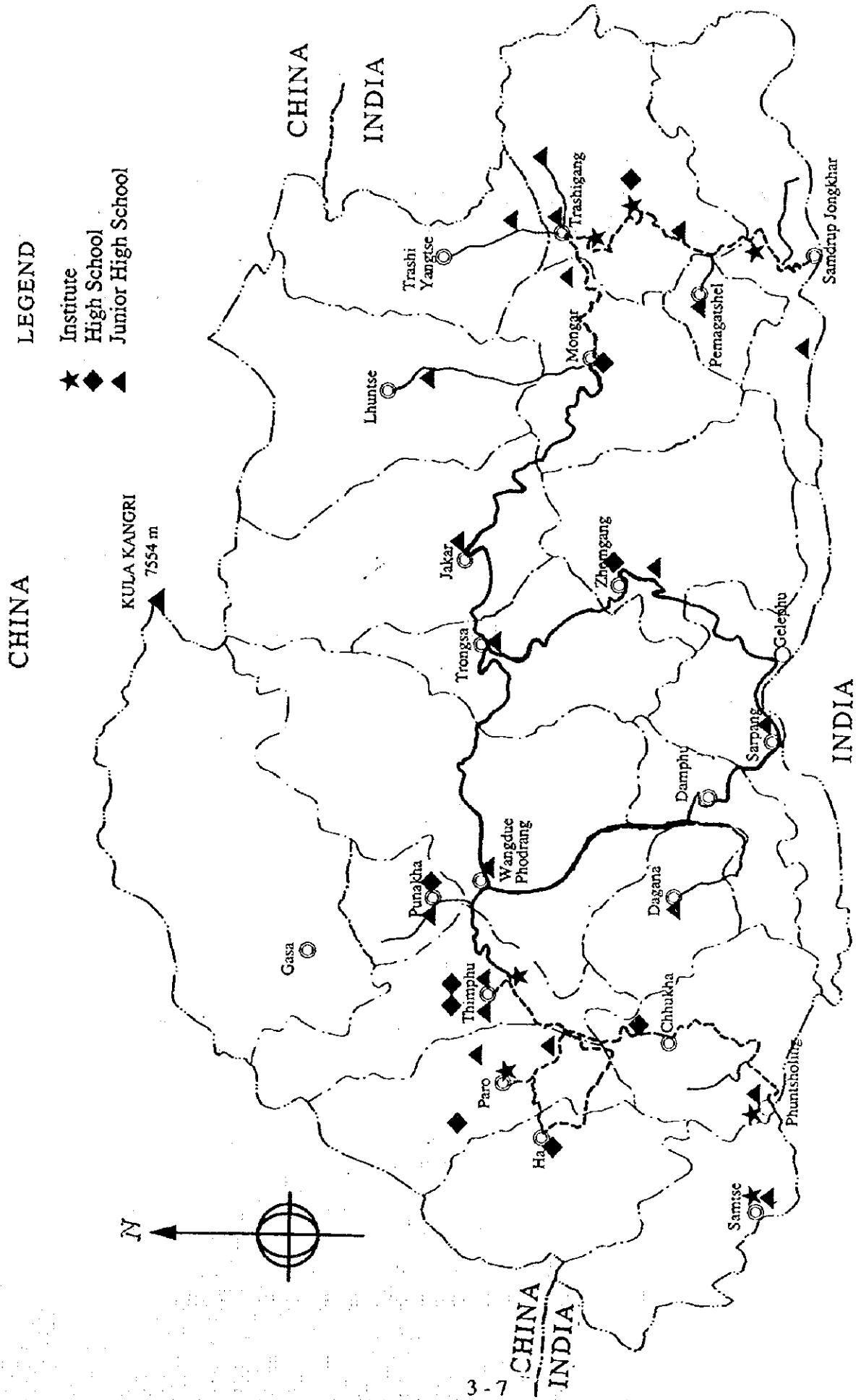


Figure 3.4 Location of Schools

3.2 Road Development Plan

3.2.1 Present Situation of the National Highwy

Bhutan's socioeconomic development depends largely on an efficient and reliable road network. Road infrastructure development has therefore been given priority in all the past five year plans. There is now over 3,200 km of road in the Kingdom serving almost all district headquarters and a good proportion of the rural settlements for the safe movement of essential goods and passengers within Bhutan and between Bhutan and India (see Figure 2.5).

The road is divided into four categories, that is, National Highway, District Road, Feeder Road and Urban Road, constituting 47.5 %, 13.5 %, 36.7 % and 2.3 % of total length, respectively.

Road construction began in 1959 with the assistance of Government of India. By the end of First Five Year Plan (1961-1966), there were bus services connecting some of the southern towns such as Phuntsholing, Samdrup Jongkhar, Sarpang, Samtse and Gelephu to neighboring Indian towns and rail terminals. Major roads such as the Gelephu - Sarpang, Phuntsholing - Thimphu, Phuntsholing - Paro, Samdrup Jongkhar - Trashigang and Gelephu - Mangdichu were constructed in the First Five Year Plan. In the first two Plans, an overwhelming percentage of the Plan outlays was allocated to the road construction sector.

Road infrastructure falls under the Public Works Division (PWD) of the Ministry of Communications. There are eight (8) regional maintenance divisions and three regional workshops at Gelehu, Limithang and Hesothangkha, and a Central Store at Phuntsholing. The organization of PWD is described in Section 3.2.2.

During the 7FYP (1992-1997), a total of 41 km of new road and 450 km of resurfacing were completed. Road improvement scheme for the 8FYP (1997-2002) is shown in Section 3.2.3.

At present, Bhutan has the following National Highways:

Route No. 1--- (Trashigang - Semtokha Highway) Length : 546 Km
East -West Lateral Highway
Route No. 2 --- (Phuentsholing - Thimphu Highway) Length : 179 Km

Route No. 3 --- (Samdrup Jongkha - Trashigang Highway) Length : 180 Km
Route No. 4 --- (Sarpang - Geylephug Highway)
(Geylephug - Trongsa Highway) Total Length : 244 Km
Route No. 5 --- (Wangdue - Tsirang Highway)
(Sunkosh - Damphu Highway)
(Damphu - Sarpang Highway) Total Length : 187 Km
Mongar - Lhuntshi Highway --- Length : 64 Km

National Highway Route No.1 connects the capital Thimphu in the West (Semtokha is 5 km south of Thimphu) with Trashigang in the East. It is connected to Southern Bhutan by four North-South Highways. This Highway, known as the Lateral Highway, was taken over from Project DANTAK of the Indian Border Road Organization in 1989-90. A length of about 116 Km from Trashigang to Kurichu (part of Route No.1) has been handed over to Border Road Organization (Dantak), Government of India since 1994 for improvement to facilitate the movement of heavy machinery and materials for the Kurichu Hydro Power Project.
An ADB project was launched for surface improvements on Route No.1 for the identified stretches since March 1994 and will be completed by the end of 1997. The contents of the project include drainage, preseal patching and resealing works. There are four temporary bridges that are bridges in this Study (Bridge No.1 - No.4) along National Highway Route No.1.

National Highway Route No.4 is another important highway connecting Central Bhutan with India. This highway was taken over from Project DANTAK of the Indian Border Road Organization in 1992. The road alignment passes through mountainous terrain, consisting of thick forest, soft soil, sinking and slide prone areas and rocky outcrops. The 28 Km road stretch between Sarpang and Gelephu is in the foothill plains. There are four temporary bridges that are bridges in this Study (Bridge No.5 - No.8) along this highway.

National Highway Route No.5 is an equally important highway connecting interior Western regions to Southern Bhutan and India. The road starts from Wangdue Bridge and the alignment passes through the almost vertical slopes of the Sunkosh Valley on its right bank up to almost 60 Km. The roads climbs up towards Tsirang after 75 Km and descends down hill to Sarpang for almost 60 Km. The road from Wangdue Bridge to 75 Km section was newly constructed by PWD during year 1983-87. There are twelve(12) temporary bridges that are bridges in this Study (Bridge No.9 - No.20, 22) along this highway.

Mongar - Lhuntshe Highway starts at Gangola Junction to Lhuntshe. The road passes through mountainous terrain, consisting of soft soil, sinking and slide prone areas and rocky outcrops and climbs along the Kurichu (river) valley on the right side and crosses the river at Tangmachu Bridge. The Tangmachu Bridge is one of the bridges included for the Study (Bridge No.21).

The national highways are characterized by sharp hairpin curves in horizontal alignment at numerous places, insufficient sight distances, narrow carriageways, surface deterioration and slope failures. Moreover, seasonal damages due to landslides, slope failure, rock fall , snowfalls and flash floods occur more frequently due to monsoonal and winter weathers.

3.2.2 Present Administration and Finance for Road Sector

(1) Administration Structure

At present, administration of the road sector in Bhutan is carried out by the Public Works Division (PWD), Ministry of Communications (see Figure 3.5).

The existing administration organization chart for the road sector is shown in Figure 3.5. The top administrator of the road sector is the Secretary, who is the Head of Division. Under the Secretary, the Director supervises two projects and five cells (or units); ADB(Asian Development Bank) project, WFP(World Food Program) project, Material Procurement Unit/Stores, Design & Planning Cell, Road Bridge & Maintenance Cell, Mechanical Cell and National Project Unit for Feeder Road(Trashigang). Superintendent engineers are in charge of each cell or unit. The management concerning road/bridge constructions and maintenance is supervised by two superintendent engineers each in charge of Road Bridge & Maintenance Cell and National Project for Feeder Road. Under Road Bridge & Maintenance cell, there are two further cells (Road Bridge and Road Maintenance Cell) in the PWD headquarters and six Road Maintenance Divisions as local PWD offices; Thimphu, Phuntsholing, Lobeysa, Trongsa, Zhemgang and Sarpang. The National Project Unit for Feeder Road (Trashigang) has two Road Maintenance Divisions; Limithang and Trashigang. Two or five Road Maintenance sub-divisions are placed under each Division, and they supervise road construction and maintenance works. The jurisdiction of each Division is shown in Figure 3.6.

Moreover, the PWD's road sector has a Central Store at Phuntsholing and a Central Workshop at Gelephu, while a new workshop at Hesothangkha in Wangdhu Phodrang District is under construction.

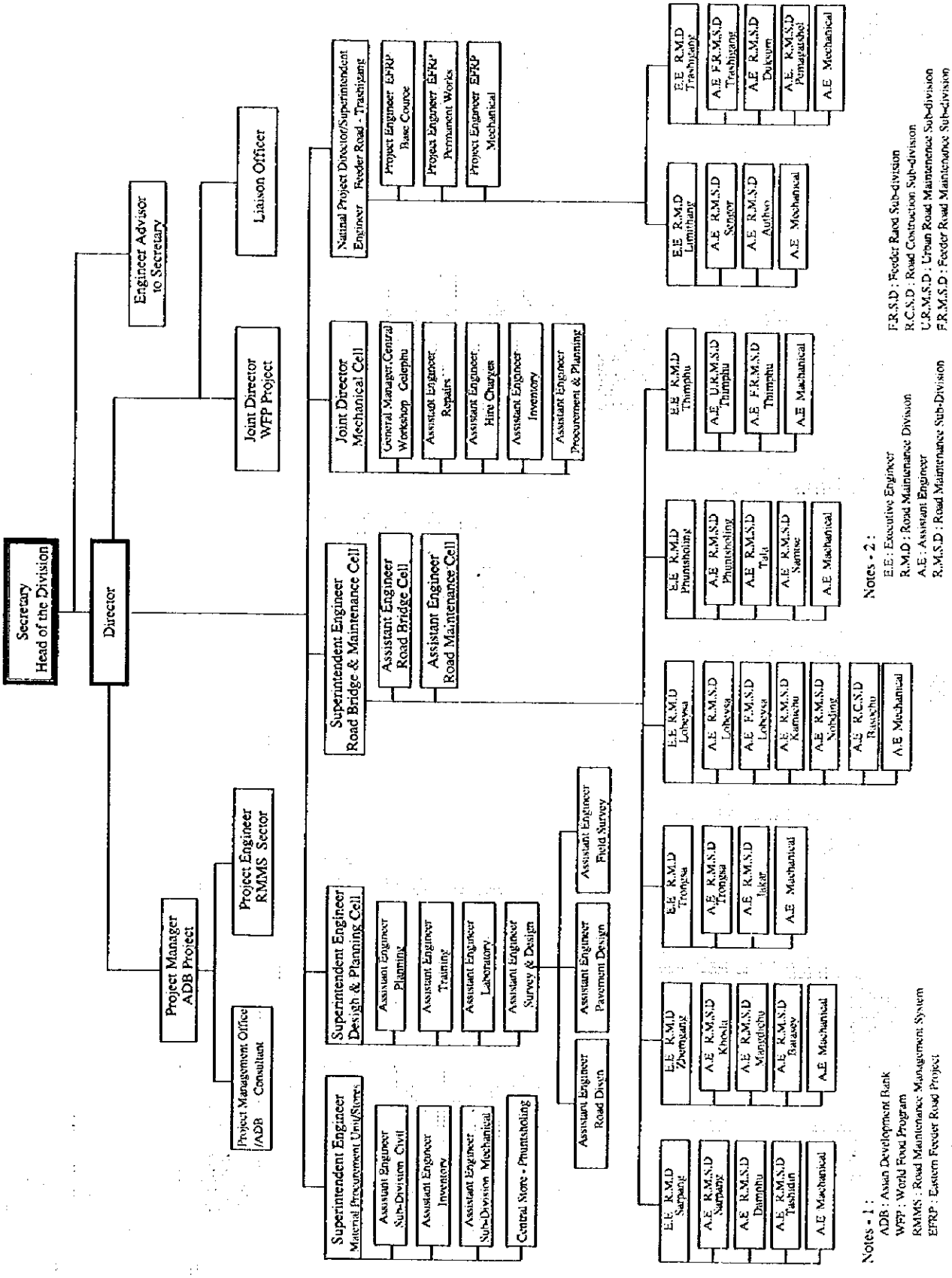


Figure 3.5 Existing Organization Chart of PWD (Road Sector)

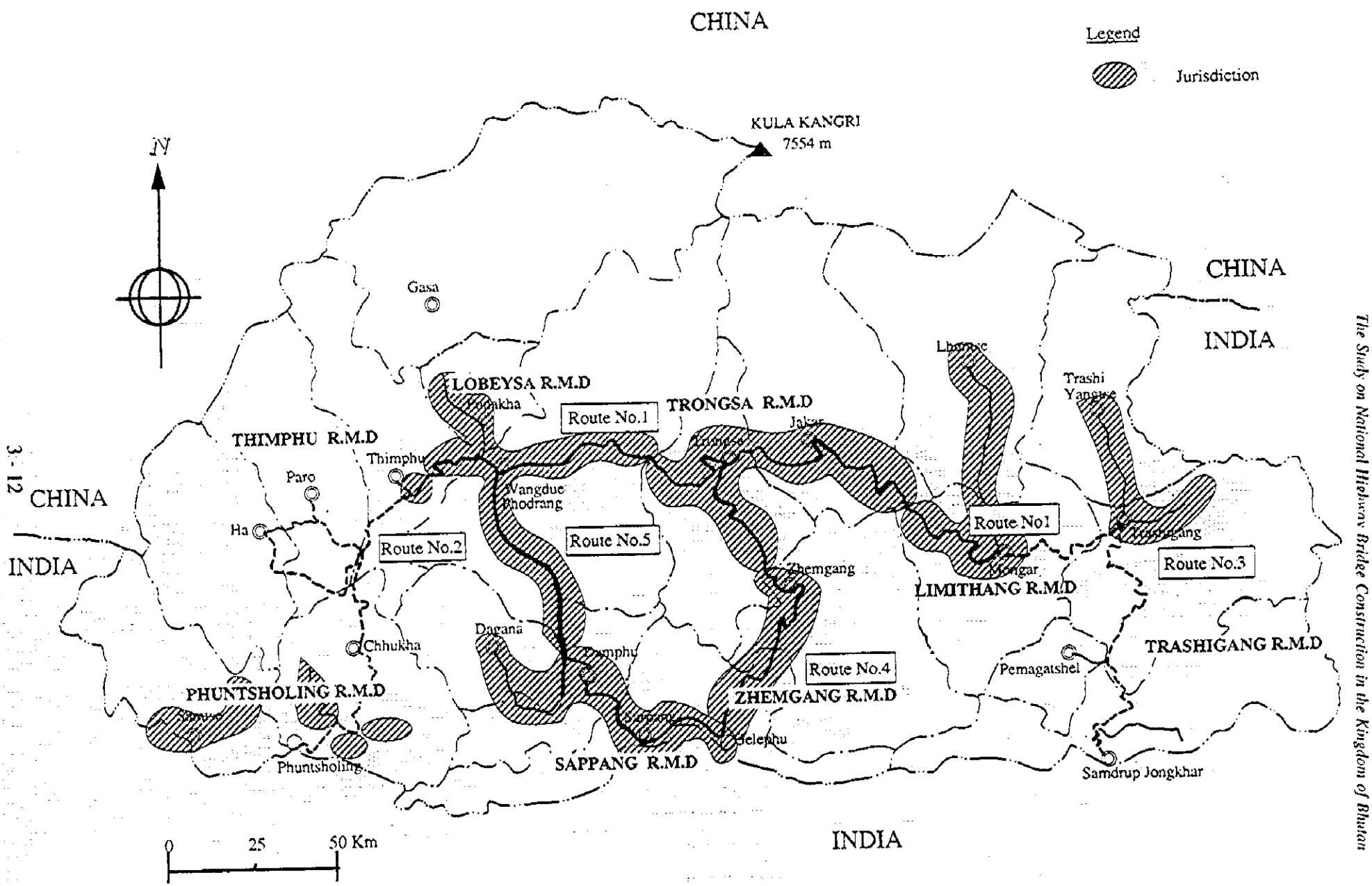


Figure 3.6 Jurisdictions of Road Maintenance Division

An abstract of staff under the road sector is as shown in Table 3.1. At present, the total staff of the road sector is 756 persons. Of these, 130 are civil engineers which is 17% of the total staff.

Table 3.1 Number of Staff under Road Sector, PWD

Item	Personnel
Secretary	1
Director	1
Joint Director	2
Officer	20
Engineer(Civil)	130
Engineer(Mechanical)	38
Engineer(Electrical)	1
Technician	113
Operator	81
Workman	89
Driver	137
Office Worker & Others	143
Total	756

Source : PWD (as of Sep. 1997)

(2) Finance for Road Sector

The steep and fragile terrain in Bhutan, the lack of trained and skilled manpower, and budgetary limitations present a serious challenge to the construction and maintenance of roads.

Table 3.2 shows the approved budget estimates for road sector from 1994/95 to 1997/98 fiscal year. The budget scales for road sector in 1996/97 and 1997/98 are Nu. 652 million and Nu. 548 million, respectively. The budget of capital investment for the road sector in 1996/97 is estimated around 15% of total capital investment in the Bhutanese government.

Table 3.2 Approved Budget Estimates for Road Sector

(Unit : Million Nu.)

Divisions	1994/95			1995/96			1996/97			1997/98		
	Current	Capital	Total	Current	Capital	Total	Current	Capital	Total	Current	Capital	Total
Headquarter	5.206	13.750	18.956	5.437	12.312	17.749	6.425	1.972	8.397	22.555	24.385	46.940
Trongsa	1.733	28.127	29.860	6.134	32.858	38.992	7.076	56.264	63.340	7.860	37.924	45.784
Lobeysa	2.970	29.044	32.014	6.847	20.874	27.721	9.233	45.764	54.997	11.937	71.584	83.521
Wangdue Road Div.	2.564	51.308	53.872	4.564	4.250	8.814	2.203	6.409	8.612	7.816	16.165	23.981
Limithang	3.453	28.574	32.027	6.088	29.985	36.073	7.015	50.910	57.925	5.245	63.979	69.224
Thimphu	2.741	13.631	16.372	4.545	0.310	4.855	5.529	8.956	14.485	10.588	16.239	26.827
Zhemgang	2.306	19.418	21.724	7.267	10.023	17.290	8.746	15.439	24.185	8.274	34.391	42.665
Sarpang	3.552	13.130	16.682	6.212	23.398	29.610	7.355	34.022	41.377	6.258	135.127	141.385
Phuntsholing	3.434	10.926	14.360	5.042	10.696	15.738	5.409	88.011	93.420	5.009	16.574	21.583
Trashigang	4.112	11.675	15.787	3.647	6.241	9.888	4.438	17.184	21.622	-	-	-
Mechanical	30.360	21.328	51.688	32.668	0.165	32.833	33.732	173.397	207.129	-	-	-
Central Workshop	2.070	5.150	7.220	2.181	5.570	7.751	2.568	6.500	9.068	-	-	-
Tala Project	-	-	-	-	-	-	-	-	-	0.448	-	0.448
Eastern Feeder Road Pro.	8.393	20.736	29.129	6.937	26.756	33.693	11.022	23.881	34.903	9.411	19.511	28.922
Stores	1.732	0.070	1.802	1.685	0.050	1.735	2.292	0.077	2.369	2.218	0.015	2.233
WFP	0.909	8.654	9.563	1.000	8.148	9.148	0.910	8.735	9.645	0.760	13.950	14.710
Modular Bridge W/Shop	0.249	-	0.249	0.105	-	0.105	-	-	-	-	-	-
Total	75.784	275.521	351.305	100.359	191.636	291.995	113.953	537.521	651.474	98.379	449.844	548.223

Source : PWD

Note: Current: Administrator's Cost
Capital: Investment Cost

Tables 3.3 and 3.4 show the financial achievement of road capital works by service item and by Division during the 7th Five Year Plan. From Table 3.3, the share of expenditure for construction of roads including bridges and culverts during five years is highest at 21.3%, followed by direction services at 16.6%, resurfacing at 16.2%, monsoon restoration works at 14.4%, maintenance of highways/district roads/feeder roads/urban roads at 14.2%, roads improvement works at 5.6% and baily bridge maintenance at 2.3%. During the last five years, the expenditure of monsoon restoration works was from Nu.21 million to Nu.45 million amounting to 27.0% of the total expenditure in 1993/94.

The budget outlay for roads services in the 8th Five Year Plan (8FYP) allocates Nu.3,869 million representing 11.0% of the total outlay (see Table 3.5). However, the allocation for roads services on capital investment is about 17% of the total. This is the second largest allocation following power services capital outlay.

3.2.3 Road Improvement Schemes

The schemes for road improvements are described only in the 8FYP document as follows:

(1) New Road Construction

Requests for over 1,000 km of new road for the 8FYP were received from various dzongkhags to increase accessibility of rural communities to markets, educational, health, agricultural facilities etc. through expansion of district and feeder roads network. Considering the limited capacity of PWD and private contractors and using population density, agricultural and industrial potentials and accessibility criteria, prioritization has been done and 328 km length of new road constructions up to formation cutting level have been earmarked for the 8FYP (tentative cost : Nu.2.2-4.2 million per km). Construction of these road will be considered in order of priority subject to the availability of funds.

(2) Road Maintenance

Timely maintenance is essential to prolong the life of road and to preserve the past capital invested in them. In the past, for financial and other reasons, timely resurfacing was not carried out and it is now overdue for almost all road. During the 8FYP the resurfacing program for 1,040 km of road has been based on the existing capacity of the private companies as well as that of PWD.

Table 3.3 Financial Achievement of Capital Works in Road Sector by Service Item during 7FYP

(Unit : Million Nu.)

Service Item	1992/93	1993/94	1994/95	1995/96	1996/97	Total
001 : Direction Servises	22.746	31.627	49.655	41.041	45.497	190.566
003 : Institutional Strengthening (Professional Services)	24.110	0.000	0.000	0.000	2.454	26.564
005 : Maintenance of Bailey Bridges	1.860	0.687	1.119	1.087	1.144	5.897
006 : Protection of Bridges	0.191	1.278	1.245	1.219	1.535	5.468
007 : Construction of Bridges & Culverts	2.786	3.577	8.664	1.126	5.788	21.941
008 : Maintenance of Highways	19.504	19.248	23.416	21.511	25.101	108.780
010 : Maintenance of District Roads	4.901	4.996	6.367	6.374	7.558	30.196
011 : Maintenance of Feeder Roads	1.368	2.570	2.846	3.478	4.107	14.369
012 : Maintenance of Urban Roads	0.705	1.565	1.521	2.296	3.384	9.471
013 : Construction of Roads	32.770	20.548	30.154	31.817	106.850	222.139
015 : Resurfacing of Roads	8.375	12.971	24.162	48.319	91.976	185.803
016 : Monsoon Restoration works	31.197	41.848	25.433	21.654	44.765	164.897
017 : Roads Improvement Works	7.371	7.733	6.400	14.310	28.767	64.581
018 : Water Supply Works	0.013	0.041	0.000	0.062	0.099	0.215
019 : Construction of Buildings	2.608	5.753	4.961	8.649	11.551	33.522
023 : Renovation of Existing Buildings	0.104	0.295	0.020	0.153	0.399	0.971
029 : Institutional Strengthening (Plants, Equipment)	0.017	0.011	0.000	0.000	0.000	0.028
030 : Flood Restoration Works	0.000	0.000	57.605	2.525	0.656	60.786
033 : F/S of Dakpi- Buli Road	0.000	0.000	0.000	0.000	0.363	0.363
Total	160.626	154.748	243.568	205.621	381.994	1,146.557

Source : PWD (as of June 1997)

Table 3.4 Financial Achievement of Capital Works in Road Sector by Division during 7FYP

(Unit : Million Nu.)

Division	1992/93	1993/94	1994/95	1995/96	1996/97	Total
01 Management & Supply Service	28.938	5.453	5.947	6.122	12.140	58.600
02 Roads Maintenance Services-Trongsa	19.379	17.305	14.163	22.433	41.369	114.649
03 Roads Maintenance Services- Lobeysa	9.284	11.601	23.387	26.700	45.883	116.855
04 Roads Maintenance Services-Limithang	17.534	15.202	19.482	25.935	37.850	116.003
05 Roads Maintenance Services-Thimphu	7.654	6.240	6.419	5.223	20.868	46.404
06 Roads Maintenance Services-Zhemgang	18.779	15.569	18.768	21.084	21.968	96.168
07 Roads Construction Services-Sarpang	7.999	14.016	19.530	27.117	47.498	116.160
08 Roads Construction Services-Phuntsholing	10.539	17.531	16.533	16.380	83.713	144.696
09 Roads Construction Services-Trashigang	14.810	12.652	11.395	10.209	15.466	64.532
10 Roads Construction Services-Wandhu Phodrang	19.626	17.835	64.746	7.068	6.762	116.037
11 Modular Bridge Manifacturing Services	0.310	0.130	0.107	0.000	0.000	0.547
12 Central Stores Division Services	1.433	1.505	1.752	2.032	2.455	9.177
13 WFP Generated Fund Services	4.341	9.886	5.007	9.046	11.568	39.848
16 Eastern Feeder Road Project	0.000	9.823	36.332	26.272	34.454	106.881
Total	160.626	154.748	243.568	205.621	381.994	1,146.557

Source : PWD (as of June 1997)

Table 3.5 8FYP Budget Outlay

(Unit : Million Nu.)

Organizations	Recurrent	Capital	Total	%
His Majesty's Secretariat	35.17	1.47	36.64	0.10
National Assembly of Bhutan	31.28	3.06	34.34	0.10
Royal Advisory Council	21.39	0.53	21.92	0.06
Council for Ecclesiastical Affairs	259.98	32.49	292.47	0.83
Special Commission for Cultural Affairs	81.63	207.99	289.62	0.82
Judiciary	123.16	118.19	241.35	0.69
Royal Audit Authority	61.78	21.02	82.80	0.24
Royal Civil Service Commission	40.79	2,035.18	2,075.97	5.90
Bhutan Olympic Committee	26.49	43.72	70.21	0.20
Dzongkha Development Commission	13.96	3.11	17.07	0.05
National Enviroment Commission	5.25	120.17	125.42	0.36
Police, Jail & Fire Services	688.29	355.01	1,043.30	2.97
Ministry of Home Affairs	208.09	366.65	574.74	1.63
Ministry of Finance	5,498.69	552.10	6,050.79	17.20
Ministry of Foreign Affairs	734.01	22.42	756.43	2.15
Ministry of Health & Education	3,662.79	2,607.49	6,270.28	17.83
Royal Instt. of Management	50.41	137.08	187.49	0.53
Ministry of Agriculture	1,453.98	2,844.95	4,298.93	12.22
- Secretariat	163.39	137.05	300.44	(0.85)
- Research, Extension & Irrigation Div.	263.66	535.80	799.46	(2.27)
- Crop & Livestock Service Div.	226.16	420.87	647.03	(1.84)
- Forest Services	275.70	794.99	1,070.69	(3.04)
- Area Development Projects	525.07	956.24	1,481.31	(4.21)
Ministry of Trade & Industry	1,077.40	3,638.12	4,715.52	13.41
- Secretariat	30.65	9.38	40.03	(0.11)
- Tourism Authority of Bhutan	12.29	24.50	36.79	(0.10)
- Trade Div.	67.66	39.93	107.59	(0.31)
- Geology & Mines Services	70.37	40.49	110.86	(0.32)
- Power Services	896.43	3,397.59	4,294.02	(12.21)
- Industries Div.	0.00	126.23	126.23	(0.36)
Ministry of Communication	1,451.09	5,664.04	7,115.13	20.23
- Secretariat	55.34	16.84	72.18	(0.21)
- Postal Services	203.89	36.08	239.97	(0.68)
- Telecommunication Services	273.14	1,149.58	1,422.72	(4.05)
- Roads Services	650.46	3,218.26	3,868.72	(11.00)
- Works & Housing Services	228.38	1,099.78	1,328.16	(3.78)
- Civil Aviation	24.29	35.54	59.83	(0.17)
- Surface Transport	15.59	42.93	58.52	(0.17)
- Thimphu City Corporation	0.00	65.02	65.02	(0.18)
Ministry of Planning	55.47	61.86	117.33	0.33
Dzongkhag Administrations (Civil)	495.84	255.69	751.53	2.14
Total	16,076.94	19,092.34	35,169.28	100.00

Source : Eighth Five Year Plan (1997-2002) Vol. I Main Document

(3) Routine Maintenance/Monsoon Damages Restoration

Routine maintenance and monsoon damage restoration are annual and seasonal features in road maintenance. The entire stock of road infrastructure will require annual routine maintenance, while the extent of monsoon damage restoration will depend on the amount of damage caused during the monsoons. Based on past annual expenditure, the cost of monsoon damage restoration is estimated at Nu.225 million. The cost of routine maintenance, amounting to Nu.300 million is reflected under the recurrent cost. This does not include an estimated maintenance cost for Project Dantak.

(4) Improvement of National Highways

The National Highways are the most heavily used of Bhutan's highways. They were originally constructed to a basic standard, with sharp curves, narrow carriage way, comparatively steep gradients and a thin bitumen seal. As traffic has increased, it has become necessary, for economic and safety reasons, to upgrade these roads. A total of 204 km of geometric improvement and widening will be carried out in the 8FYP (tentative cost : Nu.2.0-2.9 million per km).

(5) Realignment

To save travel time and to reduce transportation and maintenance costs, realignment of 27 km of road on the Thimphu-Phuntsholing highway will be carried out during the 8FYP (estimated cost : Nu.5.0 million per km).

3.2.4 Bridge Replacement Scheme

There are 180 bridges on the whole road in Bhutan at present. The number and length of bridges by type are summalized as below :

TYPE OF BRIDGES	NUMBERS	LENGTH(m)
Reinforced concrete	59	1317.35
Prestressed concrete	3	248.00
Bailey bridge	52	1768.95
Bailey suspension	7	687.00
Hemilton/Steel	7	214.00
Composite	25	476.56
Wooden	20	375.70
Submersible	7	193.50
Total	180	5281.06

(Source : Public Works Division , 1997)

Many bridges on the highway are temporary steel Bailey bridges. These were built in the 1960s and are already being used only with reduced loading capacity, and may soon be good enough only for light vehicles. In view of the increasing traffic volume and load , it is urgent that some of the critical ones be replaced by permanent bridges. The Government has a scheme to replace the following prioritized total of 11 temporary bridges by permanent bridges during the 8FYP.

1) Aie Bridge (Span - 120 m) Location : Route No. 4
2) Rongkhola Bridge (Span - 45 m) Location : Route No. 4
3) Sarpangkhola Bridge (Span - 45 m) Location : Route No. 5
4) Wangdiphodrang Bridge (Span - 104 m) Location : Route No. 1
5) Mangdichu Bridge (Span - 120 m) Location : Route No. 4
6) Bjee Bridge (Span - 50 m) Location : Route No. 1
7) Chamkhar Zam Bridge (Span - 45 m) Location : Route No. 1
8) Kurizampa Bridge (Span - 50 m) Location : Route No. 1
9) Sunkosh Bridge (Span - 93 m) Location : Route No. 5
10) Tangmachu Bridge (Span - 93 m) Location : Monggar-Lhuntshi Highway
11) Wakleytar Bridge (Span - 100 m) Location : Route No. 5

Bridges 1) - 3) are spillover from the 7FYP and are commtted to be constructed by the Government of India.
Bridge 4) design will be carried out in 1998 and commencement of consruction works in 1999 by Swiss Development Cooperation/Helvetas.
Bridges 5) - 11) are objective bridges for this Study.
Bridges 6) - 8) and 11) are spillover from the 7FYP.

In addition to the above-mentioned replacement scheme, a permanent new bridge with 120 m span has been decided to be constructed at Bhur by the Government of India.