

The second year (April 1987 - March 1988)

- Road Planning Group

Determination of optimum route, technical investigation including soil/materials survey and hydrological survey, preliminary design including cost estimate, project evaluation, implementation program and preparation of reports on Progress (II), Interim and Draft Final.

- Mapping Group

Preparation of topographic map with a scale of 1/2,000, topographic survey and preparation of map in a scale of 1/500.

The third year (April 1988 - June 1988)

- Road Planning Group

Preparation of Final Report

1.4 Organization of the Study

The Study has been carried out by the Study Team under the supervision of the Advisory Committee organized by JICA, which comprises Japanese Government officials. The Study Team, headed by Mr. M. Koshiha who replaced Mr. T. Tamura, consists of two groups, namely Road Planning Group (Nippon Koei co., Ltd.) and Mapping Group (Kokusai Kogyo Co., Ltd.).

The organization chart of the Study is illustrated in Fig. 1.2.

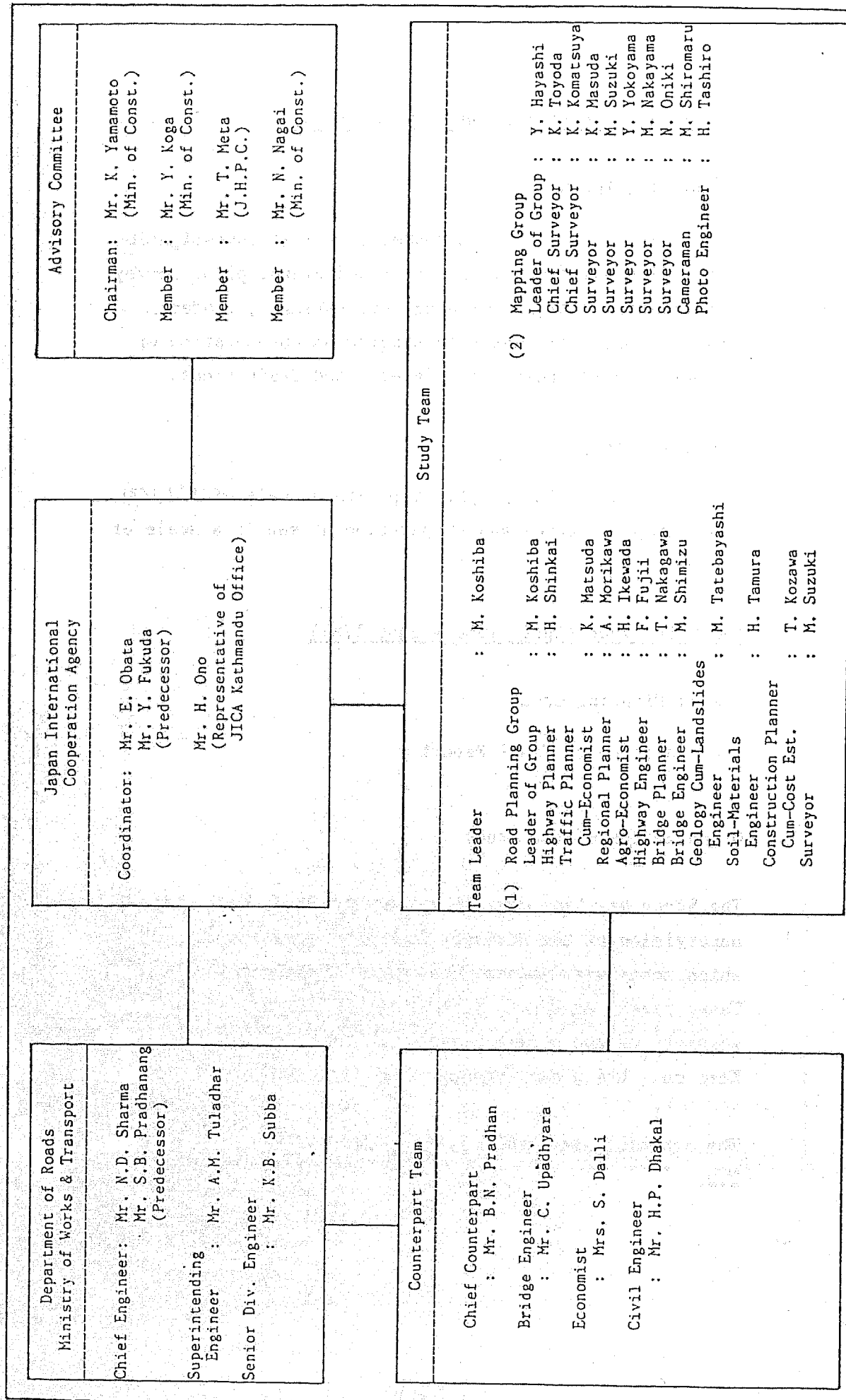


Figure 1.2 ORGANIZATION CHART





## CHAPTER 2 GENERAL CONDITIONS IN NEPAL AND THE STUDY AREA

### 2.1 Physical Conditions

#### 2.1.1 Topography

The topography of Nepal is, in physiographic, classified into three (3) belt zones as follows:

- a) Terai Region : covers Bardibas and the origin of the Project Road, Section I.
- b) Hilly Region : covers the project area, Sec. I & II.
- c) Himalaya Region: extends over the north of the project area.

The project area extends over the Terai Region and the Hilly Region, initiating in the Terai plain at Bardibas on East - West Highway and terminating in the Hilly Region at Dhulikhel on the Kodari Road. As characterized by the Gangetic alluvium deposit, the Terai Plain provides section I of the Project Road with a flat and undulating ground. Bardibas is just situated on the border of the Terai Plain to the Siwalik hills, the project area is gradually rising up to an altitude from about 200 m ASL to 350 m ASL. The topography of the Siwalik defines with rough relief, outcropping of soft sandstone and large-grained conglomerate. The terraces and the low hills are covered with comparatively thick vegetation but the other areas are fostering vegetation in sparse. Sindhuli Bazar locates on the Siwalik hill.

The project area, then, reaches on the Mahabharat range having a large scale of fault in direction from southeast to northwest. This fault suggests the location of the front of the big over-thrusted nappes and the breaker

against the Siwaliks. The Mahabharat range, sitting on the project area, forms a large syncline, composed of strongly metamorphosed sedimentary rocks and granite.

The route of Section II-1 is inevitable to cross over the Mahabharat range near by Sindhuli Garhi at an altitude of about 1,360 m ASL and it descends down to Khurkot in an altitude of about 520 m ASL. In order to make the route ascending and descending, it traverses on flanks of the range, employing suitable means like hair-pin curves.

The topography on Section II-2 placed between Khurkot and Nepalthok is characterized with rugged and steep slopes of the Mahabharat range on the left side and the Sun Kosi river flowing on the right toward the subsequent Section II-3. A numerous number of valleys and gorges are developed in the range. The route of this section goes along the foot of range by course of the Sun Kosi river. Such the topographic feature on this section makes the construction of Project Road comparatively difficult and expensive.

A part of Section II-3 between Nepalthok and Dabcha Khola gorge, the route encounters the most rigorous topography for the alignment setting, comparing with other sections. Either bank of the river rises from the river bed directly. No terrace develops at the foot of slopes. A numerous numbers of landslides slope failures and falus cones on the steep slopes of extremely weathered and deteriorated metasediments.

Mainly mica-schist distinctly define the topography in this section. A quite few of valleys and gorges, holding tributaries and streams belonging to the Dabcha Khola, develop in this section.

The remainder of the route in Section II-3 beyond the Dabcha Khola area enters into comparatively moderate topography, called Nuwakot Group. The route reaches to Dhulikhel on the Kodari Road and terminates at the proposed junction.

### 2.1.2 Climate

The climatic condition in the project area is effected by monsoons. There are two (2) distinct seasons, the dry season from November to May and the rainy season lasting from early June to October. A short transition period covers in between the two (2) seasons. Approximately 90 percent of the annual precipitation concentrates in the rainy season due to the south-east monsoon. During the dry season, winds prevailing in the upper atmosphere maintains weather generally fair and stable.

The south-east monsoon advances from the Bay of Bengal and reaches the westmost of Nepal in the beginning of June and gradually changes its direction for the westward. This monsoon brings heavier precipitation to the Terai Plain, the Mahabharat range and the Himalaya Region. Rainfall during the rainy season has a cycle of about 10-15 days, however, it is sporadic in this region. The rainfall condition varies according to altitude of elevation. It is reported that heavy downpours is apt to occur in areas with lower altitude below about 2,000 m ASL.

The annual average rainfall in the project area is assumed to range between about 1,500 mm and 2,500 mm.<sup>1/</sup> (See Fig. 2.1)

The annual average temperature in the project area ranges between about 20°C-24°C in Bardibas and about 14°C-16°C in Dhulikhel. The maximum temperature of a year is recorded

in April or May in Bardibas, occasionally rises up to more than 40°C. Even in Dhulikhel, it is about more than 32°C. The coldest time is in the period from December to January and the minimum temperature is observed below 5°C in Bardibas and about 0°C in Dhulikhel.<sup>1/</sup>

The average relative humidity is about 75 percent and it varies from 50 percent in the dry season to 90 percent in the rainy season in the north of Terai Plain.<sup>1/</sup>

1/: Sources; 1) Main Text of the Feasibility Study on East Rapti Irrigation Project, April 1986.

2) Master Plan Study on the Kosi River Water Resources Development, March 1985.



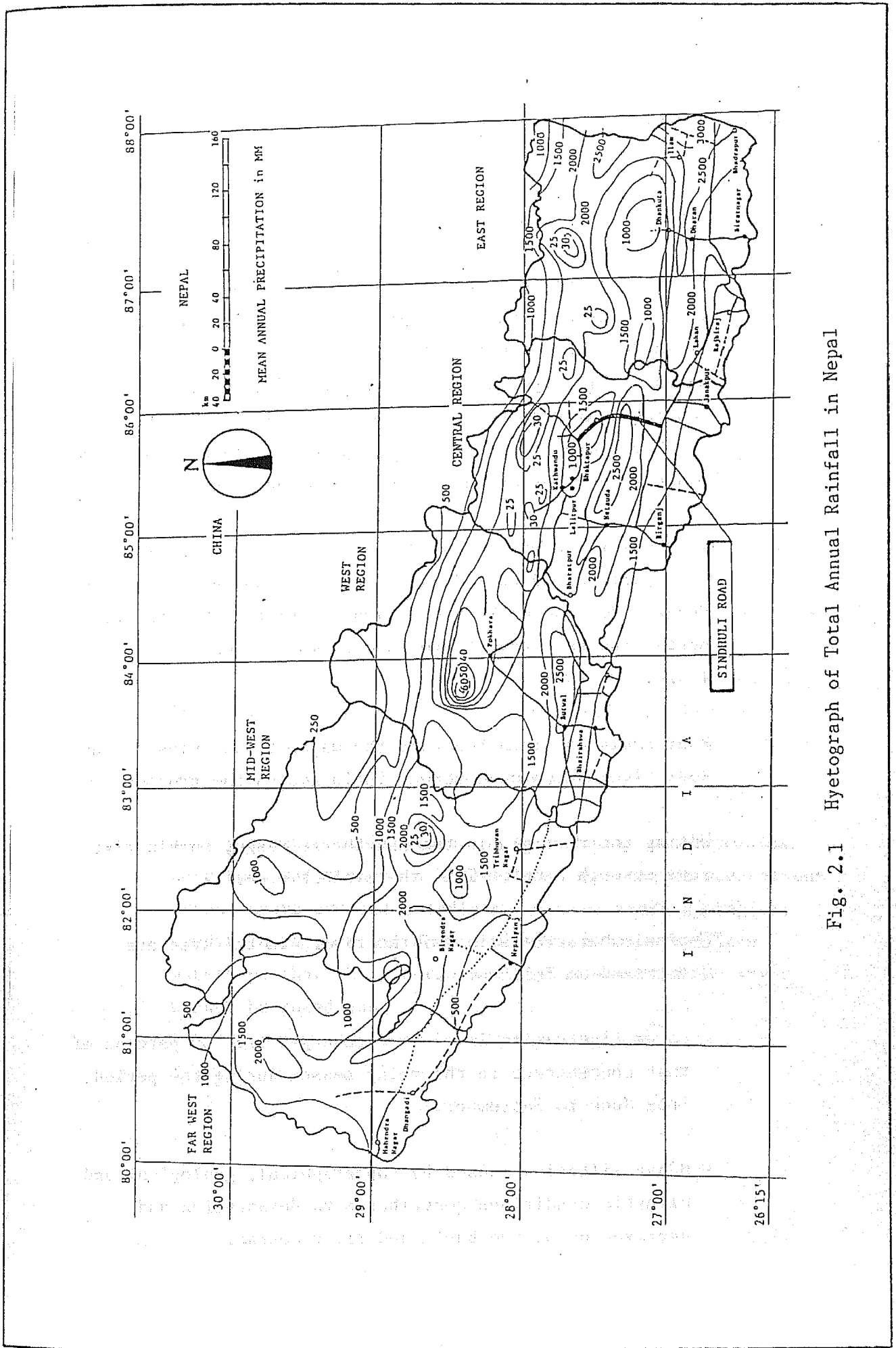


Fig. 2.1 Hyetograph of Total Annual Rainfall in Nepal

### 2.1.3 Hydrological Situation

River system in the project area is represented by the rivers of Sun Kosi and Kamala, respectively.

Sun Kosi river which dominates a numerous number of tributaries originates in Tibetan Plateau of China and flows down into the territory of Nepal across the border on China. This river is characterized by the sources consisted of snow and glaciers in Himalayas. The total catchment area is estimated at approximately 61,000 sq.km, about 45 percent of that lies in Tibetan Plateau.

Sun Kosi river encounters the project area at the vicinity of Nepalthok and runs down along the proposed route of the Project Road down the vicinity of Khurkot. Then the river parts from the project area and flows towards the border on India.

Rosi Khola and Tama Kosi are the major tributaries of Sun Kosi river which have strong influence on the project area.

Having their origin in the Mahabharat range, Kamala river runs through Section-I of the project area.

Typical characteristics of the rivers in the area are summarized as follows:

- Large fluctuation in river discharges with 80 percent of that concentrate in the rainy season during the period from June to September.
- Heavy siltation caused by topographical, geological and climatic conditions contributes to devastation and aggravation of the basin and river course.

- Steep gradient of river profile, particularly in middle and upper reaches, causes transportation of sediment load.

Regarding to sediment load including suspended load in river flows in Kosi Basin, the result of study by Dr. C.K. Sharma are shown as follows:

River	C.A. at Tribeni (km <sup>2</sup> )	Annual Sediment (m <sup>3</sup> )	Sediment (m <sup>3</sup> /km <sup>2</sup> )
Sun Kosi	19,230	54,200,000	2,818
Arun	36,533	34,600,000	948
Tamur	5,900	29,600,000	5,016

The systematic investigation of groundwater resources of Nepal began in late 1960 under the U.S.A.I.D. Program, which focused on the western areas. DIHM intends to carry out groundwater exploration in large scale.

The systematic explorations on groundwater and reservoir have been undertaken in hill areas. Throughout mountainous areas, there are undoubtedly many zones where geological condition favours the downward percolation of surface waters so that the occurrence of groundwater in the areas cannot be ruled out.

## 2.2 Socio-Economic Condition

### 2.2.1 Population

The total population of Nepal as of 1981 was 15,022,839 with average population density of 10.2 persons per km<sup>2</sup>. Annual rate of population increase for the last ten years was about 2.26 percent as shown in Table 2.1.

According to the three geographical regions in Nepal, most of the population are living in the Hilly area and the Terai region because of their living environment. On the other hand, less than 9% of the total population inhabit the Himalaya region as shown in Table 2.2.

One of the characteristics of Nepal's demography is that most people inhabit rural area. The percentage of urban population is only 6%, which is extremely small compared to those of other countries.

The population of Eastern and Central Development Regions is around 8.6 millions which accounts for some 57% of the nation's population as shown in Table 2.3. Based on districtwise data, the districts in the Kathmandu Valley and the Terai have high population density. Population densities by region in Nepal are shown in Table 2.4.

The typical patterns of migration in Nepal are that people in the Hilly and the Himalaya regions have been migrating to the Terai region seeking for employment and better living environment as shown in Table 2.5. In this respect, it is urgent for Nepal to build up regionally balanced living foundation to correct this skewed distribution of population along with the total population control policy.

Table 2.1 Total Population

Years	Total Population	Growth Rate in Percent	Annual Growth Rate within the Decade
1952/54	8,473,478	-	-
1961	9,412,996	11.10	1.32
1971	11,555,986	22.80	2.07
1981	15,022,839	30.00	2.66

Table 2.2 Population and Household Number (1981)  
(For Geographical Region)

Geographical Region	Population	Household Number
Himalaya	1,302,896 (9%)	226,294
Hilly	7,163,115 (48%)	1,240,434
Terai	6,556,828 (43%)	1,108,426
NEPAL TOTAL	15,022,839 (100%)	2,585,154

Table 2.3 Population and Household Number (1981)  
(For Development Region)

Development Region	Population	Household Number
E.D.R.	3,708,923 (25%)	651,795
C.D.R.	4,909,357 (32%)	854,545
W.D.R.	3,128,859 (21%)	544,283
M.W.D.R.	1,955,611 (13%)	322,334
F.W.D.R.	1,320,089 (9%)	212,197
NEPAL TOTAL	15,022,839 (100%)	2,585,154

Table 2.4 Population and Population Density by Main District (1981)

	Name of District	Area (km <sup>2</sup> )	Population (In 1000)	Population Density (per km <sup>2</sup> )
1	Mahottari	1,002	361.1	360
2	Danusha	1,180	432.6	367
3	Sindhuli	2,493	183.7	74
4	Ramechhap	1,546	161.4	104
5	Dolakha	2,192	150.6	69
6	Sarlahi	1,259	398.8	317
7	Kabreplanchok	1,396	307.2	220
8	Kathmandu	395	422.2	1,069
9	Bhaktapur	119	159.8	1,342
10	Lalitpur	385	184.3	479
11	Sindhupalchock	2,541	232.2	91
12	Nuwakot/Rasuwa	2,665	233.2	87
13	Dhading	1,925	243.4	126
14	Makawanpur	2,426	243.4	100
15	Rautabat/Bara/Parsa	3,668	935.8	255
16	Chitwan	2,218	260.0	117
	C.D.R. TOTAL	27,410	4,909.8	179
17	Mechi	8,194	932.6	114
18	Koshi	9,670	1,423.6	147
19	Sagarmatha	10,592	1,352.7	128
	E.D.R. TOTAL	28,456	3,708.9	130
20	Gandaki	1,228	1,107.6	90
21	Dhawalagiri	8,142	453.5	56
22	Lumbini	8,975	1,567.8	175
	W.D.R. TOTAL	29,398	3,128.9	106
23	M.W.D.R. TOTAL	42,378	1,955.6	46
24	F.W.D.R. TOTAL	19,539	1,320.1	68
	NEPAL TOTAL	147,181	15,023.4	102

Source: Central Bureau of Statistics Population Census 1981

Table 2.5 Number of Migration (1971-1981)

Region	Internal Migration	External Migration	Net Migration
Himalaya	35,619	297,086	-261,467
Hilly	169,923	594,634	-424,711
Terai	724,043	37,865	+686,178
NEPAL TOTAL	929,585	929,585	0

Note: - Net external migration from the concerned region  
 - Net internal migration to the concerned region

Source: Central Bureau of Statistics  
 Population Census 1981

### 2.2.2 Outline of the National Economy

Nepal is a nation which belongs to the least developed country in the world according to the criteria set up by the UN. Per capita annual income of Nepal as of 1981 was around 150 dollars.

The national economy heavily depend upon agricultural sector. The shares of product and employment of this sector in the nation's total are around 65% and 95% respectively. The Gross Domestic Product of Nepal in 1980-81 was amounted to be NRs. 20 billion and annual growth rate of GDP for the last five years was around 3.1% as shown in Table 2.6.

It is another characteristic of Nepal's economy that the nation's economy is under the strong influence of the Indian economy. In 1981/82, in the total foreign trade of NRs. 6.4 billion, more than 50% was conducted with India as shown in Table 2.7. Nepal's main exports are primary products such as agricultural products and raw materials while her main imports are manufacturing products. Shares in total value of exports and imports for each development region are summarized in Table 2.8 and Table 2.9. Total value of exports and imports of major commodities are shown in Table 2.10 and Table 2.11.

The structure of national economy is said to be fairly fragile under the recent fluctuation of world economy, especially that on primary industry. The methodology which vitalize national economy is being studied by the various levels of government and international organizations.



Table 2.6 Gross Domestic Product

(In Million NRs.)

Year	Agriculture	Non-Agriculture	Total
1975-76	11,615	5,686	17,301
1976-77	11,141	6,681	17,822
1977-78	11,141	7,466	18,607
1978-79	11,480	7,568	19,048
1979-80	10,933	7,673	18,606
1980-81	12,066	8,092	20,158

Source: Central Bureau of Statistics

Table 2.7 External Payments and Foreign Trade

(In Million NRs.)

	1979/80	1980/81	1981/82
Exports, F.O.B.	1,150.5	1,608.6	1,491.5
(a) India	520.9	992.4	994.3
(b) Other Countries	629.6	616.2	497.2
Imports, C.I.F.	3,480.1	4,428.2	4,930.2
(a) India	1,786.4	2,179.0	2,280.9
(b) Other countries	1,693.7	2,249.2	2,649.3
Trade Balance	-2,329.6	-2,819.6	-3,438.7
(a) India	-1,265.5	-1,186.6	-1,286.6
(b) Other countries	-1,064.1	-1,633.0	-2,152.1

\* Customs based data (at basic exchange rate)

Source: Nepal Rastra Bank.

Table 2.8 Percentage Composition of Development Regions in the Total Value of Exports 1978/79 to 1981/82

Development Region	Percentage Shared in Total Overseas Exports			
	1978/79	1979/80	1980/81	1981/82
E.D.R.	60.2	48.0	30.4	35.0
C.D.R.	34.5	44.5	65.6	55.8
W.D.R.	0.8	0.4	0.1	0.1
M.W.D.R.	-	-	2.1	7.9
F.W.D.R.	4.5	7.1	1.8	1.2
NEPAL TOTAL	100.0	100.0	100.0	100.0

Source: Trade Promotion Center.

Table 2.9 Percentage Composition of Development Regions in the Total Value of Imports 1978/79 to 1981/82

Development Regions	Percentage Shared in Total Overseas Imports			
	1978/79	1979/80	1980/81	1981/82
E.D.R.	10.7	9.9	12.2	13.6
C.D.R.	79.4	82.6	81.8	79.4
W.D.R.	6.6	4.2	2.4	2.5
M.W.D.R.	-	-	2.4	2.2
F.W.D.R.	3.3	3.3	1.2	2.3
NEPAL TOTAL	100.0	100.0	100.0	100.0

Source: Trade Promotion Center.

Table 2.10 Total Value of Exports Classified by Major  
Commodity Groups\* from 1979/80 to 1982/83

(In Million NRs.)

Commodity Groups	1979/80	1980/81	1981/82	1982/83
Food and live animals	306.5	588.7	735.9	303.6
Tobacco and beverages	2.6	15.4	18.5	13.0
Crude materials, inedibles except fuels	469.6	561.6	397.3	325.7
Mineral fuel & lubricants	0.5	0.4	1.0	0.9
Animal and vegetable oil and fats	20.4	37.8	44.0	46.1
Chemical and drugs	1.3	3.9	1.5	1.8
Manufactured goods classified chiefly by materials	291.8	254.3	225.4	369.6
Machinery and transport equipments	3.2	1.8	9.1	9.1
Miscellaneous manufactured articles	54.0	143.0	158.1	42.8
Commodity & transactions not classified according to kind	0.6	1.7	0.8	0.1
<b>Total</b>	<b>1,150.5</b>	<b>1,608.6</b>	<b>1,491.5</b>	<b>1,112.7</b>

\* On customs data basis (at basic exchange rate)

As the figures have been rounded off, total may not tally with their  
component units.

Source: Nepal Rastra Bank.

Table 2.11 Total Value of Imports Classified by Major Commodities Groups\* from 1979/80 to 1982/83

(In Million NRs.)

Commodity Groups	1979/80	1980/81	1981/82	1982/83
Food and live animals	412.9	601.2	619.2	738.3
Tobacco and beverages	25.9	24.8	35.6	51.9
Crude materials, inedibles except fuels	100.9	115.5	142.6	199.6
Mineral fuels and lubricants	409.7	583.6	579.3	693.5
Animal and vegetable oils and fats	26.0	92.5	64.3	69.8
Chemicals and drugs	396.7	527.3	599.2	666.5
Manufactured goods classified chiefly by materials	1,089.9	1,259.2	1,555.5	1,974.3
Machinery and transport equipment	719.7	802.9	892.0	1,221.5
Miscellaneous manufactured articles	288.3	407.6	430.2	593.7
Commodity and transactions not classified according to kind	10.2	13.6	12.3	3.9
<b>Total</b>	<b>3,480.1</b>	<b>4,428.2</b>	<b>4,930.2</b>	<b>6,213.0</b>

\* On customs data basis.

As the figures have been rounded off, total may not tally with their component units.

Source: Nepal Rastra Bank

### 2.2.3 Agriculture

Nepal produces a variety of agricultural products such as paddy, maize, wheat, millet, barley, potato, sugarcane, oil seed, tobacco, and jute. The quantity and productivity of each product are summarized in Table 2.12 and 2.13 respectively.

Nepal's agriculture differs by regions due to different climate, geology and soil conditions as shown in Fig. 2.2 and 2.3 and Table 2.14. Subsistence agriculture is predominant in the Hilly region and stock farming is predominant in the Himalaya region. Maize and millet are main food grains produced in these areas. The agriculture in Terai, on the other hand, is well developed and is rich in varieties due to favorable weather condition and good soils in the area. A variety of cash crops including jute, oil-seed, sugar and tobacco are planted along with many type of food grains. (Fig. 2.4)

There exist great regional unbalances in the agricultural productivities caused not only by different natural endowment but by biased distribution of infrastructure such as transportation and irrigation facilities. Terai is relatively well irrigated and endowed with these foundations. The Hilly and Himalaya regions, on the other hand, is poorly endowed with irrigation and most of the farm lands are rain-fed.

The Hilly and Himalaya regions are suffered by constant food defficient and the shortage is imported mainly from the Terai which is the great bread basket for the nation.

Although food production has increased recently (Table 2.13), Nepal, as a whole, is in short of food and importing food from abroad.

In these circumstances, Nepal government has been launching a variety of agricultural promotion projects and engaging in regional development plans aimed at overall solution of agriculture and food issues. But no great achievement has not been attained.

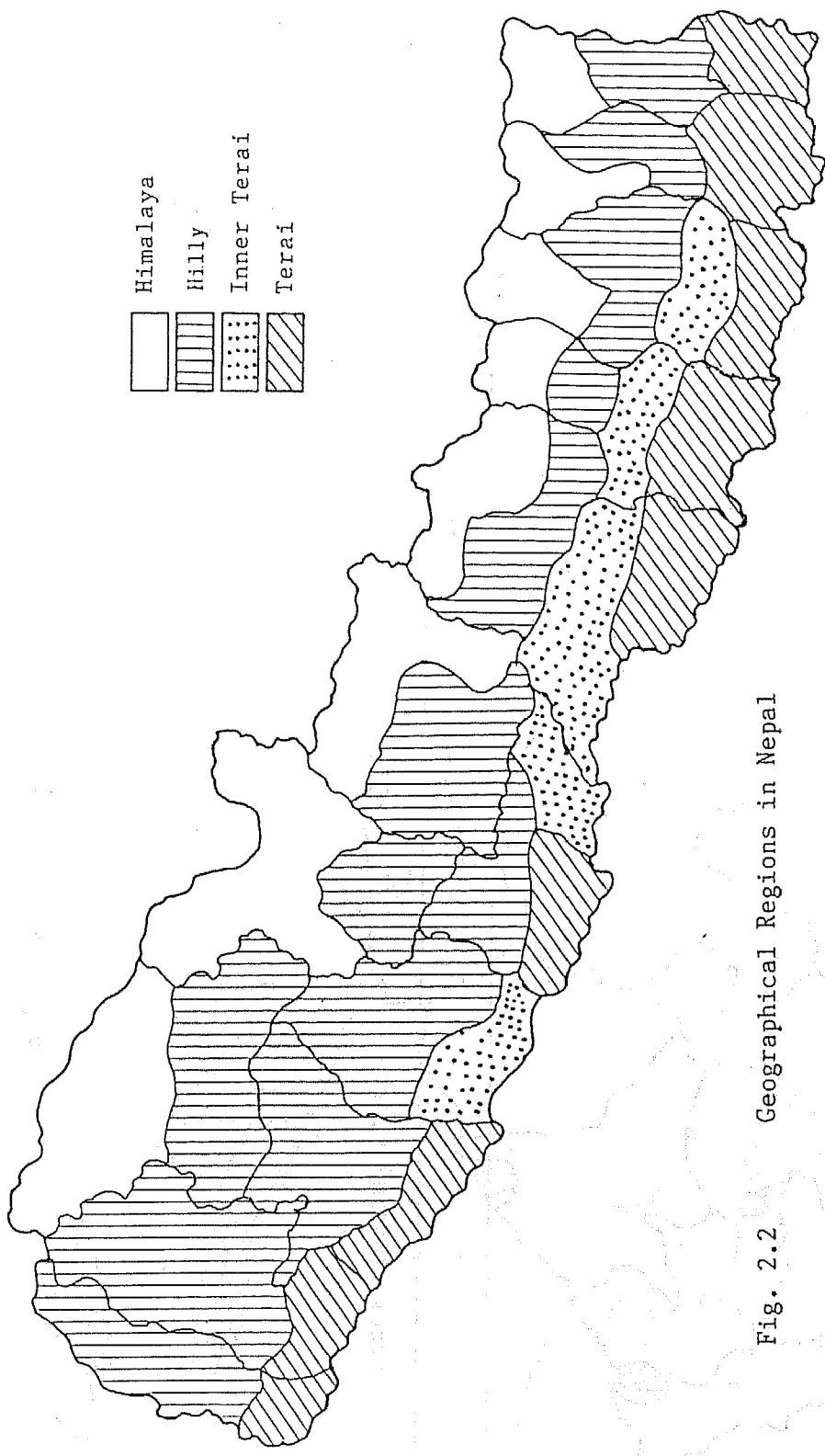


Fig. 2.2 Geographical Regions in Nepal

Source: Natural Environment and Crop Distribution in Nepal  
by K.B. RAJBHANDARY

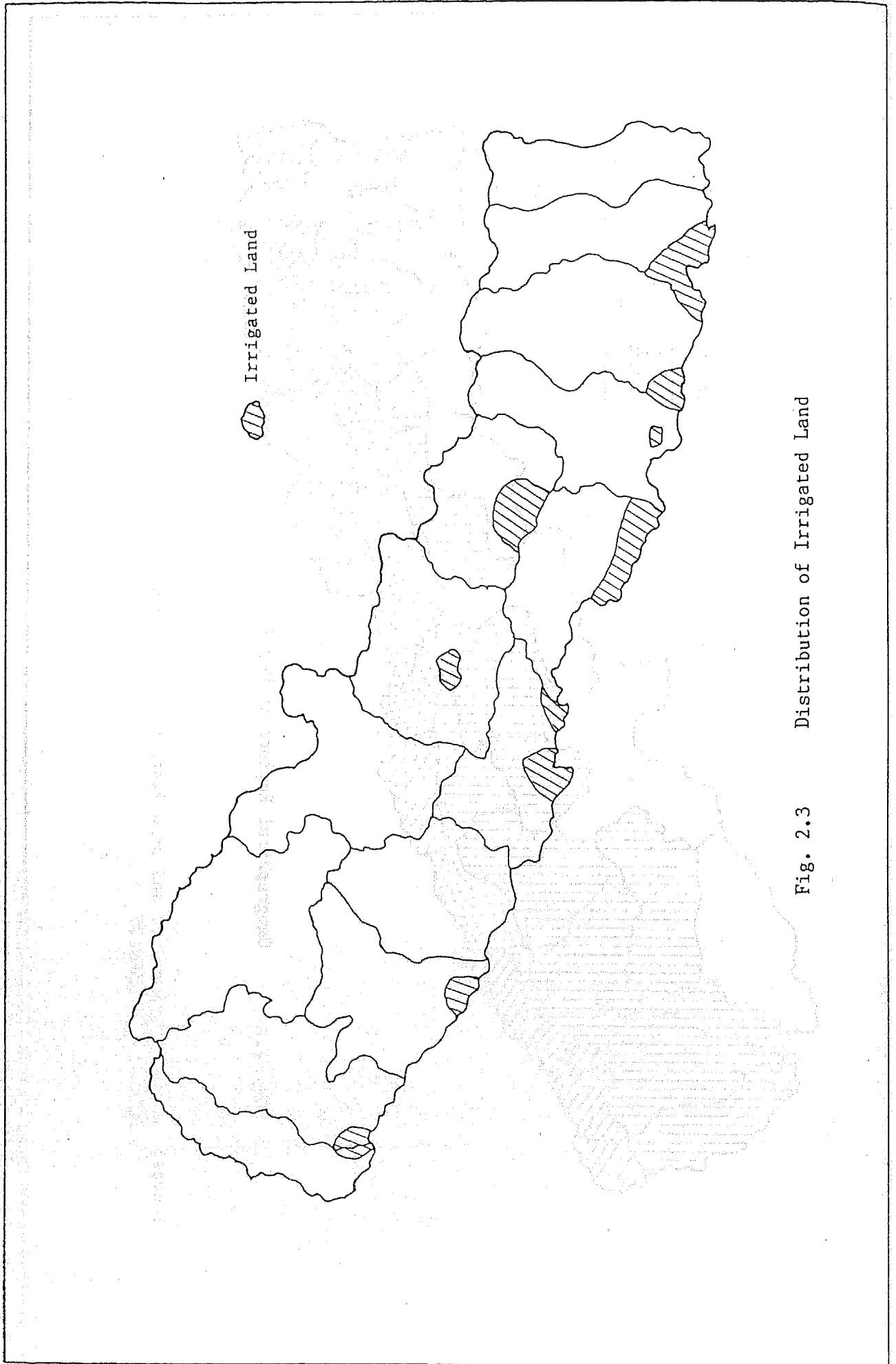


Fig. 2.3 Distribution of Irrigated Land



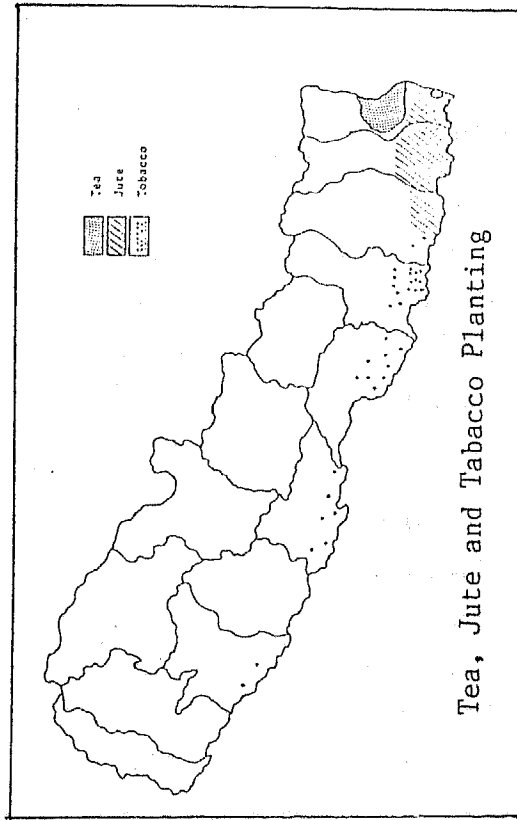
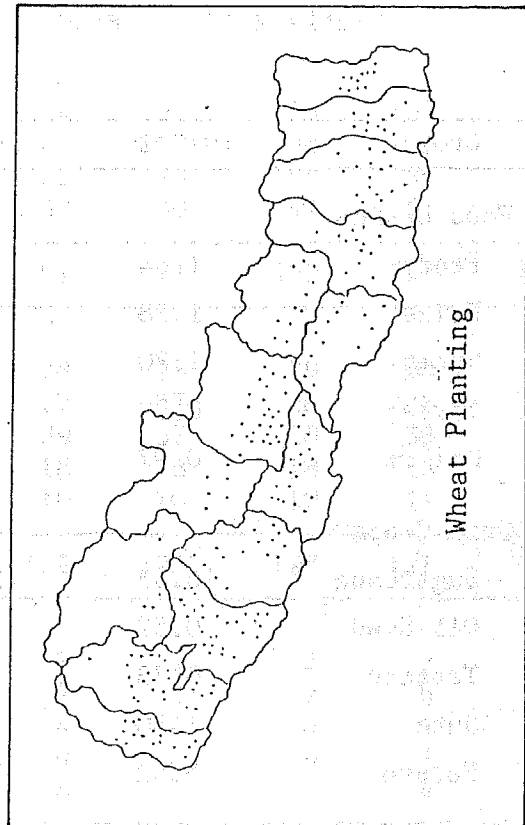
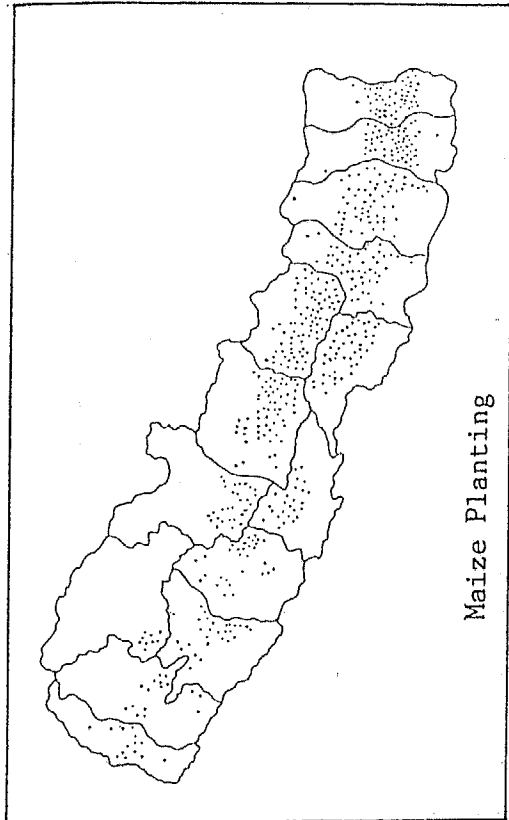
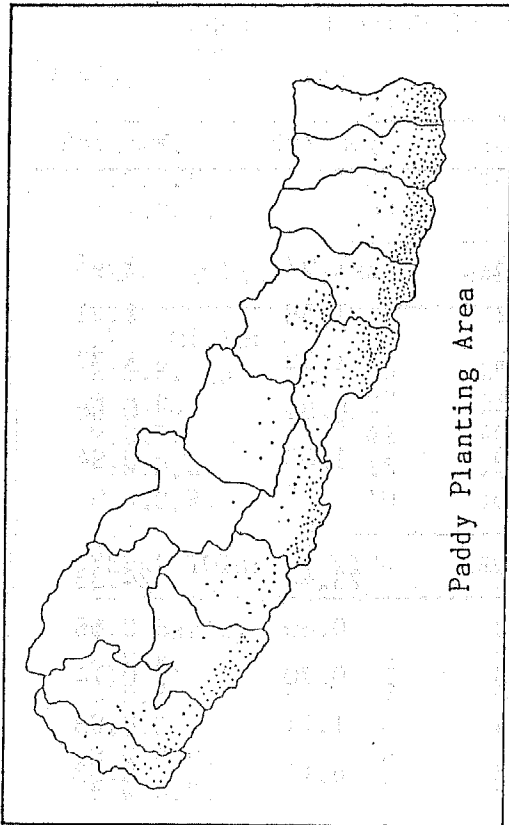


Fig. 2.4 Distribution of Agricultural Plantations

Table 2.12 Production of Principal Crops  
(In Thousand M. Ton)

Crop	1979/80	1980/81	1981/82	1982/83
<b>Food Grain</b>				
Paddy	2,060	2,464	2,560	1,833
Maize	554	743	752	718
Wheat	440	477	527	657
Barley	23	23	23	21
Millet	120	120	121	121
<b>Cash Crops</b>				
Sugarcane	385	484	591	617
Jute	68	59	43	31
Oil Seed	61	76	79	69
Tobacco	5	6	6	7
Potato	278	279	320	373

Source: Food & Agricultural Marketing Services Department & Jute Development Trading Corporation.

Table 2.13 Productivity of Principal Crops  
(M. Ton per Hectare)

Crop	1979/80	1980/81	1981/82	1982/83
<b>Food Grains</b>				
Paddy	1.64	1.93	1.97	1.45
Maize	1.28	1.62	1.58	1.41
Wheat	1.20	1.22	1.32	1.37
Barley	0.90	0.86	0.86	0.86
Millet	0.97	1.00	1.00	0.94
<b>Cash Crops</b>				
Sugarcane	16.63	20.02	23.44	24.33
Oil Seed	0.52	0.63	0.69	0.66
Tobacco	0.73	0.76	0.70	0.74
Jute	1.50	1.14	1.21	1.28
Potato	5.42	5.55	6.15	6.33

Source: Food & Agriculture Marketing Services Department & Jute Development & Trading Corporation

Table 2.14 Area and Production of Principal Crops by Regions (1/2)  
(Area in hectares and production in metric tons)

Development Region	1979/80		1980/81		1981/82		1982/83	
	Area	Pro- duc- tion	Area	Pro- duc- tion	Area	Pro- duc- tion	Area	Pro- duc- tion
I. Paddy								
E.D.R.	413	773	418	793	428	754	388	550
C.D.R.	414	780	415	832	418	961	407	573
W.D.R.	231	291	239	455	248	455	248	383
M.W.D.R.	110	137	111	220	115	224	127	187
F.W.D.R.	87	79	93	164	87	166	94	139
NEPAL TOTAL	1255	2060	1276	2464	1296	2560	1265	1833
II. Maize								
E.D.R.	98	126	109	170	119	185	125	157
C.D.R.	127	149	132	223	149	254	161	250
W.D.R.	95	111	101	167	98	148	106	147
M.W.D.R.	80	117	80	130	78	119	82	116
F.W.D.R.	32	51	35	53	32	46	37	49
NEPAL TOTAL	432	554	457	743	476	752	511	718
III. Wheat								
E.D.R.	60	71	50	65	48	69	77	112
C.D.R.	142	184	154	196	149	207	184	263
W.D.R.	77	88	86	104	88	106	96	136
M.W.D.R.	54	64	62	73	68	88	71	84
F.W.D.R.	33	33	39	39	47	57	56	62
NEPAL TOTAL	366	440	391	477	400	527	484	657
IV. Millet								
E.D.R.	30	29	28	28	29	28	30	29
C.D.R.	27	27	27	27	28	26	29	25
W.D.R.	42	40	39	37	38	38	41	39
M.W.D.R.	15	14	18	18	18	18	17	17
F.W.D.R.	10	10	10	10	10	11	11	10
NEPAL TOTAL	124	120	122	120	123	121	129	121
V. Barley								
E.D.R.	2	2	2	2	2	2	2	2
C.D.R.	7	6	7	5	7	6	5	5
W.D.R.	4	4	4	4	4	4	4	4
M.W.D.R.	8	7	9	8	9	7	9	8
F.W.D.R.	5	4	4	4	5	4	4	4
NEPAL TOTAL	26	23	26	23	27	23	24	21

Table 2.14 Area and Production of Principal Crops by Regions (2/2)

(Area in hectares and production in metric tons)

Development Region	1979/80		1980/81		1981/82		1982/83	
	Area	Pro- duc- tion	Area	Pro- duc- tion	Area	Pro- duc- tion	Area	Pro- duc- tion
VI. Potato								
E.D.R.	22	121	21	130	22	140	22	134
C.D.R.	15	81	14	73	15	99	21	147
M.D.R.	7	38	7	35	7	38	8	47
M.W.D.R.	5	26	6	30	6	31	6	32
F.W.D.R.	2	12	2	11	2	12	3	14
NEPAL TOTAL	51	278	50	279	52	320	59	373
VII. Sugarcane								
E.D.R.	3	51	3	52	3	81	3	77
C.D.R.	13	216	13	263	14	329	14	346
W.D.R.	6	111	8	153	7	165	7	182
M.W.D.R.	.27	4	.74	13	.69	13	.34	6
F.W.D.R.	.21	3	.18	3	.20	3	.33	5
NEPAL TOTAL	22.48	385	24.92	484	24.89	591	24.67	617
VIII. Oil seeds								
E.D.R.	25	11	24	14	20	13	14	8
C.D.R.	34	17	29	17	28	20	30	21
W.D.R.	17	8	18	11	15	10	12	7
M.W.D.R.	28	18	32	21	32	22	33	20
F.W.D.R.	13	7	19	13	19	14	21	13
NEPAL TOTAL	117	61	122	76	114	79	110	69
IX. Tobacco								
E.D.R.	2	2	2	2	2	2	3	2
C.D.R.	4	3	4	3	4	3	6	4
W.D.R.	.31	.16	.32	.22	.29	.22	.21	.13
M.W.D.R.	.33	.23	.52	.33	.37	.24	.26	.18
F.W.D.R.	.16	.10	.19	.12	.19	.12	.70	.30
NEPAL TOTAL	6.80	5.49	7.03	5.67	6.85	5.58	10.17	6.61

\* Figures may not add to total due to rounding errors.

Source: Food and Agricultural Marketing Services Department.

## 2.2.4 Manufacture

Nepal's manufacturing industry has relation with agricultural sector and main products are textile, jute sugar and cigarettes as shown in Table 2.15. Although many medium and large scale industries have begun to operate in the Terai, most of the industries in the nation are of small-sized cottage industries. The Central Development region which includes city of Kathmandu and such industrial centers as Birganj and Janakapur has most of the industries in the nation as shown in Table 2.16. The nation's overall industrial production is on the steady increase with annual rate of growth of some 8.8% in the period between 1979/80 and 1982/83 as shown in Table 2.17. The number of industries and workers according to different industrial censuses by regions are listed in Table 2.18 and 2.19.

Table 2.15 Production of Principal Industries

Industrial Goods	Unit	1979/80	1980/81	1981/82	1982/83
Jute Goods	M.ton	14,777	16,264	15,502	18,958
Sugar	M.ton	14,158	12,020	20,764	23,357
Cigarette	10 <sup>6</sup>	16,424	18,113	28,345	32,090
Matches	10 <sup>3</sup> gross	699	626	760	858
Liquor*	10 <sup>3</sup> litre	698	788	477	334
Soap	M.ton	1,174	2,631	3,050	5,100
Shoes	Pairs	70,299	81,845	61,450	88,148
Leather	10 <sup>3</sup> pieces	1,857	1,802	1,637	2,800
Agricultural Tools	M.ton	207	86	153	368
Tea	M.ton	387	535	625	714
Stainless Steel					
Utensils	M.ton	760	470	468	374
Straw Board	M.ton	965	1,638	1,189	737
Brick & Tile**	10 <sup>3</sup> pieces	33,791	25,642	20,884	30,689
Beer	10 <sup>3</sup> litre	1,310	1,459	1,276	1,992
Fertilizers	M.ton	287	254	400	863
Cotton Textiles	10 <sup>3</sup> metre	3,489	5,317	6,862	7,966
Cement	M.ton	29,163	32,326	30,378	36,959
Plastic goods	M.ton	69	79	82	130
Biscuits	M.ton	1,912	1,675	2,267	2,279
Plywood	10 <sup>3</sup> sq.ft	3,051	4,149	4,647	2,306
Polythene Pipes	10 <sup>3</sup> metre	426	788	1,646	2,772
Synthetic Textiles	10 <sup>3</sup> metre	2,190	2,329	2,677	3,023
Iron Goods	M.ton	5,963	5,070	7,260	11,692

\* Distillery Production only

\*\* Production of Brick & Tile Factory only

Source: Economic Survey, 1983-84, Ministry of Finance

Table 2.16 Manufacture Establishment in 1981/1982

(In Million NRs.)

Name of District	No. of Establish-ment	Gross Output	Gross Input	Value Added
1. Mahottari	184	379,892	246,638	133,254
2. Dhanusha	213	335,010	225,198	109,812
3. Sindhuli	28	5,401	3,497	1,904
4. Ramechhap	8	4,969	3,329	1,640
5. Dolakha	2	0	0	0
6. Sarlahi	194	137,614	91,242	46,372
7. Kabhreplanchok	71	56,063	38,676	17,387
8. Kathmandu	521	724,342	466,166	258,176
9. Bhaktapur	129	281,797	198,745	83,052
10. Lalitpur	148	142,039	88,807	53,232
11. Sindhupalchok	1	0	0	0
12. Nuwakot/Rasuwa	48	6,957	4,456	2,501
13. Dhading	10	24,576	17,811	6,765
14. Makawanpur	77	351,290	241,386	109,904
15. Rauthat/Bara/Parsa	614	671,542	397,130	274,412
16. Chitwan	247	238,333	172,264	66,069
C.D.R. TOTAL	2,495	3,359,825	2,195,345	1,164,480
17. Mechi	247	715,905	489,708	226,197
18. Koshi	407	880,572	643,727	236,845
19. Sagarmatha	323	374,889	221,286	153,603
E.D.R. TOTAL	977	1,971,366	1,354,721	616,645
20. Gandaki	305	171,428	119,855	51,573
21. Dhawalagiri	43	18,610	10,831	7,779
22. Lumbini	626	1,001,478	673,956	327,522
W.D.R. TOTAL	974	1,191,516	804,642	386,874
23. M.W.D.R. TOTAL	265	301,240	212,121	89,119
24. F.W.D.R. TOTAL	192	274,222	170,048	104,174
NEPAL TOTAL	4,903	7,098,169	4,736,877	2,361,292

Source: National Planning Commission

Table 2.17 Production Index of Principal Industries\*  
(Base Year 1974/75 = 100)

	1978/79	1979/80	1980/81	1981/82	1982/83
Jute Goods	126.54	120.48	132.60	126.39	154.57
Sugar	228.07	118.72	100.79	174.11	187.46
Cigarettes	68.92	54.72	60.35	94.44	106.92
Matches	111.56	107.70	96.46	117.10	132.20
Liquor	203.12	311.61	351.79	212.95	149.11
Soap	125.81	131.76	295.29	342.31	572.39
Shoes	79.63	100.36	116.85	87.73	125.85
Leather	211.88	298.07	289.25	262.76	449.44
Agricultural	59.67	69.00	28.67	51.00	122.67
Tools					
Tea	128.35	152.36	210.63	246.06	281.10
Stainless Steel	188.46	487.18	301.28	300.00	239.74
Utensils					
Brick and Tiles	48.50	132.13	100.26	81.66	120.00
Beer	171.66	190.41	212.06	185.47	289.53
Cotton Textiles	57.83	83.08	126.60	163.38	189.67
Cement	78.04	108.27	120.02	112.79	137.23
Biscuits	338.94	318.14	278.70	377.20	379.20
Plywood	298.02	502.64	683.53	765.57	379.90
Synthetic Textiles	157.36	194.15	206.47	237.32	268.00
<b>TOTAL</b>	<b>134.86</b>	<b>142.53</b>	<b>143.12</b>	<b>159.55</b>	<b>188.88</b>

\* Based on Industrial Survey of 1976/77

Source: Central Bureau of Statistics.



Table 2.18 Number of Industries by Development Region

Unit: Number of Firms

	E.D.R.	C.D.R.	W.D.R.	M.W.D.R.	F.W.D.R.	NEPAL TOTAL
1965/66	277	690	195	53	42	1,257
1972/73	507	1,391	382	142	82	2,434
1977/78	745	1,787	665	180	151	3,528
1982/83	992	2,527	888	300	177	4,884

Source: Central Bureau of Statistics.

Table 2.19 Number of Industrial Employment by  
Development Region

Unit: Number of Employments

	1965/66	1972/73	1977/78	1982/83
E.D.R.	7,050	15,538	15,561	30,239
C.D.R.	5,474	24,881	22,134	46,418
W.D.R.	1,045	4,672	7,864	5,132
M.W.D.R.	578	1,897	3,186	3,900
F.W.D.R.	250	650	1,375	2,927
NEPAL TOTAL	14,397	47,638	50,120	88,616

Source: Central Bureau of Statistics.

### 2.2.5 Tourism

Tourism is one of the industries to be expected further development for rich endowment with cultural tradition and natural beauty. Contribution of tourism in national account is significantly great with foreign-exchange earning of about NRs. 491 million as of 1981/82, which accounts for 33% of nation's total export earning through the figures listed in Table 2.7 and 2.20. Number of foreign tourist is increasing as shown in Table 2.21. But it can be pointed out that development of tourism is slow in progress for its insufficient provision of related infrastructure. Future plan for the development should be compiled in a comprehensive manner in which such provisions of regional foundations as motorble road and facilities for accomodation are considered as well.

Table 2.20 Nepal-Foreign Exchange Earnings from Tourism

Fiscal year	NRs. (in thousand)	U.S. dollar (in thousand)	Variation over previous year
1978/79	416,592	35,007	21.6%
1979/80	518,706	44,716	24.5%
1980/81	616,795	51,831	18.9%
1981/82	493,842	38,149	-19.9%
1982/83	491,077	35,072	-0.6%

Table 2.21 Number of Tourists Arrival in Nepal

Year	Total		By Air		By Land	
	Number	Annual rate of change	Number	Percen- tage	Number	Percen- tage
1979	162,276	3.9	137,865	85	24,411	15
1980	162,897	0.4	139,387	86	23,510	14
1981	161,669	0.8	142,084	88	19,585	12
1982	175,448	8.5	133,309	87	21,939	13
1983	179,405	2.3	152,470	85	26,935	15

Source: Department of Tourism.

## 2.2.6 Land Use

According to recent report prepared by the Survey Department, nearly 55,000 km<sup>2</sup> of land, or 38% of the total land in Nepal, is covered with forest. Agricultural area is about 27,000 km<sup>2</sup> which accounts for about 18% of the total area. The rest of the area which amount to some 65,000 km<sup>2</sup> is used for other purposes as shown in Table 2.22. Waste land covers about 30% of the nations total area.

The project area has rather developed pattern in its land use with cultivated land. There is a distinct difference in the pattern of land-use between the Hilly region and the Terai within the project area; A great number of hillsides in the Hilly region are used as terraced fields and shrub forest. On the other hand, flat paddy fields and forest stretch in the Terai.

Table 2.22 Land-use Pattern in Nepal (1979)

Land-use Pattern	Area in sq.kilometer	Percent of Total area
1. Agriculture area	26,533	18.00
2. Forest area	55,334	37.60
3. Himali area	22,463	15.30
4. Grazing area	19,785	13.40
5. Water area	4,000	2.70
6. Habitation area and roads	1,033	0.70
7. Others (barren land, land slide, etc.)	18,033	12.30
<b>TOTAL</b>	<b>147,181</b>	<b>100.00</b>

Source: The Seventh Plan.



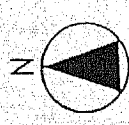


## CHAPTER 3      PRESENT TRANSPORTATION SYSTEM

### 3.1 General

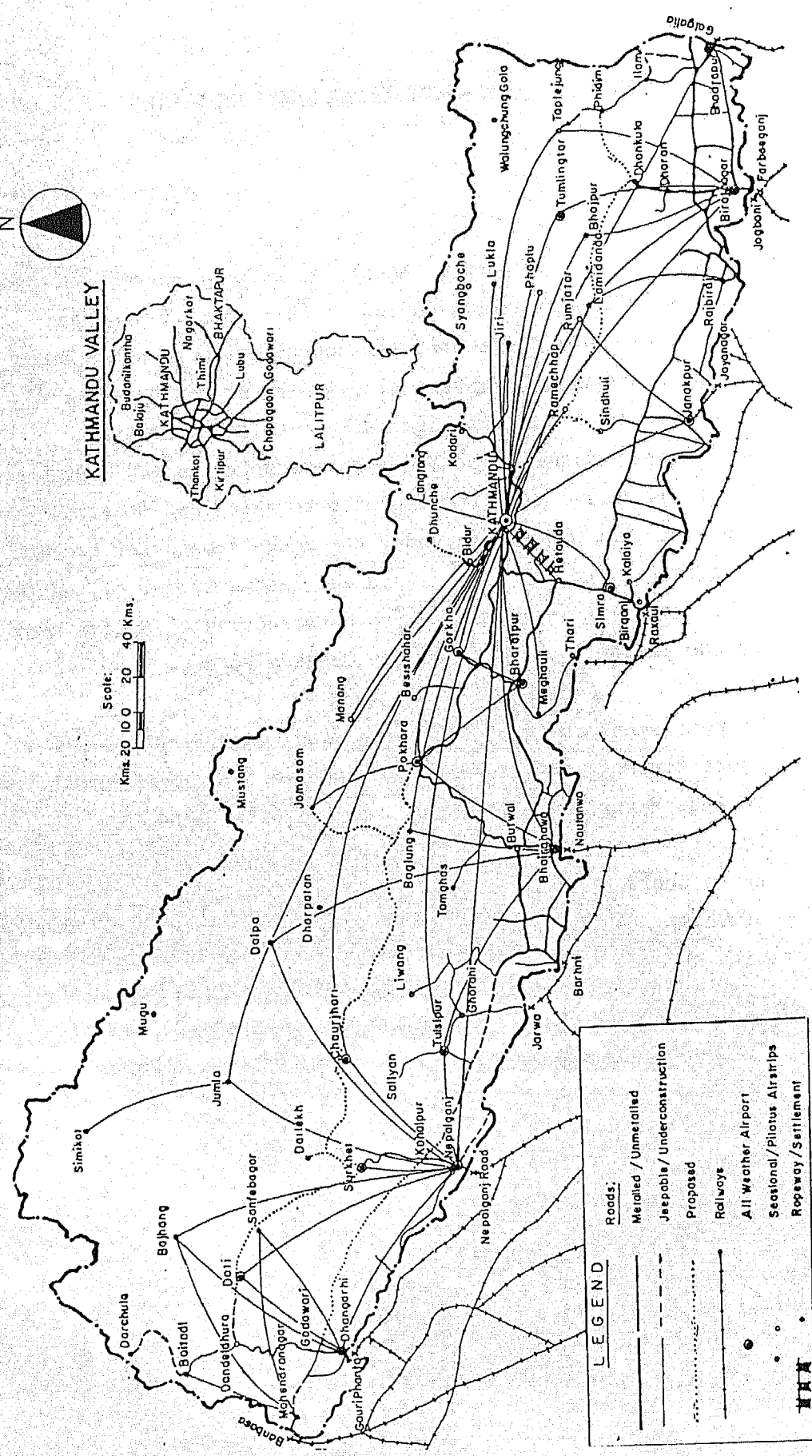
Historically, transport in Nepal has been by porter and pack animals. Transportation demand in this country has been locally oriented by nature, limited to trade among adjacent villages and nearest market places. First construction of motorable road began as late as in the 1950s with the Government's emphasis on building infrastructure. In the Terai Plain, the construction of motorable road started with the east-west connection under the acute demand for traffic on this axis of the nation. In the Kathmandu Valley, on the other hand, it was started with construction of access road to the Indian border and to the Chinese border.

To complement to this developing road, many airports and short-take-off and landing runways have been constructed in various parts of the country. On the other hand, transport by railway, ropeway and waterway is insignificant. There are three short narrow gauge railway lines with the total length of 96 km. The only ropeway, between Kathmandu and Hetauda, with the length of 42 km and capacity of 11,200 tons. Due of rapid stream of river and great fluctuation of water level, transport by waterways is negligible. Present transportation network is shown in Fig. 3.1.



**KATHMANDU VALLEY**

Scale:  
Kms. 20 10 0 20 40 Kms.



**Fig. 3.1 Present Transportation Network in Nepal**



## 3.2 Road Transportation

### 3.2.1 Road Networks and Existing Facilities

#### (1) Motorable Road

The Total length of the nation's motorable road is 6,306 km in 1986/87 as shown in Table 3.1. Of this 2,794 km (44.0%) is black-topped, 1,180 km (19.0%) gravelled and 2,332 km (37.0%) earth road. The total road length in 1956, which is the beginning year of the first 5 year plan, was only 624 km as shown in Table 3.1. The above facts mean that average 190 km of road has been constructed annually.

The lack of linked roads has long hindered the socio-economic development throughout the Nepal's history. Many parts of the country remained isolated from the other parts because of inadequate functional linkage. Topographic condition is main reason for the lagged construction of motorable roads. Construction of motorable roads began with the aids of foreign countries, but in the beginning most of the road constructions were focussed on the east-west axis in Terai and on the Kathmandu Valley because of urgent necessity for regional economies at that time. Table 3.2 shows the historical process of road development in the nation and Fig. 3.2 illustrates present road network in Nepal.

Road network in the project area is shown in Fig. 3.3. East-West highway in the Terai and Kathmandu-Pokhara road in the Hilly region constitute east-west axis of the highway network in the nation. On the other hand, such roads as Tribhuvan Highway which connects Kathmandu and Birganj, Mugling-Bharatpur bypass which links Mugling on Kathmandu-Pokhara road to Baratpur on the East-West highway, Kodari road which links Kathmandu Valley to areas

near the Chinese border, and Janakpur-Jaleswor road near the Indian border are main arterial roads in the north-south direction.

Most of the highways which go from north to south contain a great number of sections with curves and up-and-down slopes, as most of these roads pass through steep Hilly areas. Innovative plans which vitalize the north-south axis in the Central Development Region are urgent to be introduced.

## (2) Trails in Hill Areas

Total length of the hill trails in Nepal is estimated to be about 15,000 km to 20,000 km. These trails serve to link villages and regional centers and are playing a vital role in unifying the country. For the sake of easier movement of people and goods in the hill areas during the rainy season, HMG has been taken a number of measures to vitalize the trails. Construction of suspension bridges is one of them. The role of trails in this country is quite significant in the sense that they function complement to the nation's trunk road in the transportation of agriculture products and consumption goods to any corner of the nation's domain.

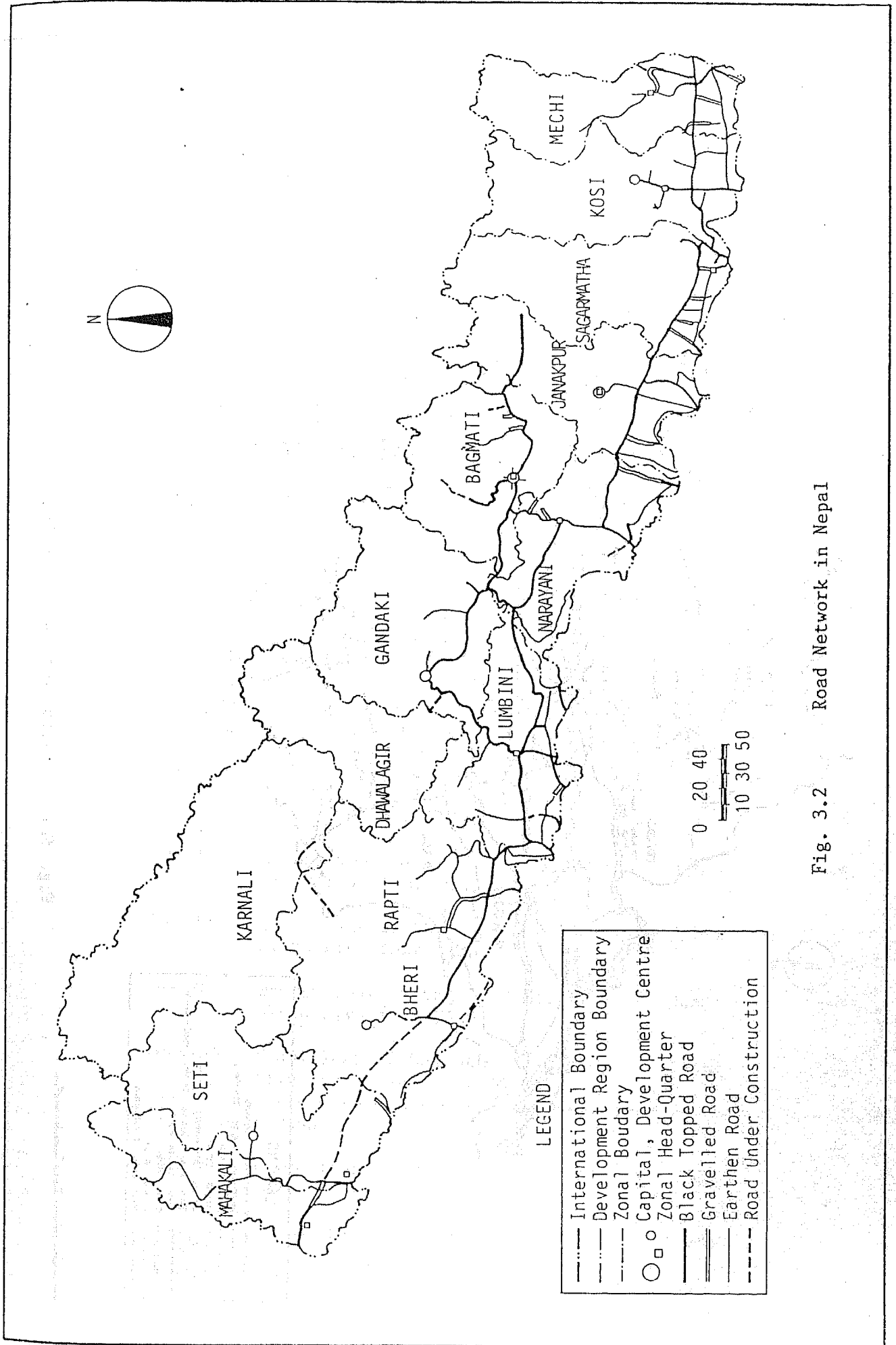
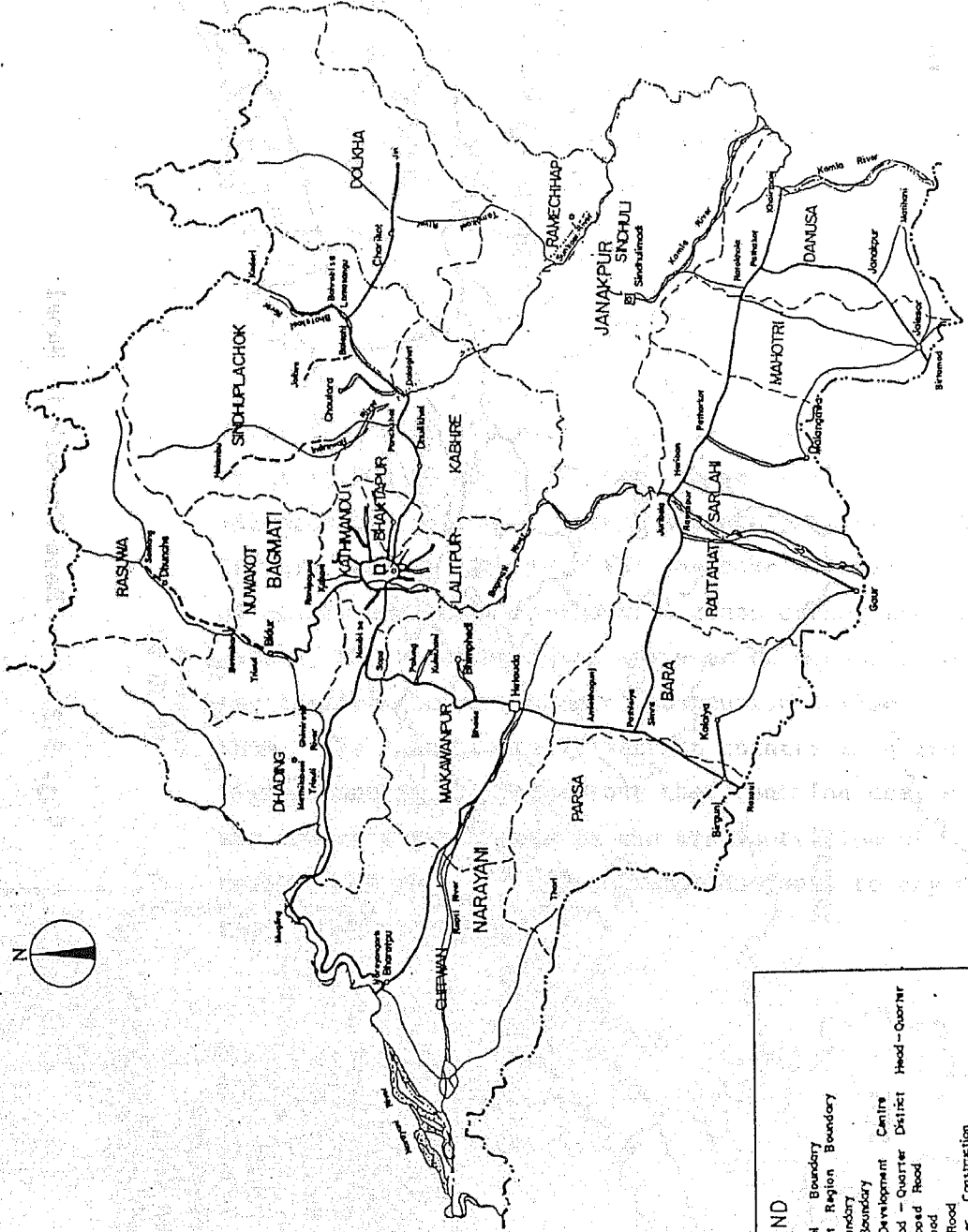


Fig. 3.2 Road Network in Nepal



**LEGEND**

- International Boundary
- Development Region Boundary
- Zonal Boundary
- District Boundary
- Capital
- Development Centre
- Zonal Head - Quarter
- District Head - Quarter
- Block Topped Road
- Gravel Road
- Earthen Road
- Road Under Construction



Fig. 3.3 Road Network in the Study Area

Table 3.1 Road Length, Influenced Population and Area

Plan Year	Description	Total Length (km)	Influenced Population (person)	Influenced Area (km <sup>2</sup> )
- 1951		376	21,250	378
1956	First Five Year Plan	624	13,600	228
1962	Second Five Year Plan	1,193	7,970	119
1965	Third Five Year Plan	2,049	5,130	69
1970	Fourth Five Year Plan	2,504	4,600	57
1974/75	Fifth Five Year Plan	3,173	3,800	45
1975/76	First Year of Fifth Five Year Plan	3,444	3,594	42
1976/77	Second Year of Fifth Five Year Plan	4,136	3,132	35
1977/78	Third Year of Fifth Five Year Plan	4,594	2,921	32
1978/79	Fourth Year of Fifth Five Year Plan	4,691	2,925	31
1979/80	Fifth (Final) Year of Fifth five Year Plan	4,940	2,844	28
1980/81	First Year of the Sixth Five Year Plan	5,021	2,869	28
1981/82	Second Year of the Sixth Five Year Plan	5,270	2,854	28
1982/83	Third Year of the Sixth Five Year Plan	5,546	2,894	27
1983/84	Fourth Year of the Sixth Five Year Plan	5,717	2,882	25
1984/85	Final Year of Seventh Five Year Plan	5,925	2,840	25
The Seventh Plan				
1985/86	First Year of the Seventh Five Year Plan	6,039	2,841	24
1986/87	Second Year of Current Plan	6,306	2,775	23

Source: Department of Road

Table 3.2 Road Development in Nepal

Name of Road	Total Length km	Date of Start	Date of Completion	Foreign Assistance
1. Thankot-Naubise	17	1953	1956	India
(Reconstruction)	17	1978	1982	World Bank
2. Naubise-Mugling	84	1967	1974	China
3. Naubise-Bhainse	97	1953	1956	India
4. Bhainse-Hetauda	10	1958	1967	U.S.A.
5. Hetauda-Narayangarh	78	1973	1983	A.D.B.
6. Narayangarh-Butwal	116	1969	1975	U.K.
7. Narayangarh-Mugling	36	1978	1982	China
8. Khaireni-Gorkha	25	1978	1982	China
9. Mugling-Pokhara	90	1967	1974	China
10. Dhangadi-Dadeldhura	140	1967	-	U.S.A.
11. Pokhara-Sunauli	184	1964	1972	India
12. Kohalpur-Banbasa	204	1973	-	Nepal-India
13. Hetauda-Raxaul	57	1958	1967	U.S.A.
14. Kohalpur-Surkhet	92	1975	-	Nepal
15. Kathmandu-Kodari	114	1963	1967	China
16. Kathmandu-Trishuli	68	1957	1963	Nepal-India-U.S.
17. Butwal-Kohalpur	251	1973	-	India
A. Butwal-Chandrauta	-	-	-	-
B. Chandrauta-Krishna-nagar	-	-	-	-
C. Chandrauta-Shivapur	-	-	-	-
18. Bhairahawa-Lumbini	22	1973	1978	Nepal
19. Pathalैया-Dhalkebar	109	1967	1972	U.S.S.R.
20. Dhalkebar-Rajbiraj	95	1967	1974	India
21. Rajbiraj-Itahari	69	1967	1974	India
22. Itahari-Kakarbhitta	92	1967	1974	India
23. Charali-Ilam	78	-	-	Nepal
24. Jogbani-Dharan	50	-	-	U.K.
25. Lamosangu-Jiri	110	1975	-	Switzerland
26. Dharan-Dhankuta	50	1976	1985	U.K.

Source: Department of Road

### 3.2.2 Road Traffic

The present traffic volumes on some major arterial roads, surveyed by the study team in 1986 and some of the data by the DOR, are shown in Table 3.3. From these data, following road use patterns nearby the Project Road are pointed out: The most heavily trafficked route in the study area is one which goes from Kathmandu to Pathlaiya via Hetauda, Narayangarh, Mugling and Naubise. The traffic volume on this route is ranging 800 to 1,400 vehicles a day. The maximum traffic volume of about 1,400 was recorded on the section between Kathmandu and Naubise. According to the information by DOR, the Mugling - Baratpur bypass is more used than Tribhuvan highway by the traffic between the Kathmandu Valley and the Terai Plain. Traffic volumes on the East-West highway are in the range of 600 to 1,100 a day. The traffic on the Kodari road is about 700 per day. Traffic on the existing Sindhuli road near Bardibas is about 80 a day including very local traffic. The average annual growth rate of traffic volume on highways in Nepal was about 8% in the last decade.

### 3.2.3 Administration

HMG/N has given all the responsibility to the Department of Road for the development of the roads in Nepal. The Department of Road belongs to under the Ministry of Works and Transport. This department looks after all about the road planning, construction and maintenance work. The organization chart for highway management is shown in Fig. 3.4.

Nepal is divided into 75 districts forming 14 zones and 5 development regions. To maintain law and order, zonal commissioners and chief district officers are responsible for the zones and districts respectively.

Table 3.3 Traffic Volume on Major Highways (24 hours)

Name of Highway	Survey Point	1986 Traffic Survey (by the Study Team)	1984 (by DOR)
Kathmandu - Pokhara	Kathmandu	1401	-
	Naubise		
	Naubise	-	546
	Mugling		
East West Highway	Narayangarh	-	1136
	Hetauda		
	Pathlaiya	639	495
	Dhalkebar		
Tribhuvan Highway	Naubise	-	218
	Hetauda		
	Hetauda	836	776
	Pathlaiya		
	Pathlaiya	-	894
	Birgunj		
Mugling Baratpur Bypass	Mugling	842	670
	Baratpur		
Kodari Road	Banepa	695	-
	Dolanghat		
Sindhuli Road	Near Bardibas	79	-



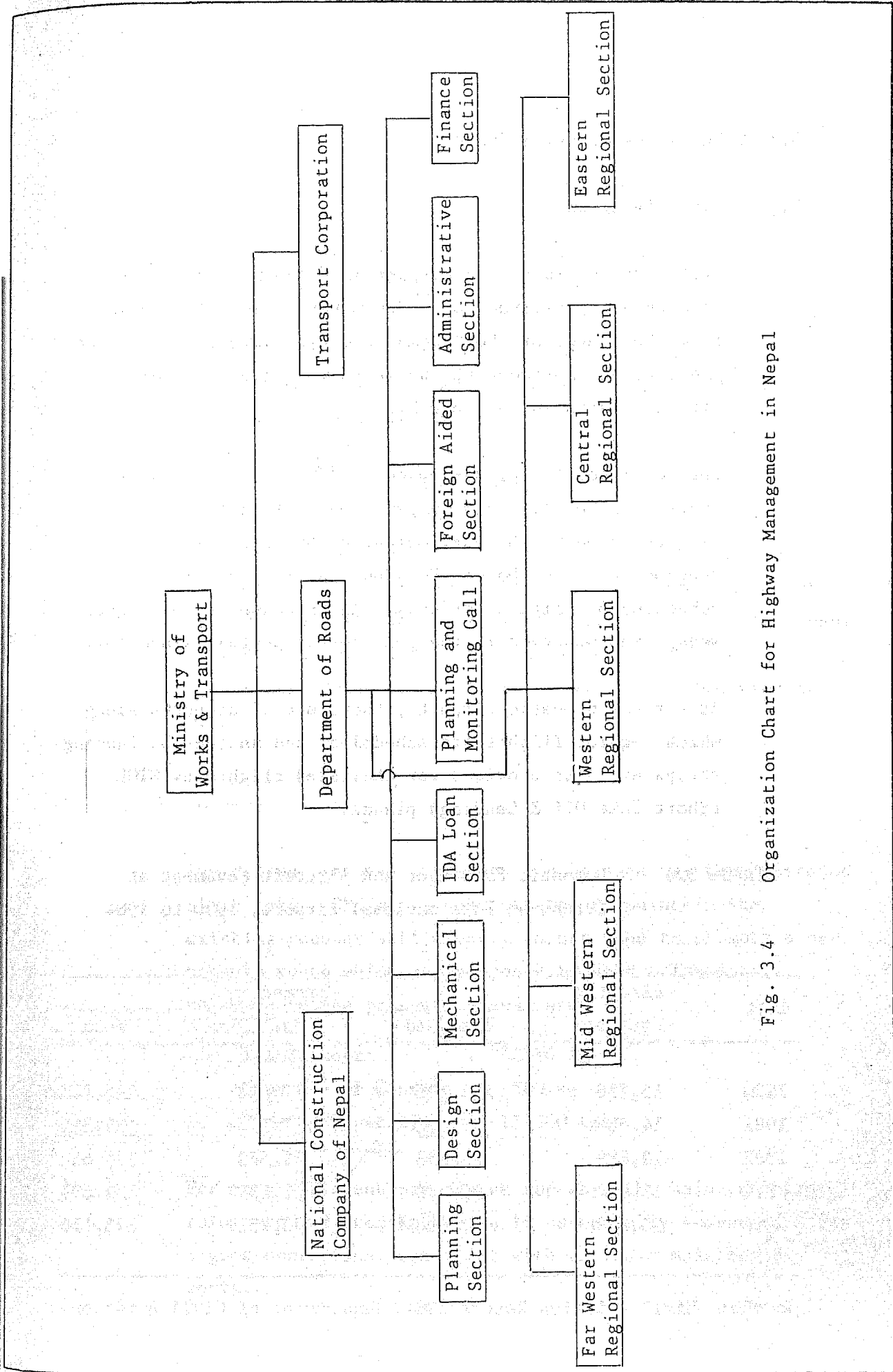


Fig. 3.4 Organization Chart for Highway Management in Nepal

### 3.3 Other Transportation System

#### 3.3.1 Civil Aviation

Tribhuvan International Airport in Kathmandu Valley is located at an altitude of 1,296 meters, and only 6.5 km from the center of the Kathmandu city. Domestic passenger and aircraft movement at the Tribhuvan International Airport are shown in Table 3.4.

The Royal Nepal Airlines owned by HMG is the sole airline company in Nepal. This company operates international flights to Delhi, Bombay, Calcutta, Benares, Patna, Bangkok, Colombo, Dacca, Hongkong and Rangoon with scheduled 57 flights per week. An increase of 20 flights weekly was observed in the past 3-year period, since 1979.

As for the domestic airports, there are 26 airports among which regular flights are scheduled, and another 35 landing strips are also provided for chartered flights by STOL (Short Take Off & Landing) planes.

Table 3.4 Domestic Passenger and Aircraft Movement at Tribhuvan International Airport, 1980 to 1984

Year	Aircraft Movement	Passenger		
		Embarked	Disembarked	Total
1980	15,256	104,499	106,308	216,807
1981	14,457	94,438	96,494	190,332
1982	12,889	73,038	79,573	152,611
1983	13,994	76,463	76,167	152,639
1984	15,119	86,400	86,756	173,156

Source: Civil Aviation Report 1984, Department of Civil Aviation.

### 3.3.2 Railway

Railways in Nepal consists of three lines. The Janakpur line in a length of 53 km has been built in 1929. The Nepal Railroad line has a length of 8 km. The Kosi line is in a length of 35 km. The function of Janakpur line which is an extension of the Indian Railway network from Janakpur caters to pilgrims from India. The line also meet the local demand. The number of passengers was estimated to be about 1.5 million in 1982. The Nepal Railroad Line is also an extension of Indian Railway, extending from Raxaul to Birganj, established for the sake of transporting bulk cargoes. The Kosi line, which was built to transport construction materials to the Kosi River Barrage, operates now seasonally to transport materials for maintenance of the barrage. The Jankapur line is now managed by the Nepal Transport Corporation. In fact, Railways play no significant role in the inter-regional transportation in Nepal.

### 3.3.3 Ropeways

The ropeway between Kathmandu and Hetauda has been operated since 1964. HMG/N has concentrated to maintain the existing ropeway sufficiently rather than to promote a new ropeway route which was proposed by UNDP. The data relating to the present ropeway are;

Total length	:	42.14 km
Capacity of Gondola	:	560 kg
Ropeway Capacity	:	11,200 tons

For more efficient use of the ropeway, the balanced cargo volume to and from Kathmandu is essentially necessary under a good operational condition with periodic maintenance works.

#### 3.3.4 Waterway

Topographic condition of Nepal has restricted use of waterway as a method of transportation. A very few rivers in Terai area accept navigation by small boats and transport of grain food to India by the said measure. In 1968, a private shipping company was licensed by HMG. Two private shipping companies is now operating but the transportation by waterway does not play significant role in Nepal.



