

KINGDOM OF NEPAL  
UDAIPUR CEMENT PLANT ESTABLISHMENT PROJECT  
FEASIBILITY STUDY REPORT  
( VOL. I MAIN PART )

June, 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

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## P R E F A C E

The Government of Japan, at the request of His Majesty's Government of Nepal, decided to undertake a Feasibility study in order to promote a plan for establishment of a cement plant in Udaipur district, Sagar-matha zone, and entrusted its implementation to The Japan International Cooperation Agency.

The Agency organized a survey team consisting of ten experts, headed by Mr. Ryo TOYABE, Onoda Engineering and Consulting Co., Ltd. and dispatched the team to Nepal for a period of 50 days from January 5 to February 23, 1978.

The survey team carried out the field survey of raw materials and collected the samples in Sindali, Beltar and peripheral areas. The team carried out a detailed studies concerning the cement market and the economic situation in Kathmandu City, Biratnagar City, Rajbiraj City and Gaighat Town.

With regard to the site of the cement plant, the selection of potential site was made and site surveys and studies for making basic plan and basic design as well as the survey on the infrastructure of neighboring areas were carried out.

Upon returning to Japan, the team promoted analytical and design work based on the data collected in Nepal, and made up the report.

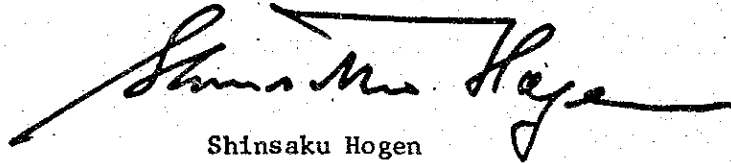
In this report, we presented the outline of Nepal, the cement raw materials in Udaipur district, the basic plan for establishment of cement plant, the calculation of construction cost of the plant, the economic evaluation and the recommendations for the implementation of the project.

We hope that this report will contribute to the promotion of economic development in Nepal, and will promote friendship between the two countries.



In conclusion, I would like to express our hearty gratitude to the survey team members for their effort to accomplish their task and to those governmental officials of Nepal, the Embassy of Japan in Nepal, the Ministry of Foreign Affairs and the Ministry of Trade and Industry who cooperated in this effort.

June, 1978

A handwritten signature in black ink, appearing to read 'Shinsaku Hogen', with a long horizontal stroke extending to the right.

Shinsaku Hogen

President

Japan International Cooperation Agency





June, 1978

Mr. Sinsaku Hogen  
President  
Japan International Cooperation Agency

Dear Sir,

Attached please find our report on the results of our studies carried out in Japan concerning the "Study on the Udaipur Cement Plant Project of the Kingdom of Nepal" with which we have been entrusted.

This complements the report submitted to you in March this year on the on-the-spot studies effected between January 5 and February 23, 1978.

*Tadashi Matsumoto*

Tadashi Matsumoto  
Vice President  
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## FOREWORD

### - Purpose and Development of this Study -

Until only 27 years ago now, i.e. 1951, Nepal was almost totally inaccessible to the outsiders.

Negligible efforts were made for the economic development of the country at that time. On account of the political and geographical situation, the country remained isolated for a long time from the rest of the world.

Immediately after a new political set up was established in 1951 replacing the old one, versatile development works was set about. Namely, since the start of the First Five Year Plan\* in 1951 the Five Year Plans were implemented continuously and now the Fifth Five Year Plan is being executed.

As compared with the agricultural sector which plays a dominant role in the economy of Nepal accounting for about two-thirds of Gross Domestic Product (GDP), the contribution of the industrial sector to the overall economy is small because of the early stage of general economic development and the smallness of domestic market for manufactures in Nepal etc.

In consideration of the situation, His Majesty's Government of Nepal (HMG) started to promote the development of industrial sector.

In February 1974, HMG issued an industrial policy statement which aims at : \*\*

- (1) improvements in industrial production and productivity ;
- (2) creation of employment opportunities ;
- (3) maximum mobilization of local capital, skills and natural resources ;
- (4) Self-reliance in essential consumer goods and construction materials ;
- (5) minimization of regional economic imbalance ; and
- (6) improvement in the balance of payments through increased exports and imports substitution.

With such a background Department of Mines and Geology (DMG) of HMG is making steady efforts for exploration of natural resources.

In the fiscal year 1972/73 limestone of good quality was discovered in Tawa river and its tributaries in Udaipur district of Sagarmatha zone and then a sizeable deposit of high grade limestone was discovered in Sindali in the eastern part of Udaipur district in the fiscal year 1973/74.

After DMG confirmed the excellent quality and scale of this limestone deposit by the detailed investigation including drilling works extending over a period from 1974 to 1977, referring to the results of investigation on Beltar clay deposit discovered simultaneously and market survey of cement, HMG requested the Government of Japan to carry out the feasibility study on plan for establishment of a cement plant utilizing those natural resources as raw materials.

Upon the request from HMG, Japan International Co-operation Agency (JICA) performed the detailed investigation as a part of the technical co-operation of Japan for oversea countries. Accordingly the object of this investigation is quite clear.

That is, after grasping the overall background of the plan for establishment of the cement plant (Project) to carry out :

- (1) market survey ;
- (2) the investigation on raw materials, fuel, utilities, sites, infrastructure, natural and social conditions ;
- (3) the basic study of the plant ;
- (4) the preparation of program for plant construction ;
- (5) the investigation on the profitability ;
- (6) the economic evaluation ; and then based on the overall consideration on the results obtained to judge the feasibility of the Project as well as to give recommendation for the implementation of the Project.

The investigation was started with the departure of the raw material survey team from Japan on 5th January, 1978.

Since the results of initial investigation carried out by this team proved that the raw materials occurred in the deposits are suitable for the Project both in quality and quantity, the general investigation by the main team was carried out in succession from 25th January.

The field investigation progressed favourably throughout the whole period with the positive co-operation extended by DMG and other Departments concerned and completed on 23rd February. After the returning home of the team, the arrangement and analysis of the results of field investigation, the laboratory test of samples collected at field and the design of plant and quarries were carried out and then finally this report was completed in May, 1978.

Note. (1) \* : Refer to II-1-1.

(2) \*\* : Refer to III-1.

The outline of the field investigation is described as follows.

- (1) Raw material investigation
  - Investigation of limestone deposit (including drilling works)
  - Investigation of clay deposit (including pitting works and topographical survey)
  - Investigation of additional raw materials
  - Chemical analysis in field
  - Investigation of mining and transportation of raw materials
- (2) Site investigation
  - Vast area investigation
  - Topographical survey at the favourable site
  - Investigation of utilities (electricity, water etc.)
- (3) Investigation of infrastructure
  - Investigation of roads and bridges
  - Investigation of electricity and communication
- (4) Investigation of natural and social conditions
  - All Nepal
  - Udaipur district
- (5) Market survey of cement
  - Survey of the domestic market
  - Investigation of the possibility of export
- (6) Collection of necessary data and information

## SECTION I GENERAL OBSERVATIONS

### I-1 Premise for the Study

This report has been prepared under the following premises.

#### I-1-1 Cement Market

Although the domestic demand in Nepal and the export to India and Bangladesh are investigated as market, any change of affairs which will reform remarkably the present market conditions will not be taken place.

#### I-1-2 Raw Materials

Since the main raw materials, limestone and clay, were fully investigated by Department of Mines and Geology (DMG), Nepal, the following raw materials were further investigated and confirmed referring to the results obtained so far.

(1) Limestone

Limestone of Sindali deposit

(2) Clay

Clay of Beltar deposit and others

(3) Siliceous material

Silica sand of Trijuga river basin

(4) Ferrous material

Iron ore of Phulchoki deposit (in the suburbs of Kathmandu) and others

(5) Gypsum

Gypsum of Rajasthan, India

Note. No investigation was made on (4) and (5) by our team.

#### I-1-3 Utilities

(1) Electric power

The electric power necessary for the Project will be developed by His Majesty's Government of Nepal (HMG) separately and the construction of power transmission line to the plant site will be carried out by Department of Electricity, Nepal.

Note. The Project : The project of establishment of cement plant in Udaipur district, Nepal.

(2) Fuel

The coal of good quality will be supplied steadily from India at reasonable price.

In this report, Assam coal was used as an example.

#### I-1-4 Infrastructure

##### Road

The roads which link the existing highway with the plant site as well as the plant site with the limestone and clay quarries will be constructed by other project except the access roads of short length.

The new construction and remodeling of the roads for transportation of cement will be performed by other project, too.

#### I-1-5 International Co-operation

The favourable friendly relations will be maintained with the neighboring countries for the implementation of the Project. Especially the transportation of machinery and construction materials, import of raw materials and fuels and export of products etc. will be carried out smoothly.

#### I-1-6 Basic Data for Profitability Calculation

##### (1) General conditions

###### (i) Exchange rate of foreign currency

1 US\$ = 12.45 Rs

1 IC = 1.39 Rs

1 Tk = 0.86 Rs

1 US\$ = 240 Yen

Note. 1. Rs : Nepalese currency (Rupee)

2. IC : Indian currency (Rupee)

3. Tk : Bangladesh currency (Taka)

###### (ii) Depreciation

(a) Residual value 0

###### (b) Durable years

Building and structure 30 years, 3.3 %/y

Mechanical and electrical equipment 18 years, 5.6 %/y

Vehicle and quarry equipment 5 years, 20 %/y

###### (iii) Financing

###### (a) Construction cost and construction interest

Loan (long term) 70 %

Investment by HMG 30 %

- (b) Working capital
  - Loan (short term)            100 % (mostly local loan)
- (iv) Interest
  - (a) Construction cost and construction interest
    - Interest rate                3, 7, 9, 9.5, or 11 %/y
    - Repayment term              20 years
    - Grace period                 5 years
  - (b) Working capital
    - Interest rate                9 or 11 %/y
- (v) Price and unit price
 

The price and unit price in February, 1978 were used as the basis of calculation and no escalation was taken into consideration.
- (vi) Taxes (as per the Industrial Policy - 1974)
  - (a) Income tax
    - Period of exemption : 18 years
  - (b) Excise duty
    - 100 Rs/t.cement
    - Exemption of initial years
      - for first year                100 %
      - second year                   75 %
      - third year                    50 %
  - (c) Sales tax
    - (Exfactory price + Excise duty) x 0.12
- (vii) Sales price of cement at plant
  - 880.8 Rs/t.cement

## I-2 Summary of the Study

### I-2-1 Outline of Nepal and Background of the Project

Nepal is a land-locked country with a land of about 141,000 km<sup>2</sup> surrounded by India (the southern border) and China (the northern border) and is located in the northern part of Indian Subcontinent.

The population has reached as many as about 13,000,000 in 1978.

The topography is rich in variation from the low land in the south to the Great Himalayan Range, the highest of the world, in the north.

With the change of the topography, the climate varies from subtropic climate to alpine climate.



Although most of the people are making a living at agriculture, the cultivated area occupies only 14 % of the country land and therefore the rate of latent unemployment is considerably high.

While the opportunities of employment in sectors other than agriculture are very limited.

Besides 17 kinds of main mother tongues several local languages are used and more than 50 % of the people speak Nepali.

About 90 % of the people are Hindu and 7.5 % are Buddhist.

On account of the political and geographical situation, the development of the country are far behind as compared with the rest of the world. Although since 1956 the development plans have been implemented over several times, the development of the country is still on the way. (Refer to II-1 and II-2.)

The agricultural sector plays a dominant role in national economy among all the industries and the contribution of other industries are very small.

Under in the circumstances HMG has recognized the importance of industrial development and started to promote it.

Since the establishment of a cement plant coincides particularly with the purpose, after the discovery of favourable raw material deposits in Udaipur district the promotion of the Project has been proposed. Accordingly the expectation for the Project both of HMG and the people is remarkable.

#### I-2-2 Supply and Demand of Cement

As for the cement market condition in future, the domestic demand in Nepal seems to increase favourably by her development policy etc.

After the completion of the plant of Hetauda Cement Industries Ltd. which is the second cement company in Nepal in addition to the existing Himal Cement Co. the considerable amount of shortage in supply is foreseen.

As for the export, a certain amount of shipment is expected to the neighboring countries such as India and Bangladesh.

(Refer to II-3.)

### I-2-3 Developmental Environment in Udaipur District

#### (1) Natural conditions

Udaipur district lies in the middle-south of Sagarmatha zone, eastern development region, and extends over about 85 km in east and west and about 30 km in south and north.

The southern side is separated from Terai plain by Siwalik range of several hundred meters above the sea level and the hills of about 1,000 meters above the sea level stick out in the north.

The large and small rivers thread their way through those hills and from plains in their basins.

No observatory has been established in Udaipur district and sufficient meteorological data can not be obtained. From the topographical point of view the climate is subtropical monsoon climate, the same as that of Terai plain.

(Refer to IV-1.)

#### (2) Social conditions

Since Udaipur district is adjacent to but separated from Terai plain by Siwarik range, its development is considerably behind compared with the latter.

Even in Gaighat (headquarter of the district, population about 8,000) no utilities such as electricity and water supply are available, and the transportation to and from is made through an unpaved seasonal road linking with Fathepur.

Total population in Udaipur district is about 113,000 and really 98 % of the working population are engaged in agriculture (census in 1971). No special commercial activity exists except the market in big towns opened regularly once or twice a week to cater goods of daily needs. Being out of those towns, small villages connected with a mountain path are spattered.

(Refer to IV-2.)

### I-2-4 Assessment of the Raw Materials

#### (1) Geology (Raw material condition)

##### (a) Limestone

The limestone of Sindali deposit contains more than 52 % of CaO (principal composition) on the average and the content of harmful

compositions are lower than the allowable limit and therefore this limestone is of very good quality for manufacturing portland cement. The proved reserves is about 51,400,000 t which will last for about 80 years in case that plant capacity is 1,500 t/d (clinker base).

(b) Clay

In the clay of Beltar deposit, the main compositions such as  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  are contained in favourable proportion and the content of harmful compositions are low. The particles are very fine and well weathered.

The reactivity is favourable too.

This clay is of good quality for manufacturing portland cement.

The proved reserves is about 6,550,000 t which will last for about 42 years in case plant capacity is 1,500 t/d (clinker base).

(c) Silica sand

The silica sand occurred in the basins of Trijuga river contains more than 85 % of  $\text{SiO}_2$  (principal composition) and is of suitable quality for manufacturing portland cement.

Since the silica sand is distributed widely over the basins of main stream and tributaries its reserves is sufficient for the Project.

(d) Iron ore

As a ferrous material the iron ore of Phulchoki is scheduled to be purchased.

This iron ore contains about 80 % of  $\text{Fe}_2\text{O}_3$  (principal composition) and is of good quality for manufacturing portland cement.

The quantity to be used for the Project is small and its reserves is sufficient. The use of an imported iron ore can be considered too.

(e) Gypsum

Gypsum of Rajasthan, India is scheduled to be imported. The purity of the gypsum is more than 80 % and can be used as a retarder of portland cement.

As described above all the raw materials are suitable for manufacturing portland cement both in quality and quantity for the Project.

Although it is confirmed that 3.5 million tons of iron ore at Phulchoki

has been proved by DMG, the reserve of gypsum will have to be confirmed in future. (Refer to V-1 and V-3.)

(2) Supply of raw materials

(a) Limestone

The limestone is exploited by drilling and blasting, blasted secondary and crushed, stored tentatively in the open storage of quarry and transported to the plant site by a ropeway for long distance.

(b) Clay

The clay, being soft, is exploited by manpower and transported to the plant site by trucks.

(c) Silica sand

Like clay, the silica sand is exploited by manpower and transported to the plant site by trucks.

(d) Iron ore and gypsum

Both of them are purchased and transported by suppliers to the plant site.

(Refer to V-2.)

I-2-5 Basic Study of the Cement Plant Project

Examining various factors the following basic plans are recommended.

(1) Choice of the process

Dry process with a suspension preheater system is adopted.

This modern system is widely adopted recently all over the world and can produce steadily the cement of favourable quality with a low heat consumption.

The raw materials in Udaipur district are suitable for this system.

(Refer to VI-1.)

(2) Production capacity of the plant (clinker base)

Taking account of various factors such as the reserves of raw materials, the domestic demand of cement, export possibility etc., the plant capacity of the Project is set in the range from 750 t/d to 1,500 t/d.

In case the Project is commenced immediately to supply the product mainly to the domestic market the plant capacity is either 750 t/d or 1,000 t/d, out of which the capacity of 1,000 t/d is recommended taking the profitability into account.

In case the Project is started comparatively late (after several years) the plant capacity is 1,500 t/d.

In every case, the future expansion should be taken into account in the plant layout.

(Refer to VI-2.)

(3) Location of the plant

After investigated five proposed sites and their vicinities previously selected by DMG, the southern plateau of Trijuga river near Gaighat is selected as the plant site. (N.L. 26°46'50" and Long 86°41'00"E)

(Refer to VI-3.)

(4) Utilities

(i) Fuel

The coal imported from India is used as the fuel for clinker burning process.

(ii) Electric power

The electric power is received through the power transmission line of 132 kV branched from the transmission trunk line constructed along the East-west highway.

The electric power for the limestone quarry is supplied from the plant through the power transmission line of 11 kV.

No electric power is supplied to the clay quarry.

A diesel generator is installed in the plant as an emergency power source.

(iii) Water

Both industrial water and drinking water are taken from Trijuga river (or its underflow) or from wells in the southern plateau of the river.

(Refer to VI-4.)

(5) Transportation of the product

The cement produced in the plant is shipped in bag.

The transportation of the product is made by either truck or trailer.

It is necessary to make efforts for reduction of transportation cost in future.

(Refer to VI-5.)

I-2-6 Basic Design of the Plant

(1) Standards, laws and regulations

Since some of standards have not been established yet in Nepal, the

standards accepted internationally are used.

As for laws and regulations, the legislations such as labor and enterprise legislations, tax legislations and mining legislation etc. are related to the Project.

(Refer to VII-1.)

(2) Quality of cement

The kind of cement to be produced in the Project is ordinary portland cement.

As the quality of raw materials in Udaipur district is favourable, the ordinary portland cement of good quality is produced easily.

(Refer to VII-2.)

(3) Specification of main machinery and equipment

The specification of main machinery and equipment are selected for the plant capacity of 750 t/d, 1,000 t/d and 1,500 t/d (clinker base) respectively.

(Refer to VII-3.)

(4) Plant flow-sheet and layout

(Refer to the attached Dwg. No. P-01 and P-02 as well as VI-4 and VI-5.)

I-2-7 Organization and Personnel Requirements

(1) Organization

The plant is placed under the board of director.

The plant is composed of four division such as production, mining, business and administrative forming a standard organization.

The operations of clay quarry and silica sand quarry are undertaken by contractors.

(Refer to VIII-1.)

(2) Personnel requirements

The personnel requirements are shown in Table 1-2-1.

Table 1-2-1 Personnel Requirements (men)

Plant capacity (clinker base)	Plant	Limestone quarry	Total	Clay quarry	Silica sand quarry
750 t/d	342	95	437	94	22
1,000 t/d	346	106	452	123	29
1,500 t/d	350	125	475	185	44

(Refer to VIII-2.)

## I-2-8 Construction Plan and Schedule of Cement Plant

### (1) Procurement of machinery and equipment and construction materials

The machinery and equipment should be procured taking account of their durability, interchangeability and standardization.

As to construction materials, steel material should be processed steel and cement in paper bag is desirable.

The large scale construction machines which are not available in Nepal are leased from India.

(Refer to IX-1.)

### (2) Transportation of machinery and equipment and construction materials

Four routes stated in X-1-1 are considered for the transportation of machinery and equipment and construction materials.

It is necessary to investigate the bridges whose strength are not clear.

(4 bridges in the East-west highway) (Refer to IX-2.)

### (3) Implementation and time schedule of plant construction

For the implementation of the Project, it is necessary to employ a well experienced consultant.

Although various forms are considered for the contract of construction, care should be taken for the determination.

The period required for the implementation of the Project reaches as long as about 5 years including the construction period of 3 years even in case of smooth progress.

(Refer to IX-3.)

## I-2-9 Infrastructure

### (1) Infrastructures to be developed

#### (i) Roads

The following three roads are necessary for the Project.

#### (a) between Gaighat and East-west highway

(Length 25 km, black top road)

Use : Transportation of machinery and equipment and construction materials together with workers ; raw materials and fuels to be purchased as well as transportation of cement.

#### (b) between Gaighat-Sindali

(Length 18 km, gravelled road)

Use : Transportation of machinery and equipment and construction materials and workers for operation.

(c) between Gaighat-Beltar

(Length 20 km, crushed stone Macadam road)

Use : Transportation of clay and silica sand exploited.

Besides, it is desirable to carry out the extension of width of the roads which are expected to be used for the transportation of cement and the remodeling of bridges of Buri river.

(ii) Housing facilities of workers

In case plant capacity is 1,500 t/d (clinker base) it is necessary to build 412 houses for workers, provided that the company provides 85 % of workers of the plant and 90 % of workers of the limestone quarry with company houses.

(Total land area necessary for the houses reaches as wide as about 13 ha.)

(iii) Communication

The plant site, Gaighat is only connected with Kathmandu and Rajbiraj by wireless communication facilities at present.

It is, therefore, desirable that Gaighat will be linked with main cities such as Rajbiraj, Biratnagar and Kathmandu etc. organically with appropriate communication facilities by the time of the completion of the Project.

(iv) Power transmission facilities

The transmission facilities necessary for the Project are as follows.

(a) Power transmission line between

East-west power transmission truck line and Gaighat

(Length 25 km, 132 kV)

Purpose : The supply of electric power necessary for the Project.

(b) Power transmission line between Gaighat and Sindali

(Length 18 km, 6.6 kV or 11 kV)

Purpose : The supply of electric power necessary for the limestone quarry and the ropeway.

(c) Neighboring area of the plant site

Although no power transmission line is constructed, a feeder for power transmission to the outside of plant is equipped in the plant substation for the purpose of regional development.

The power transmission to the clay quarry is not necessary, because no special load exists in the clay quarry.

(Refer to X-1.)



(2) Approximate cost estimate

(i) Road

The construction cost of three roads described in (a), (b), and (c)  
about  $180 \times 10^6$  Rs

The cost for extension of width of the existing roads and remodeling  
of the bridge of Buri river.

about  $73 \times 10^6$  Rs

Total about  $253 \times 10^6$  Rs

Since these roads etc. are considerably used for public purpose too,  
the cost is assumed to be borne by HMG or other project.

(ii) Housing facilities of workers

The cost for construction of houses, attached facilities and land  
aquisition and preparation amount to :

about  $34 \times 10^6$  Rs

This cost should be borne by the Project because of its purpose.

(iii) Communication

Unless any public communication facilities are completed by the time  
of completion of the Project, minimum quantity of wireless communica-  
tion facilities should be installed at the cost of the Project.

(iv) Power transmission facilities

(a) Construction cost of power transmission line between the East-west  
trunk line and the plant site.

about  $10 \times 10^6$  Rs

This cost is assumed to be borne by HMG or other project.

(b) Construction cost of power transmission line between Gaighat and  
Sindali.

This cost should be borne by the Project because of its purpose.

(Refer to X-2.)

I-2-10 Calculation of Cost and Profitability

(1) Construction cost

The construction cost by plant capacity are shown in Table 1-2-2.

Table 1-2-2 Construction Cost

(Rs)

Plant capacity (clinker base)		750 t/d	1,000 t/d	1,500 t/d
Construction cost		767,157,000	888,635,000	1,086,675,500
Construction interest (C.I.)	rate 9.5 %/y	123,229,480	142,740,700	174,551,770
	7 %/y	90,799,400	105,177,200	128,617,000
	3 %/y	38,914,500	45,076,000	55,121,000
Working capital		17,816,000	23,258,000	34,313,000
Total	C.I. 9.5 %/y	908,203,280	1,054,633,700	1,295,540,200
	7 %/y	875,773,200	1,017,070,200	1,249,605,500
	3 %/y	823,888,300	956,969,000	1,176,110,100

(Refer to XI-1.)

## (2) Production cost

The production costs by plant capacity are shown in Table 1-2-3.

Table 1-2-3 Production cost

(Rs/t.cement)

Plant capacity (clinker base)		750 t/d	1,000 t/d	1,500 t/d
Interest rate of loan				
long term	short term			
9.5 %/y	9 %/y	656.6	604.0	541.5
7 %/y	9 %/y	590.5	546.6	494.7
3 %/y	9 %/y	493.9	461.7	426.3

Note. Year of calculation base : 4th year of the plant operation

(Refer to XI-2.)

## (3) Profitability

Thoroughly examining the break-even points (Table 1-2-4) and the economic indices (Table 1-2-5) obtained from DCF analysis etc., the profitability of the Project are described as follows.

- (i) Although the Project is judged to be profitable for all the plant capacity, i.e., 750, 1,000, 1,500 t/d (clinker base), the more the plant capacity, the better the profitability.
- (ii) Speaking in general, the effect of interest rate is remarkable and especially in small plant capacity the profitability is lowered by high interest rate.
- (iii) The break-even points are favourable figures except the case of high

interest rate (9.5 %/y) for 750 and 1,000 t/d plant showing 78 per cent at maximum and mostly less than 60 per cent. They are lowered as reduction of interest due to the repayment of loan.

- (iv) The economical indices are generally in the favourable range.
- (v) Judging from the results of the sensitivity analysis made for the plant capacity of 1,000 and 1,500 t.c/d, the variations of condition of such ranges as assumed (Table 11-3-4) do not have so much effect on the profitability and in that regards the profitability of the Project is considered to be flexible.

Table 1-2-4 Break-Even Points (%)

Plant capacity (clinker base)	Interest rate (%/y)		Year	Break-even point	Cash Break-even point
	Long term loan	Short term loan			
750	9.5	9	4	93.3	61.2
			18	62.5	30.4
	7	9	4	78.4	46.3
			18	56.6	24.5
	3	9	4	56.7	24.6
			18	47.9	15.8
1,000	9.5	9	4	81.5	53.2
			18	55.6	27.3
	7	9	4	68.7	40.4
			18	49.7	21.5
	3	9	4	49.6	21.3
			18	42.2	13.9
1,500	9.5	9	4	67.6	44.1
			18	45.9	22.4
	7	9	4	57.1	33.6
			18	41.7	18.2
	3	9	4	41.8	18.3
			18	35.6	12.1

Table 1-2-5 Economic Indices

Plant Capacity (clinker base)	Case No.	RME (%)	RMR (%)	Payout (year)	IRR (%)	Remark		
						Interest rate(%/y)		Other conditions
						Construction cost	Working capital	
750 t/d	1-1	16.5	3.8	11.3	2.6	7	9	B.C.
	1-2	28.2	6.6	9.0	6.2	3	9	B.C.
1,000 t/d	2-1	16.0	4.3	10.8	3.9	9.5	9	B.C.
	2-2	23.4	6.0	9.3	6.1	7	9	B.C.
	2-3	33.0	8.8	7.5	9.4	3	9	B.C.
	2-4	32.8	8.8	7.6	9.3	3	11	} Refer to Table 11-3-4.
	2-5	24.3	5.8	9.5	5.2	3	9	
	2-6	39.9	11.9	6.3	13.1	3	9	
	2-7	35.6	10.6	6.7	11.6	3	9	
	2-8	30.4	7.4	8.3	7.5	3	9	
	2-9	35.1	9.4	7.3	10.1	3	9	
	2-10	33.0	8.8	10.0	4.5	3	9	
	2-11	32.6	8.3	7.9	8.4	3	9	
	2-12	31.9	8.5	7.7	8.7	3	9	
1,500 t/d	3-1	21.2	7.0	8.6	7.9	11	9	
	3-2	24.4	8.0	8.0	9.1	9.5	9	B.C.
	3-3	25.4	8.4	7.8	9.5	9	9	B.C.
	3-4	29.7	9.8	7.1	11.1	7	9	B.C.
	3-5	38.2	12.6	5.9	14.1	3	9	} Refer to Table 11-3-4.
	3-6	38.0	12.5	6.0	14.0	3	11	
	3-7	30.2	8.8	7.4	9.7	3	9	
	3-8	44.6	16.3	5.0	18.1	3	9	
	3-9	40.4	14.7	5.1	16.6	3	9	
	3-10	36.1	10.8	6.6	12.0	3	9	
	3-11	40.3	13.2	5.7	14.9	3	9	
	3-12	29.7	9.8	7.4	8.6	3	9	
	3-13	37.5	11.0	6.7	11.7	3	9	
	3-14	37.3	12.3	6.0	13.5	3	9	

Note. B.C. : Basic condition

## I-2-11 Economic Evaluation

The effect of the Project on external economy namely the evaluation from national or regional economic point of view is described as follows. The evaluation on the profitability of the Project is started in I-2-9.

### (1) Improvement of international payments

The Project would help Nepal not only to achieve import substitution of cement but to export a part of cement produced to the neighboring countries.

The amount of foreign exchange saving and acquisition will reach annually as much as about  $137.7 \times 10^6$  Rs in case the plant capacity is 1,000 t/d (clinker base).

### (2) Self-reliance in construction materials

By self-supplying cement, one of the materials for development, the Project would directly contribute to the development of infrastructure in Nepal by ensuring a reliable supply of cement to construction industries.

### (3) Generation of employment opportunities

The Project will generate considerable employment opportunities.

In case the plant capacity is 1,000 t/d (clinker base) number of personnel to be employed is about 600, which corresponds about 3,300 persons of total family member.

Besides quite a few employment opportunities seem to be generated indirectly through the related industries.

### (4) Minimization of regional economic imbalance

The development of the eastern development region, which includes Udaipur district, will be promoted.

### (5) Improvement of technology

The level of industrial technology will remarkably be improved by the establishment of the cement plant.

### (6) Maximum utilization of natural resources

The natural resources of good quality occurred in Udaipur district will be utilized.

### (7) Economic rate of return

The economic internal rate of return of the Project is shown in Table 1-2-6.

Table 1-2-6 Economic Internal Rate of Return (%)

Plant capacity (clinker base)		1,000 t/d	1,500 t/d
Economic price	684.75 Rs or 55 US\$/t.cement	11.4	14.4
	597.60 Rs or 48 US\$/t.cement	8.3	11.1
	498.00 Rs or 40 US\$/t.cement	4.2	6.7

Table 1-2-6 shows that, 1,000 and 1,500 t/d (clinker base) plant :

- (i) in case the economic price is higher than 597.60 Rs (48 US\$)/t.cement, the Project will bring sufficient profit, and
- (ii) in case the economic price is between 597.60 Rs (48 US\$) ~ 498.00 Rs (40 US\$)/t.cement, the profitability will be lowered.

However, if 50 % of the production is sold at this price and the rest is sold at 684.75 Rs (55 US\$)/t.cement, sufficient profit can be obtained.

(Refer to XII.)

#### I-2-12 Conclusion

To sum up we have come to the following conclusion.

The Project for establishment of dry process cement plant in Gaighat is feasible from both economic and technical points of view and its contribution of the economic development of Nepal is highly evaluated.

### I-3 Recommendations for the Implementation of the Project

The Project is one of the large scaled projects in Nepal and therefore its implementation is related not only to Nepal but also to India, Bangladesh and other oversea countries.

To promote the Project satisfactorily, it is necessary to make a detailed plan and sufficient preparation.

It is recommended that immediate attention should be paid to the following items.

#### (1) Construction funds

The development of Nepal achieved so far has been considerably due to the technical and economical co-operation of foreign countries.

The proportion of the loan and grant from foreign countries in the total outlay for development projects in Nepal is about 45 %.

For the project which requires huge construction funds, the financial aid of foreign countries and international financial institution is indispensable. On the other hand a part of funds should be composed of the equity capital and this is assumed to be invested by HMG.

In this report it is assumed that the proportion of foreign aid and the investment of HMG is 70 % and 30 % of the total construction funds respectively.

Since the amount of interest to be borne by the Project is considerably large (Refer to VI-3.), it is desirable to make the interest rate as low as possible and to make the grace period as long as possible.

#### (2) Development of infrastructure (Refer to X-1.)

For the implementation of the Project, the development and remodeling of infrastructures such as construction of roads and power transmission line are necessary.

Since some of them have to be completed before the construction works of the plant, it is desirable to start the works in advance.

Taking it into account that the regional development is remarkably promoted directly or indirectly by these infrastructures, the costs for development of infrastructure should be disbursed by HMG or other project.

#### (3) Acquisition of land

It is necessary to acquire the land necessary for the Project such as the plant site, the quarry sites etc. in advance. After the acquisition the preliminary works such as foundation investigation, preliminary land preparation, construction of access road and piping of water supply can be commenced.

(4) Topographical survey

To facilitate the commencement of the Project in early stage, it is necessary to carry out the topographical survey of the plant site, raw material deposits and transportation line etc.

(5) Negotiation for long term procurement

His Majesty's Government of Nepal should start negotiation with India to procure steadily the following material for long term.

(1) Coal and gypsum

(2) Construction material and construction machinery

(6) Negotiation for export of product

His Majesty's Government of Nepal should start negotiation with India and Bangladesh on export of the products.

For the export to Bangladesh, it is necessary to transport the product through Indian territory for which the approval of India is required.

(Refer to III-3-2.)

(7) Measurement of natural condition

Most of natural conditions such as meteorological data and flooding level etc. at the plant site have not been obtained yet. (Refer to IV-1.)

It is necessary to establish the simple observatories to commence the measurement in advance.

(8) Employment of personnel and training

Since Nepal is short of the engineers of high class and administrative officers, it is necessary to employ those personnel in advance and train them.

(9) Appointment of the technical consultant

In order to execute the Project favourably, it is necessary to get the advice of the foreign technical consultant who is well experienced in the full scale consulting services of the construction of cement plant.

(Refer to IX-3.)

The consultant will carry out from now on the basic design of the plant, the preparation of tender document for international competitive bid, the evaluation of tender submitted by the tenderers, determination of the contractor, supervision of the construction works including commissioning and acceptance and the management guidance of the cement plant. Thus the consultant will play an important role in expediting the construction period, in saving the construction cost and in constructing excellent plant.



(10) Estimate of the construction cost

It is necessary to take the estimate of plant construction cost from a reliable supplier in early stage.

## SECTION II OUTLINE OF THE KINGDOM OF NEPAL

### II-1 The Development Planning in Nepal

#### II-1-1 The Outline of the Development Planning in Nepal

##### (1) The First Plan (1956 ~ 1961)

For over a century, until 1951, Nepal was ruled by the Rana regime. During this period, rigid isolationism was instituted and strictly adhered to, inhibiting development and condemning the country to economic stagnation.

In 1951, a new Government was formed replacing the Rana regime. With the object of adopting phasewise development programs, a new planning nucleus called the "Planning Board" was established in 1955, and this marked the beginning of planned national development in Nepal.

The first plan came into operation in fiscal 1956 with a total expenditure of Rs 330 million. The main objectives of the plan were : to increase production, to create employment opportunities, to raise the standard of living of the ordinary people, to prepare and introduce development-oriented administrative rules and regulations, to develop public institutions necessary for development, to create an economic infrastructure, and to amass statistics.

The plan covered development activities only in the public sector.

As there was a lack of adequate statistics and other relevant information, it was not possible to include private sector activities.

Apart from maintaining law and order, the State was to assume the sole responsibility for : the creation of an effective infrastructure including transport and communication facilities and installation of power plants, the development of social services, the provision of irrigation facilities, and the establishment of large-scale industries. The rest was to be left to the private sector. In addition, the plan proposed that industries in the private sector would be helped to develop with technical and financial assistance from the Government.

The first plan had a modest annual investment expenditure of approximately Rs 7 per head or less than 2 per cent of GDP. However, actual utilization during the plan period amounted to only Rs 210 million against the planned expenditure of Rs 330 million.

The rate of progress is shown in Tables 2-1-1 and 2-1-2.

Table 2-1-1 Allocation of Planned Expenditure and its Utilization  
(Rs. in millions)

Heading	Planned expenditure	Actual expenditure	(%)
Village development	42.5	26.7	(62.8)
Agriculture and forestry	32	7	(21.9)
Public works, communication and transportation	124	94.9	(76.5)
Electricity	30	13.3	(44.3)
Industries, mining and tourism	25	10.4	(41.6)
Health	25	16	(64)
Education	19	21.3	(112.1)
Irrigation and drinking water	20	13.1	(65.5)
Miscellaneous	12.5	11.8	(94.4)
Total	330	214.5	(65)

Table 2-1-2 Planned Targets and Achievements

Heading	Unit	Planned target	Achievement
Village development centers	number	48	55
Cereal development centers	number	18	10
Livestock development centers	number	7	4
Dairy development centers	number	-	5
Cottage industries centers	number	5	21
Industrial estates	number	-	3
Irrigation	acres	275,000	65,000
Power * <sup>1</sup>	kW	20,000	750
Roads	miles	900	564
Ropeways(25 t/h)	miles	28	70 %
Airports	number	-	7
Post offices	number	100	292
Telephones	number of connections	1,500	700
Primary schools	number	630	2,000
Middle and high schools	number	136	165
Colleges	number	-	15
Universities	number	1	1
Hospital beds	number	423	148
Health centers	number	54	94
Ayurvedic hospitals * <sup>2</sup>	number	43	57
Co-operative societies	number	-	378

\*<sup>1</sup> Shows the production capacity.

\*<sup>2</sup> Shows the hospitals giving medical treatment by plants and drugs indigenous to Nepal.

At the time that the first plan was formulated, very little was known about the country's economy. Production, national income, trade and manpower statistics, which are essential for any systematic planning, were not available. Nor was there any assessment of the country's

natural resources. Under the circumstances, the plan could not, of course, set a definite strategy for the country's development. Indeed, it merely reflected an expression of the Government's intentions, and also included such programs as were found to be desirable from the experiences of other developing countries. As a result, some projects were found to be unrealistic after closer investigation, while others had to wait for many years in the absence of an economic infrastructure, such as transport and communication facilities and electricity, that was needed for their implementation. In addition, the country did not have a development-oriented administrative mechanism nor the public institutions needed to effectively execute a development plan. In the absence of an economic infrastructure, the private sector naturally remained very inactive and was not able to fulfil the role assigned to it in the plan.

However, the first plan did serve some useful purposes. First, it was able to create an awareness of the importance of planning for coordinated and speedy national development. Second, obstacles for planning were identified in the course of the implementation of the plan. Attempts were made to remove such obstacles in subsequent plans. Third, some statistical information about the country's economy collected during this period has proved useful for planning in subsequent years. Fourth, difficulties encountered during the implementation of the plan helped the Government to identify areas within the administrative structure that required improvement. In short, despite its shortcomings and failures, the first plan laid a foundation for systematic planning in the following years.

(2) The Second Plan (1962 ~ 1965)

There was a gap of a year between the end of the first plan and the beginning of the second plan, which was of three years' duration. The main purpose for allowing this one year gap was to complete projects which were started during the first plan but not completed, and also to amass more statistical data and other information about the economy so that the second plan could be started with a clean slate and formulated on a sounder basis.

The objectives of the second plan were : to increase production ; to maintain economic stability ; to create employment opportunities ; and to gradually establish a welfare society through equitable distribution of income and wealth. Like the first plan, and for the same reason,

the second plan was not able to include activities in the private sector. During the plan period, the gross domestic product, according to an estimate prepared by the Central Bureau of Statistics, increased by 7 per cent, which was just enough to offset the rise in population. Though the financial target of the plan was virtually achieved, physical achievements remained far behind planned targets in many areas. In fact, contrary to the planners' expectations, the private sector's activities remained almost stagnant. No new industries were set up in the private sector. However, progress was satisfactory in the fields of education and health services. The rate of progress is shown in Tables 2-1-3 and 2-1-4.

Table 2-1-3 Allocation of Planned Expenditure and its Utilization  
(Rs. in millions)

Heading	Planned expenditure	Actual expenditure	(%)
Land reform, survey and statistics, and training	79.2	51.8	(65.4)
Transport, communication and power	234.5	230.9	(98.5)
Agriculture, irrigation and forests	81.6	87.3	(107)
Industry and tourism	102	103.7	(101.7)
Social services	102.7	95.3	(92.8)
Miscellaneous	-	27.8	-
Total	600	596.8	(99.5)

Table 2-1-4 Planned Targets and Achievements

Heading	Unit	Planned target	Achievement
Metaled roads	km	320	72
Fair-weather roads	km	1,120	848
Airports	number	3	-
Store facilities	number	20	3
Telephones	number	900	-
Irrigation	acres	116,000	100,000
Power *	kW	22,000	4,430
Power transmission lines	miles	200	75
Primary schools	number	1,200	1,200
Secondary schools	number	50	163
Cigarettes *	millions/y	2,000	27
Sugar *	tons /y	29,993	2,873
Cement*	tons /y	50,000	-
Paper*	tons /y	6,000	-
Cotton textiles *	million yards/y	20	-
Jute *	tons /y	8,600	-
Cereal development centers	number	8	2
Agriculture centers	number	14	5
Livestock and poultry development centers	number	9	4
Fishery development centers	number	3	1
Hospitals	number	21	22

\* Shows the production capacity.

From the above facts it is clear that the Nepalese people remained as poor at the end of the plan as before. However, from the point of view of the country's long-term development, the second plan made outstanding contributions. For the first time, different ministries and departments of the Government were made to develop their annual programs within the framework of a plan. Second, substantial progress was made in the amassment of basic statistics required to improve planning techniques. Third, works accomplished in the field of transport and communications and power development certainly helped to improve implementation of programs in other areas in subsequent periods.

(3) The Third Plan (1965 ~ 1970)

The first two plans were centered on the marshaling of departmental programs and projects and more or less medium-term capital budgets for the public sector. As such they were not able to define clearly long-term socio-economic objectives of development. Nor were they able to set overall plan targets. The third plan was also partial in scope since the activities of the private sector were covered only in a very general way. However, the plan document did reflect some improvements in planning techniques and maturity in the approach to planning. For the first time, the long-term target and the plan target were fixed in terms of GDP and per capita income.

The plan set an overall target of doubling the national income in 15 years. To achieve this, the national income would have to increase at an average annual rate of 4.7 per cent. It was estimated that the population would increase at a rate of 2.2 per cent per annum during the third plan period and 2.4 per cent thereafter. In this way, the per capita real income would be increased by 62 per cent in 15 years. In view of Nepal's past performance, this target seemed rather ambitious. The plan also fixed long-term targets for road construction and education. The road development program called for the construction of 2,500 miles of road in 15 years. By 1980, primary education was expected to be made free of charge and compulsory.

The third plan set a target of increasing national income by 19 per cent over the five years. This would have raised per capita income by 9 per cent. To do this, the plan called for an expenditure of Rs 2,500 million, of which the public sector's share was Rs 1,980 million and the private sector's share was Rs 520 million.

In the absence of data, the plan was not able to include all investment activities in the private sector. Thus, only private investments in industry, agriculture, transport and housing were projected for the plan period and incorporated in the plan. In fact, planned private sector investments included only those which were expected to be generated as a result of activities of government financial institutions.

In the public sector investment programs, major emphasis was given to the expansion of economic overheads, such as the construction of roads, the creation of communications facilities and the development of power. Emphasis was also placed on institutional changes, building up of

statistical data, maintenance of land records and the development of social services. The development of industry, housing and agriculture was left to the private sector.

GDP increased during the plan period by only 2.7 per cent per annum, as against the target of 3.8 per cent. The per capita income remained more or less unchanged. There were shortfalls in the production of foodgrains and power and in the creation of irrigation facilities. Hardly any progress was made in the field of industry. The rate of progress is shown in Table 2-1-5.

Table 2-1-5 Planned Targets and Achievements

Heading	Unit	Planned target	Achievement
Jute (additional)*	tons/y	15,000	-
Sugar (additional)*	tons/y	25,000	-
Cement *	tons/y	60,000	-
Paper *	tons/y	15,000	-
Plywood *	million sq ft/y	15,000	-
Brewery *	thousand liters/y	1,136	Construction work completed
Textiles *	million meters/y	18	-
Industrial estates	number	5	-
Fair-weather roads	miles	607	455
All-weather roads	miles	758	635
All-weather airfields	number	5	3
Railway terminals	number	1	-
Irrigation	thousand hectares	177	57
Foodgrains (additional)*	thousand tons/y	500	367
Cash crops (additional)*	thousand tons/y	164	88
Power *	kW	48,000	32,000
Primary and secondary schools	number	900	1,619
Hospital beds	number	475	850

\* Shows the production capacity.



(4) The Fourth Plan (1970 ~ 1975)

The fourth plan called for an expenditure of Rs 3,540 million, of which the public sector's share, the panchayat sector's share and the private sector's share were Rs 2,550 million, Rs 120 million and Rs 870 million respectively. Like its predecessor, this was more or less a public investment plan and did not cover all development activities in the private sector. The increase in GDP was estimated at 4 per cent per annum during the plan period and the development objectives were : to maximize output of the GDP ; to establish a base for sustained and long-term economic growth ; to expand and diversify international trade ; to secure accelerated pace of development with maximum economic stability by controlling price levels ; to make effective use of manpower resources and control population growth ; and to create conditions conducive to the emergence of a society free from exploitation. In conformity with these objectives, the plan fixed the following order of priority : the completion of projects started during the third plan ; the construction of roads and creation of communication facilities ; the development of agriculture ; and the development of industry. With respect to education and health services, greater emphasis was given to the improvement and strengthening of the existing facilities than to the expansion of such facilities.

Table 2-1-6 Allocation of Planned Expenditure in Different Sectors  
(Rs. in millions)

Heading	Public sector	Panchayat sector	Private sector	Total
Transport and communication	1,050	52	150	1,252
Agriculture, land reform, irrigation, and forest	662.8	39	470	1,171.8
Industry, commerce, electricity and mining	470	-	250	720
Panchayat, education, health and social services	352.5	29	-	381.5
Statistics	14.7	-	-	14.7
Total	2,550	120	870	3,540

\* The achievements of the fourth plan as against the planned target are not yet made public.

The fourth plan was adversely affected by the oil crisis and world-wide inflation and remained far behind planned targets for want of construction materials at the time when they were needed. Nepal was

dependent chiefly on import for such materials. Under these circumstances, GDP increased during the plan period by only 2.2 per cent per annum, as against the target of 4 per cent.

(5) The Fifth Plan (1975 ~ 1980)

The outline of the fifth plan is shown in Tables 2-1-7 to 2-1-9.

Table 2-1-7 Outline of the Fifth Plan  
(Rs. in millions)

Heading	Minimum	Maximum
1. Gross domestic product	80,160	81,579
2. Annual growth rate	4 %	5 %
3. Total development expenditure	9,197	11,404
(a) Public sector	(6,170)	(7,545)
(b) Panchayat sector	(931)	(1,187)
(c) Private sector	(2,096)	(2,672)
4. Public sector expenditure	6,170	7,545
(a) Domestic resources	(3,994)	(4,150)
(b) External assistance	(2,776)	(3,395)

Table 2-1-8 Allocation of Planned Expenditure  
(Rs. in millions)

Heading	Public sector		Panchayat sector		Private sector		Total	
	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)
(Minimum)								
Agriculture, irrigation, land reform and forest	1,840	(29.8)	279	(30)	1,048	(50)	3,167	(34.4)
Industry, commerce and power	1,381	(22.4)	-	-	419	(20)	1,800	(19.6)
Transport and communications	1,433	(24.2)	466	(50)	629	(30)	2,527	(27.5)
Social services	1,517	(23.6)	186	(20)	-	-	1,703	(18.5)
Total	6,170	(100)	931	(100)	2,096	(100)	9,197	(100)
(Maximum)								
Agriculture, irrigation, land reform and forest	2,279	(30.2)	536	(30)	1,336	(50)	3,971	(34.8)
Industry, commerce and power	1,506	(20)	-	-	534	(20)	2,040	(17.9)
Transport and communications	1,990	(26.4)	594	(50)	802	(30)	3,385	(29.7)
Social services	1,770	(23.4)	237	(20)	-	-	2,007	(17.6)
Total	7,545	(100)	1,187	(100)	2,672	(100)	11,404	(100)

Table 2-1-9 Planned Expenditure of Public Sector by Development Region  
(Rs. in millions)

Heading	Far western development region		Western development region		Central development region		Eastern development region		Un-specified		Total	
	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)
(Minimum)												
Agriculture, irrigation and forest	188	(10.2)	217	(11.1)	485	(26.4)	173	(9.4)	776	(42.2)	1,840	(100)
Industry, commerce and power	50	(3.5)	53	(3.9)	890	(64.3)	127	(9.2)	262	(19.9)	1,381	(100)
Transport and communications	439	(30.6)	142	(9.9)	502	(35)	164	(11.4)	187	(13)	1,433	(100)
Social services	181	(12.1)	185	(12.2)	563	(37.1)	153	(10.1)	435	(28.6)	1,517	(100)
Total	856	(13.9)	598	(9.7)	2,439	(39.5)	617	(10)	1,659	(26.9)	6,170	(100)
(Maximum)												
Agriculture, irrigation and forest	241	(10.6)	289	(12.7)	575	(25.2)	192	(8.4)	982	(43.1)	2,279	(100)
Industry, commerce and power	124	(8.2)	72	(4.8)	904	(60)	131	(8.7)	275	(18.3)	1,506	(100)
Transport and communications	655	(32.9)	252	(12.7)	615	(30.9)	176	(8.9)	292	(14.7)	1,990	(100)
Social services	225	(12.7)	217	(12.3)	646	(36.4)	184	(10.4)	498	(28.2)	1,770	(100)
Total	1,245	(16.5)	830	(11)	2,739	(36.3)	684	(9.1)	2,047	(27.1)	7,545	(100)

In the fifth plan the size of the development plan has first been divided into minimum and maximum. The annual average rate of overall growth has, therefore, been set at 5 per cent at maximum and 4 per cent at minimum. By setting the average rate of growth in the agricultural sector at 3.5 per cent, the rate in the other sectors has been afforded a wide margin of actual growth.

The expenditure is 2.6 to 3.2 times as high as the Fourth plan and its largest share is appropriated toward agricultural sector. The reasons are as follows : first, promotion of industries starts in the agricultural sector ; second, about 80 per cent of exports consists of agricultural products including paddy destined for India and Tibet ; third, the increase in the rate of population is more than 2 per cent and it is estimated that the present population of approximately 12.5 million will double in thirty years.

Regarding social services, the greatest emphasis is placed on education. The present rate of literacy is said to be 19 per cent, and in order to raise this percentage, primary education is made free of charge from the first year. Thus, the rate of school attendance is expected to be raised from 43 per cent to 64 per cent. Moreover, as the demand for technical manpower is estimated at around 24,000 in the fifth plan, more than 15,000 technicians, mostly of middle and low levels, will be trained. Next to education, emphasis is placed on health, for example, eradication of smallpox, tuberculosis and malaria, provision of drinking water and family planning programs.

The share of expenditure in the transport and communication sector has decreased compared with that in the fourth plan, but the amount itself has increased by a large margin. This sector was badly behind in the fourth plan, particularly in road construction because of a sudden rise in the import price of cement and steel products. In the fifth plan, this sector is given continuous emphasis in areas such as completion of highway projects already under construction, construction work on 25 to 50 bridges, 4 to 5 new STOL airstrips, installation of 13,900 new telephone lines (24,000 telephone lines will be in operation by the end of the fifth plan) and extension of post offices.

With the objectives of import substitute and promotion of employment, 20 to 22.4 per cent of the expenditure for the public sector is allocated to the industry and power sector from which more than 53 per cent of the resources are earmarked for the electricity development program.

About 59,000 kW of additional power generating capacity will be available. Sugar and cigarette production capacity is likely to increase by 50 per cent. Likewise, the following plants are scheduled to go into production towards the end of the plan : a cotton textile mill with an annual production capacity of 10 million meters of textile goods, a cement plant with 260,000 tons capacity, a fused magnesium phosphate fertilizer plant with 30,000 tons, a rosin plant with 2,900 tons and a turpentine plant with 737,000 liters and others.

## II-1-2 The Economic Situation of Nepal

### (1) General economic situation

Nepal, being one of the 25 countries classified as least developed, is one of the poorest countries of the world and is also greatly handicapped in developing its economy by geographical constraints. As in other developing countries, agriculture occupies a key place in the economy, amounting to about 70 per cent of GDP, 80 per cent of the export and more than 90 per cent of the employed population. Though Nepal has actually attained 2.4 per cent rate of growth per annum in terms of GDP for the past 10 years since 1965, it may be said that the real growth of GDP per capita has remained almost on the same level, taking into consideration the growth rate of population estimated at more than 2 per cent. The annual and sectorwise GDP is shown in Table 2-1-10.

Table 2-1-10 Annual & Sectorwise GDP (Rs. in millions)

Sector	1970/71		1971/72		1972/73		1973/74		1974/75	
	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)
Agriculture	6,034	(67.5)	7,106	(68.5)	6,578	(66)	8,851	(69.1)	9,949	(66)
Mining	1	-	2	-	3	-	3	-	4	-
Manufacturing	215	(2.4)	285	(2.7)	312	(3.1)	397	(3.1)	660	(4.4)
Construction	135	(1.5)	149	(1.4)	153	(1.6)	163	(1.3)	172	(1.2)
Transport and communications	234	(2.6)	285	(2.8)	347	(3.5)	422	(3.3)	664	(4.4)
Cottage industry	603	(6.8)	711	(6.9)	659	(6.6)	885	(6.9)	995	(6.6)
Financial institutions	139	(1.6)	145	(1.4)	163	(1.6)	183	(1.4)	272	(1.8)
Ownership of dwellings	745	(8.3)	762	(7.4)	779	(7.8)	796	(6.2)	813	(5.4)
Public administration & defence	215	(2.4)	230	(2.2)	228	(2.3)	250	(2)	332	(2.2)
Electricity	20	(0.2)	23	(0.2)	29	(0.3)	28	(0.2)	34	(0.2)
Wholesale and retail trade	318	(3.6)	339	(3.3)	336	(3.4)	374	(2.9)	547	(3.6)
Services	279	(3.1)	332	(3.2)	382	(3.8)	456	(3.6)	632	(4.2)
<b>Total</b>	<b>8,938</b>	<b>(100)</b>	<b>10,369</b>	<b>(100)</b>	<b>9,969</b>	<b>(100)</b>	<b>12,808</b>	<b>(100)</b>	<b>15,074</b>	<b>(100)</b>
Real rate of growth	Δ 1.2		3.1		Δ 0.5		6.3		3.5	
GDP per capita in Rs	771		879		824		1,041		1,196	
GDP per capita in US\$	76		87		82		99		114	

(2) Government finance

According to the budget for the fiscal year 1977/78, the revenue and the expenditure are estimated at Rs 1,724.6 million and Rs 3,087.4 million respectively and their respective increases over the previous year are 30.5 per cent and 30.2 per cent. The sharp increase of the revenue is expected to be gained by the tax reform to be carried out newly, the improvement of the tax collection system and the increase of non-tax revenue such as the sale of government property. Whereas regular expenditure has been limited to within 9 per cent of the increase over the previous year, a substantial increase has been allowed for development expenditure. The deficit is expected to be covered by the sharp increase of foreign aid and internal borrowing. In addition to India, U.S.A., U.K., West Germany and U.S.S.R., such countries as Japan, Canada and Switzerland are steadily increasing aid. Oil-producing countries, such as Kuwait and Saudi Arabia are also extending aid. Moreover, international institutions such as the World Bank and the Asian Development Bank are greatly increasing their support. The financial situation is shown in Table 2-1-11.

Table 2-1-11 Financial Situation  
(Rs. in millions)

Heading	1975/76	1976/77	1977/78
	Actual	Revised	Estimated
Total revenue	1,913.4	2,371.6	3,087.4
Revenue	1,115.6	1,321.3	1,724.6
Foreign aid in grants	359.7	386.3	505.9
Foreign aid in loans	146.0	206.0	614.7
Internal borrowings	200.0	300.0	242.3
Deficit	92.1	158.5	-
Total expenditure	1,913.4	2,371.6	3,087.4
Regular	674.5	861.1	938.5
Development	1,238.9	1,510.5	2,148.9

(3) Trade structure and balance of payment

The formal trade with India still occupies 70 to 80 per cent of the total amount of trade, though its relative importance is slightly decreasing year by year. The staple articles for export to India are food grains and oil seeds, among which paddy alone forms 60 per cent

of the total amount. On the other hand, the main items for import from India are petroleum products, mustard oil, wheat flour, chemicals, cotton piece goods, construction materials (cement steel products, etc.). The balance of trade with India has shown a consistent excess of large amount of imports over exports and has been made up by earnings on invisibles and capital transactions resulting in a small deficit. The 70 to 80 per cent of export to overseas countries other than India consists of raw jute and jute products, whereas the main items from these countries are machinery and machine parts, raw materials, construction materials, vehicles, agricultural tools, fertilizers, clothing, etc. Though the balance of trade with these countries has shown a small deficiency on the part of Nepal, international payments have shown a large favourable balance. This is explained by a rapid increase in income from invisibles such as private remittances, receipt of annuities, investment income of surplus foreign exchange, income from foreigners' sightseeing travel, etc. and these have more than offset the deficit in balance of trade. The trade situation is shown in Tables 2-1-12 to 2-1-14.

Table 2-1-12 Foreign Trade  
(Rs. in millions)

Heading	1974/75		1975/76		1976/77	
	Amount	(%)	Amount	(%)	Amount	(%)
Export (FOB)	889.6	(100)	1,185.8	(100)	1,168.9	(100)
to India	746.7	(83.9)	893.7	(75.4)	808.8	(69.2)
to other foreign countries	142.9	(16.1)	292.1	(24.6)	360.1	(30.8)
Import (CIF)	1,814.6	(100)	1,981.7	(100)	1,987.3	(100)
from India	1,475.8	(81.3)	1,227.1	(61.9)	1,425.5	(71.7)
from other foreign countries	338.9	(18.7)	754.6	(38.1)	561.8	(28.3)
Trade balance	Δ 925.0	(100)	Δ 795.9	(100)	Δ 818.4	(100)
with India	Δ 729.0	(78.8)	Δ 333.4	(41.9)	Δ 616.7	(75.4)
with other foreign countries	Δ 196.0	(21.2)	Δ 462.5	(58.1)	Δ 201.7	(24.6)

\* On a customs clearance basis

Table 2-1-13 Balance of Payment  
(Rs. in millions)

Heading	1974/75	1975/76	1976/77 First nine months
Trade balance	Δ 1,182.4	Δ 724.4	Δ 652.0
Export (FOB)	884.8	1,209.7	832.0
Import (CIF)	2,067.2	1,934.1	1,484.0
Services	280.8	284.3	359.4
Receipts	(693.3)	(747.6)	(667.1)
Travel	170.6	209.9	201.0
Investment income	108.7	82.9	54.4
Others	414.0	454.8	411.7
Payments	(412.5)	(463.3)	(307.7)
Transfers	564.7	588.6	423.4
Receipts	(598.7)	(606.5)	(437.6)
Private remittances	207.7	235.1	213.9
Official grants	282.8	259.2	152.5
Indian excise refund	108.2	112.2	71.2
Payments	(34.0)	(17.9)	(14.2)
Current account balance	Δ 336.9	148.5	130.8
Foreign loans	86.7	145.8	143.2
Miscellaneous	Δ 168.7	60.3	Δ 4.2
Total balance	Δ 418.9	354.6	269.8

\* On a payment basis

Table 2-1-14 Foreign Exchange Reserve

As of	US\$ in millions	Rs. equivalent in millions
1970 July	91.5	924
1971 July	102.3	1,033
1972 July	110.9	1,120
1973 July	123.5	1,297
1974 July	131.1	1,376
1975 July	112.4	1,181
1976 July	120.3	1,498
1977 July	143.3	1,791



## II-1-3 Actual Industrial Conditions in Nepal

### (1) Agriculture

Agriculture plays an extremely important role in the Nepalese economy. In the fifth plan the greatest emphasis has been placed on agricultural sector and its production is expected to increase 3.5 per cent annually. In 1975/76 approximately 2.6 million tons of paddy was produced with an increase of 6.2 per cent over the previous year, but agricultural production as a whole increased only 2.8 per cent owing to decreased production of maize. In 1976/77 the agricultural production showed a decrease of about 4 per cent over the previous year because the unseasonable weather reduced paddy production by about 8.4 per cent and also adversely affected the yield of maize, wheat, potato, etc. The production of principal crops is shown in Table 2-1-15.

Table 2-1-15 Production of Principal Crops  
(Tons in thousands)

Crops	1972/73	1973/74	1974/75	1975/76	1976/77
Food grains					
Paddy	2,010	2,416	2,452	2,605	2,385
Maize	822	814	827	748	787
Wheat	312	308	331	387	362
Barley	25	26	26	25	21
Millet	135	142	143	143	138
Cash crops					
Sugar cane	246	267	251	253	311
Oil seeds	60	64	65	68	61
Tobacco	7	4	5	5	5
Jute	55	40	40	42	45
Potato	292	304	307	314	269

### (2) Industry

The role played by industry in the Nepalese economy is rather small. Even in 1974/75 it occupied only 4.4 per cent of GDP. However, it may be said that rapid progress has been made in this sphere during this 10 year period, as against 1.5 per cent in 1964/65. At the same time the cottage industry has maintained around 7 per cent of GDP. The number of industrial employees excluding those in the cottage industry is estimated at about 20,000 and most enterprises employ less than 30 people.

Nepalese industry is centered around agricultural products processing industries and is export-oriented rather than domestic market oriented. Rice milling and lumbering industries are directed at the Indian market and the jute industry is directed at overseas countries other than India. But the textile and tobacco industries may be said to be import substituting. Against the development of Nepalese industry, there are many insuperable obstacles : first, Nepal is a land-locked country ; second, the domestic market is too small to offer scale merit ; and third, domestic entrepreneurs are still at the emergence stage. Accordingly, the target for industrial development should be put on the promotion of small-scale and labor-intensive industries. The production of principal industries is shown in Table 2-1-16.

Table 2-1-16 Production of Principal Industries

Goods	Unit	1972/73	1973/74	1974/75	1975/76	1976/77 First nine months
Jute goods	tons	13,709	12,888	12,265	15,994	13,843
Sugar	tons	11,482	14,197	11,926	10,632	16,215
Cigarettes	millions	2,364	2,522	3,001	2,447	1,362
Matches	thousand gross	587	662	649	679	488
Liquor	thousand liters	188	206	224	580	350
Soap	tons	827	952	891	970	448
Shoes	pairs	83	82	70	59	35
Leather	kg	187	80	55	665	739
Agricultural tools	tons	150	150	300	68 (thousand pieces)	200 (thousand pieces)
Tea	tons	36	44	47	328	130
Stainless steel utensils	tons	245	209	156	175	n.a
Strawboard	tons	705	937	1,022	900	n.a
Fertilizer	tons	671	560	441	576	n.a
Brick and tile	millions	26	23	26	25	n.a
Beer	thousand liters	403	542	688	816	450
Cotton textiles	thousand meters	-	-	-	3,896	3,100
Cement	tons	-	-	14,000	29,565	31,255

(3) Tourism

The most remarkable progress has been made in the growth of tourism in Nepal. The number of tourists soared up to 86,000 in 1976 compared with 6,000 in 1962. 70 per cent of the tourists come in group tours mainly from Europe and U.S.A.

Tourism related data are shown in Tables 2-1-17 and 2-1-18.

Table 2-1-17 Number of Tourists (excluding Indians)

Region	1972	1973	1974	1975	1976
Europe	25,510	35,121	39,805	41,031	48,024
U.S.A.	18,057	18,869	17,492	15,851	17,220
Asia and Oceania	6,633	9,854	10,751	12,485	14,776
Others	2,730	4,263	4,553	5,192	5,749
Total	52,930	68,047	72,601	74,559	85,769
Number of hotel beds	n.a	n.a	11,822	21,304	23,000

Table 2-1-18 Foreign Exchange Earnings from Tourists (excluding Indians)

Fiscal year	US\$ in millions	Rs. equivalent in millions
1971/72	2.2	22
1972/73	5.2	54
1973/74	9.1	95
1974/75	9.7	102
1975/76	13.7	170

(4) Summary

The Nepalese economy is overwhelmingly weighted towards agriculture. In addition, owing to the mountainous nature of the country and the extremely inadequate surface transport facilities, the regional economies are isolated from each other and not consolidated into the national economy as a whole.

On the other hand, the industrial sector still plays a small part in the Nepalese economy. This industrial activity is mainly in the area of the processing of agricultural products and cottage industries. Most of them are rather small-scale. To foster a large population

within the country and raise the standard of living, it is essential to industrialize and modernize the Nepalese economy immediately. Hence Nepal is requested to go a step further than the mere improvement of infrastructure, to concentrate on augmenting the producing capacity of such export industries as paddy, oil seeds, lumbering, electricity, and to develop the import substitute industries such as cement.

## II-2 Environmental Conditions for the Development of Nepal

### II-2-1 Natural Conditions

#### (1) Geography

Nepal lies to the north of the Indian subcontinent (longitudes  $80^{\circ} \sim 88^{\circ}E$  and latitudes  $26^{\circ} \sim 30^{\circ}N$ ) and has an area of about 141,000 km<sup>2</sup>.

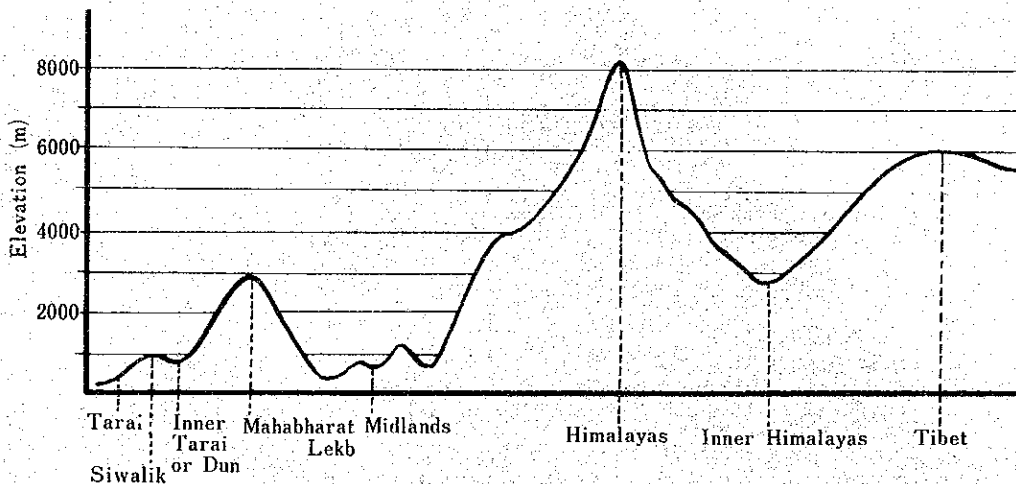
The country varies in altitude from the Terai in the south which is below 200 m to the Himalayas, the highest mountain ranges in the world in the north.

Consequently, the activities of the people and their way of life vary according to locality. Fig. 2-2-1 is a geophysical map showing the elevation of various regions of Nepal.

#### (2) Topography

As shown in Fig. 2-2-2 a Sectional Plan of Nepal, the land is roughly divided into 7 or 8 regions.

Fig.2-2-2 Sectional Plan of Nepal

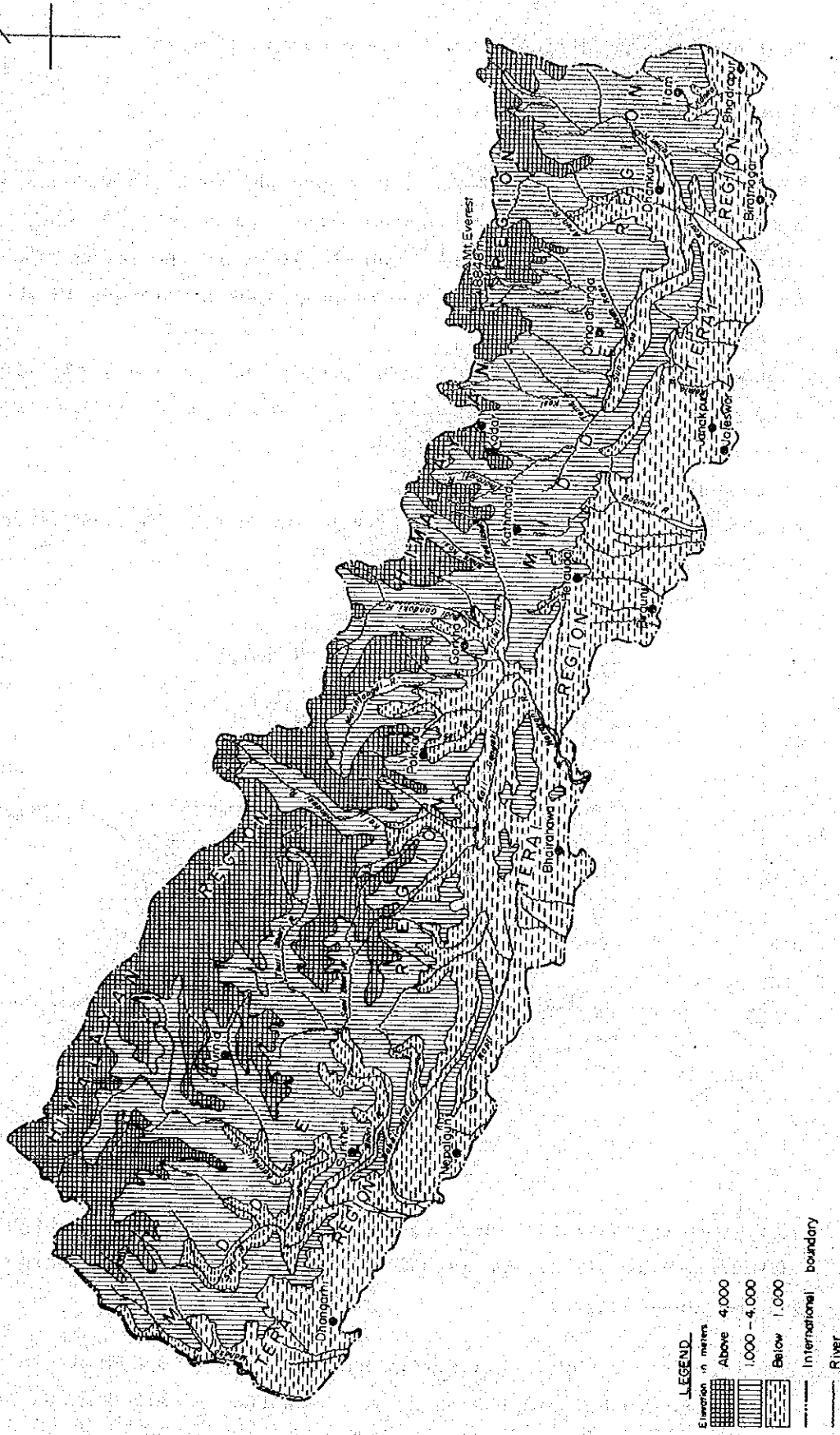


The Terai region which makes up the southern plains is not higher than 200 m above sea level and is belt-shaped and has a common border with the Indian plains.

The Siwalik, or Churia Hills region, spreading from Kashmir in the west to the eastern borders, has an average altitude of 1,500 m and lies next to the Terai region.

Fig. 2-2-1

GEOPHYSICAL MAP OF NEPAL



The lowland called the Inner Terai, or the Dun, lies between the Siwalik and the Mahabharat.

The Mahabharat Lekh which forms the preliminary of the Himalayas at an altitude of 3,000 m, runs from west to east.

Kathmandu valley is one of the centers of the Midlands. This region varies in altitude from several hundred to 2,000 meters and is divided into several regions by wide crossing rivers. The climatic conditions of this area are the most favourable in the country.

The Himalayas rise behind the Midlands at an altitude of up to 8,000 m and lead to Inner Himalaya and to Tibet.

### (3) Climate

Nepal is roughly divided into four climatic zones as follows.

#### (i) Sub-tropical monsoon climate

Areas up to 1,200 m high such as the Terai, Siwalik and Inner Terai fall into this zone. It is humid in summer. The wet monsoon arrives in the East one month earlier than the West. The annual rainfall also varies from over 2,000 mm in the East to only 1,000 mm in the West. The record maximum annual rainfall in the country of 4,005 mm was recorded in Pokhara in 1966.

The maximum temperature sometimes exceeds 40°C in the dry season in spring, but it is not so hot in the monsoon season. It is moderate in winter.

#### (ii) Temperate monsoon climate

The areas from 1,200 m to 2,100 m high are included in this zone. The rainfall is about 1,500 mm per annum and the average temperature is 27°C in summer and 4°C in winter.

#### (iii) Cool temperature climate

The areas from 2,100 m to 3,700 m high make up this zone. The temperature in summer is about 20°C and in winter around zero.

#### (iv) Alpine climate

The Himalayan region falling into this zone is covered with perpetual snow.

The temperature is low throughout the year.

### (4) Rivers

There are a considerable number of rivers in Nepal.

The Sapta Kosi, the Sapta Gandaki or the Narayani, the Karnali and the Mahakali river are the biggest rivers having their source in the

perpetual snows of the Himalayas. Numerous rivers run through steep valleys and low hills of the Siwalik region. The quantity of water in all the rivers increases sharply in the monsoon season, however, most of them run dry in the dry season.

Refer to II-2-2 (2).

(5) Earthquakes

Nepal adjoins the Trans-Asian Belt which is one of the world's most seismic regions and runs from Malaysia to Middle Asia.

A major earthquake of Magnitude 8.2 on the Richter scale occurred in the region in 1934 causing considerable loss of life and property.

After this, in late 1960's, sporadic earthquakes of Magnitude around 6.0 occurred.

II-2-2 Social Conditions

(1) Roads conditions

(Refer to the attached Dwg. C-01 Nepal Road Network.)

Roads have been constructed successively in Nepal partially participated in by the aid of foreign countries.

The total length of roads except mountain path has reached as long as 4,136 km in 1978.

The roads constructed since 1951 are shown in Table 2-2-1.

Table 2-2-1 Road Constructed since 1951

Types	(km)			
	Black top	Gravelled	Earth work	Total
1951	-	-	-	376
1955	295	-	365	660
1965	289	147	1,390	1,826
1967	536	344	1,552	2,432
1969	661	408	1,611	2,680
1970	820	433	1,495	2,748
1971	950	465	1,365	2,780
1972	1,080	500	1,250	2,830
1973	1,376	306	1,371	3,053
1974	1,489	288	1,396	3,173
1978	1,751	566	1,829	4,136

Average annual extension rate was 8 % for the black top road and about 9 % for all the roads.



The length of the existing roads is shown by types and classification in Table 2-2-2.

Table 2-2-2 Length of Roads by Types and Classes (1978)

Classification	Types	(km)			Total
		Black top	Gravelled	Earth work	
Highway		1,231	248	319	1,798
Feeder road		291	177	821	1,289
District road		25	57	581	663
Town road		204	74	108	386
Total		1,751	556	1,829	4,136

The representative roads are :

- (i) the roads linking Kathmandu with Birgunj (Indian border), 195 km ;
- (ii) the roads linking Kathmandu with Kodari (Chinese border), 104 km ;
- (iii) the roads linking Kathmandu with Pokhara, 200 km ; and
- (iv) the roads leading from Pokhara to Sunauli (Indian border) through Bhairahwa, 209 km.

Further, as a trunk road of the south the road leading through Terai plain from east to west is under construction, in which the eastern portion linking Kakarbitta (Indian border) with Pathlaiya (365 km) has been completed.

The mountain pathes which have been constructed. Since old times to link isolated villages each other are estimated to reach as long as 10,000 km in total length all over the country. However except several modern suspension bridges those mountain pathes have hardly been improved.

As for the future construction plan, in the Fifth Five Year Plan launched in 1975 the roads of minimum 1,173 km and maximum 1,590 km are planned to be constructed and further in long term plan for 20 years the construction of about 6,250 km are scheduled.

The main construction works to be performed are the completion of the East-west highway through Terai plain, the construction of new East-west highway through northern hills linking Ilam with Baitadi and the construction of the feeder roads which link this East-west highway to the southern and northern parts of the country.

The availability of roads by development region is shown in Table 2-2-3 with regards to population and area.

Table 2-2-3 Availability of Road Facility in Development  
Regions and Number of Population and Area Influenced

Development region	Population *	Area (km <sup>2</sup> )	Road** (km)	Population	Area(km <sup>2</sup> )
				km Road	km Road
Eastern	3,141,754	28,202	952	3,300	29.62
Central	4,413,718	28,250	1,617	2,729	17.47
Western	2,758,432	28,128	835	3,303	33.68
Far western	2,823,333	60,725	732	3,857	82.95
Total	13,137,237	145,305	4,136	3,176	35.13

Note. \* Population : estimated value in 1977

\*\* Length : value in 1978

As shown in the table mentioned above, as far as road is concerned, the central region is most developed and follow this the eastern, the western and the far western region in order.

In other hand the number of motor cars registered by 1974 is as follows.

Motor car : about 9,600 units  
Truck : 4,120 units  
Bus : 1,070 units

The increase of number of trucks by development region is shown in Table 2-2-4.

Table 2-2-4 Increase of Trucks by Region (unit)

Development region	1969/70	1974/75	Increase
Eastern	478	704	226
Central	1,783	3,597	1,814
Western	260	270	10
Far western	32	102	70
Total	2,553	4,673	2,120

The total operating distance of long distance bus reached as long as 3,488 km and number of buses was 477 units in 1974/75.

Thus the construction of roads has earnestly been progressed, however, quite a few areas have not been linked by the road network even today and many roads still remain seasonal.

(2) Energy resources

(i) Fuel (Petroleum and coal)

Although the exploration of petroleum and natural gas is included in the industrial sector of the Fifth Five Year Plan, Nepal has not been blessed with the resources of petroleum and coal except lignite produced in small quantity.

Accordingly almost all the fuel have to be imported.

Only firewood is available fuel in Nepal in addition to lignite.

However the price of firewood rises remarkably in recent year due to indiscriminate deforestation.

(a) Petroleum fuel

The kinds of petroleum fuel used in Nepal at present are motor spirit (Petrol), high speed diesel oil (HSD), Kerosene, light diesel oil (LDO) and furnace oil (FO) and all of them are imported from India.

The consumption of petroleum fuel in the last 5 years in Nepal is shown in Table 2-2-5.

Table 2-2-5 Consumption of Petroleum Fuel

Kinds	(kl)				
	1973/74	1974/75	1975/76	1976/77	1977/78
Petrol	11,746	10,302	10,469	10,969	12,000
HSD	20,832	26,878	30,805	33,207	34,651
Kerosene	30,094	33,104	32,162	30,293	37,000
LDO	10,686	9,446	9,286	9,080	13,820
FO	792	467	1,805	1,166	5,400

Note. FO : Heavy oil

(b) Coal fuel

Coal fuel is imported from India too.

The kinds of coal fuel are steam slack coal, soft coal, coke breeze and beehive hard coke etc.. Though small quantity, several thousand tons of lignite is exploited yearly in Nepal.

(ii) Electric power

The steep mountains of Nepal are subject to heavy rainfall, thus hydroelectric power is the major exploitable energy source in the country. Natural resources such as oil, coal, etc. have not yet been established.

The total hydro-potentiality is reported to be 83 million kW, which is more than twice that of Japan and equivalent to that of the whole of the North American Continent. However, the installed capacity of hydro-power plants in the country by 1980 will only be 90 MW (estimated). This is because (1) demand for electric power is quite low in this developing country,—the consumption rate of electric energy in Nepal is one of the lowest in the world, annual electric energy consumption per capita is estimated to be about 10 kWh—, and (2) heavy investment is needed to install hydroelectric power plants and power transmission lines, compared with the case of power plants utilizing diesel or steam powered engines.

The total capacity of power plants (other than hydro-power) in Nepal at present is 15 MW from diesel engine plants and 4 MW from steam engine plants. These power plants need fuel such as petroleum, coal, etc., all of which must be imported and thus result in much higher unit energy cost than that of hydro-power generation. No large scale power plants using such engines will be proposed from now on.

The present state of, and future forecast for electric power in Nepal, in particular concerning hydro-power generation :

(a) Hydro-potentiality

The rivers in Nepal are roughly divided into three types as follows :

1. Big rivers flowing continuously with a large volume of water even in the dry season
  - The Sapta Kosi, the Sapta Gandaki or the Narayani, the Karnali and the Mahakali river are included in this type. About 80 % of total water flow in Nepal is concentrated in these rivers which have their source in the glaciers and the snows of the Himalayas.
  - These rivers are suitable for large-scale hydro-power generation.
2. Medium size rivers which do not dry up even in the dry season
  - The Kankai-Mai, the Kamala, the Bagmati, the Rapti and the Babai river are included in this group.
  - Possible to develop for hydro-power generation, but flooding in the monsoon season must be taken into consideration.
3. Small rivers which almost dry up in the dry season
  - Numerous rivers running in the Siwalik and the Inner Tarai
  - Not suitable for hydro-power generation

(b) Prospective sites for hydro-power plants

Many preliminary and feasibility studies of prospective sites for power generation have been carried out recently. Table 2-2-6 shows those proposed sites by region. As shown on the table, the total capacity of such prospective plant sites amounts to 18.7 million kW. It may be said that the realization of those hydro-power generation projects depends entirely on the electric power supply and demand balance.

(c) Present state of electric power supply

Fig. 2-2-3 shows the main existing and proposed power plants and main power transmission networks (including proposed transmission lines). As shown on the figure, all the existing power transmission networks are of a small scale ; in Kathmandu valley, in and around Biratnagar in the East, and in the Terai region from the Central to the Far-West. Under the treaty between Nepal and India concerning the mutual supply of electric power, Nepal supplies power from the Central region to Raxaul in India and receives power from India to several areas in the Terai.

The power supplied through these transmission lines, however, is not stable but is subject to voltage and frequency fluctuations, and sometimes fails altogether due to limited supply capacity.

(d) Future prospect of supply and demand

Fig. 2-2-4 shows a regional electrical load forecast in Nepal. As shown in Fig. 2-2-4 and Table 2-2-6, prospective power plant sites are located far from the main power consuming area, in and around Kathmandu. Therefore, it is necessary to provide a power transmission network over a wide region. A 132 kV power transmission line connecting the East and the West of Nepal (hereinafter in this report called "the East-West power transmission line") is planned, and part of the line has already been constructed according to this plan. A huge hydro-power plant at Chisapani is also proposed for the purpose of supplying power mainly to India, but, for the time being, it must be considered separately from the plan for the East-West power transmission line.

Table 2-2-6 Hydro-Potentiality and Prospective Plant Sites

Name of river	Name of main dam site and potentiality	Prospective capacity	Name of proposed project and capacity
	MW <u>Total (27 %) 22,000</u>	MW <u>Total (36 %) 6,800</u>	MW
the Sapta Kosi river (the East)	1. Tamur Kosi 2,077 2. Arun 6,850 3. Sun Kosi, main 4,800 4. Dudh Kosi 2,013 5. Tamba Kosi 1,864	Barakshetra 1,800 and others	⑬ Phidin 1 ⑭ Bhojpur 1 ⑮ Khandbari 1 - ⑩ Namche Bazar 1
	MW <u>Total (25 %) 21,000</u>	MW <u>Total (17 %) 3,100</u>	MW
the Sapta Gandaki, or the Narayani river (the Central and the West)	1. Kali-Gandaki, main 5,200 2. Trisuli-Gandaki, main 2,740 3. Buri-Gandaki, main 3,920 4. Marsyandi 2,080 5. Seti 622 6. East Rapti ?	Kali-Grandaki High-dam 1,840 and others	- ② Devigat 14 - Buri-Gandaki 200 ① Marsyandi 40 - ⑤ Kulekhani 60 ⑥ Kulekhani 35
	MW <u>Total (43 %) 36,000</u>	MW <u>Total (45 %) 8,500</u>	MW
the Karnali & the Mahakali river (the Far West)	1. Karnali, main, Humla 12,000 2. Mugu-Karnali 3,900 3. Tila ? 4. Bheri and around 8,000 5. Seti 2,500 6. Mahakali 3,100	Chisapani 3,600 Bhanakot 1,100 Lakarpata 1,400 Thapna 950 Surkhet 940 Seti 400	⑨ Chisapani 1,800 - - - - Seti 230 -
	MW <u>Total (5 %) 4,000</u>	MW <u>Total (2 %) 300</u>	MW
the Southern rivers	(the East) 1. Kankai-Mai 224 (the East-Central) 2. Kamala 144 (the Central) 3. Bagmati 688 (the Far West) 4. Rapti 170 5. West Rapti 1,300 6. Babai 336	65 61 28? ? Babai-Rapti 27 Sarda-Babai 53	③ Kankai 37 ⑦ Kamala 30 ⑧ Bagmati 70 - - ④ Sarda 49
Total	MW (100 %) 83,000	MW (100 %) 18,700	

Note : ⑬ in the column of "Proposed Projects" refers to Fig. 2-2-3.

Data source : Hydro-Power Potentiality of Nepal, (Dept. of Electricity)1971

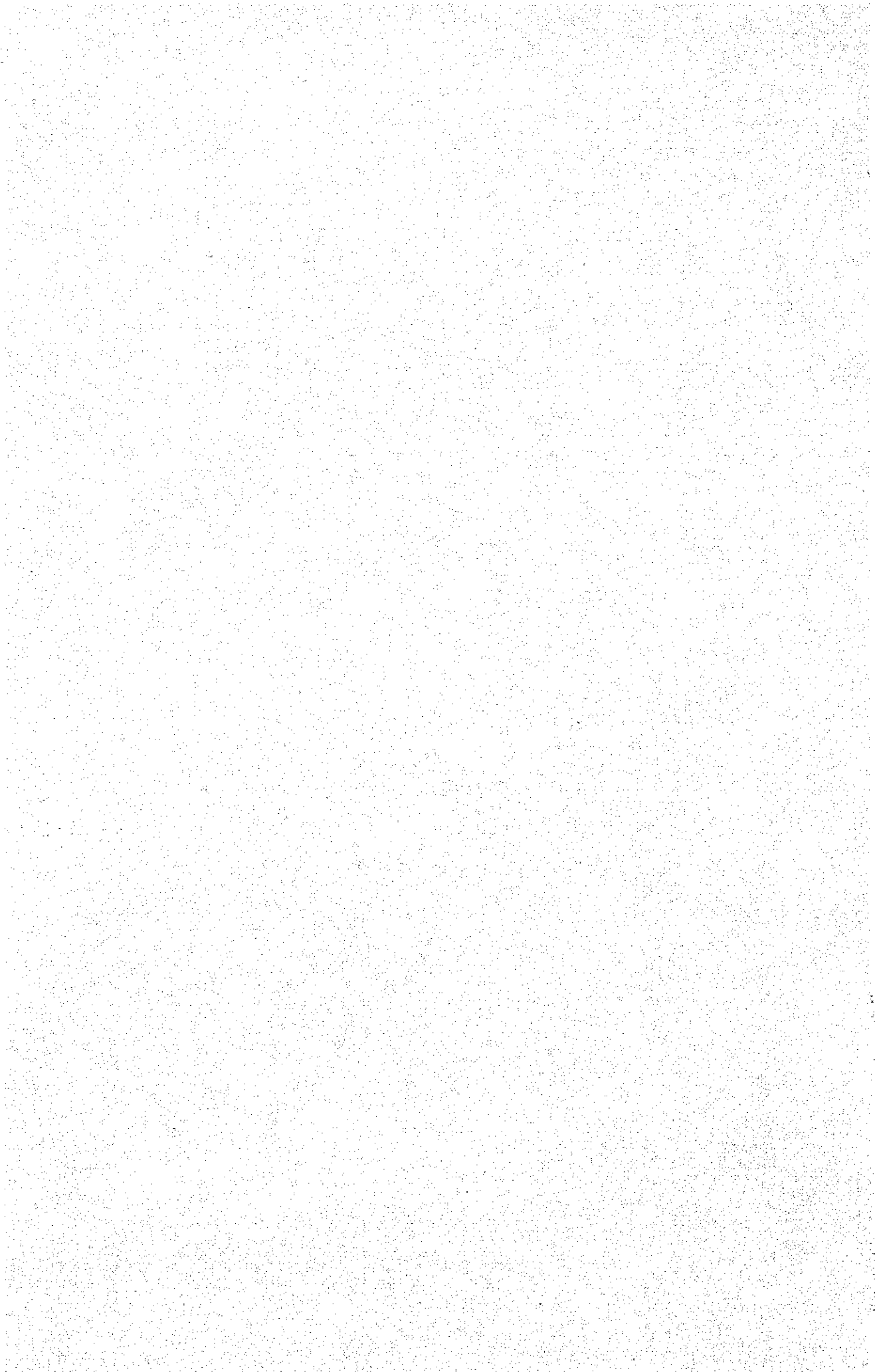
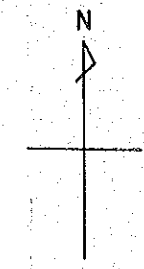


Fig. 2-2-3

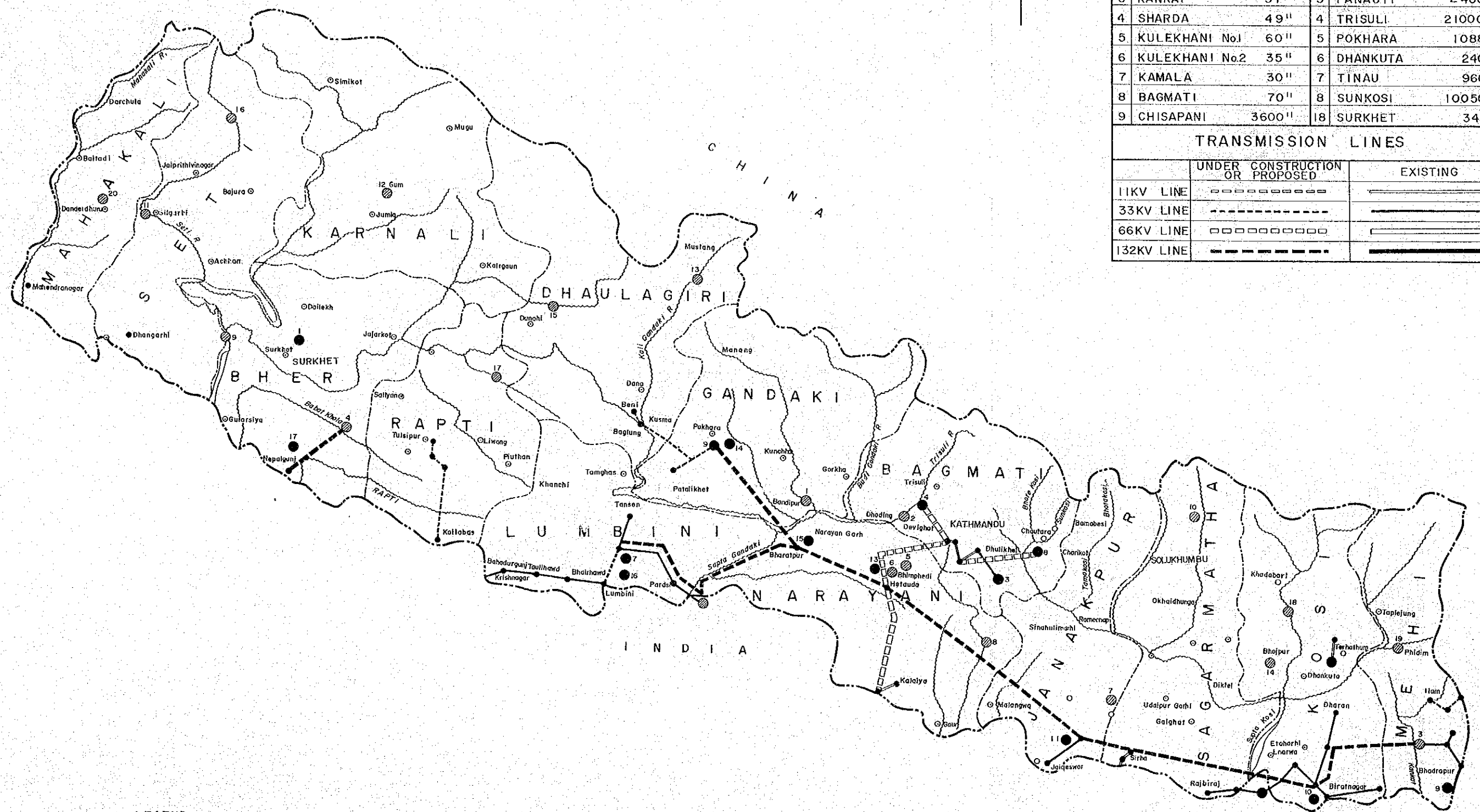
# HYDRO POWER STATIONS AND MAIN POWER TRANSMISSION LINES IN NEPAL



UNDER CONSTRUCTION OR PROPOSED PROJECTS		EXISTING PROJECTS	
1	MARSHYANGDI 40 MW	1	PHARPING 500KW
2	DEVIGHAT 14 "	2	SUNDARIJAL 640 "
3	KANKAI 37 "	3	PANAUTI 2400 "
4	SHARDA 49 "	4	TRISULI 21000 "
5	KULEKHANI No.1 60 "	5	POKHARA 1088 "
6	KULEKHANI No.2 35 "	6	DHANKUTA 240 "
7	KAMALA 30 "	7	TINAU 960 "
8	BAGMATI 70 "	8	SUNKOSI 10050 "
9	CHISAPANI 3600 "	18	SURKHET 345 "

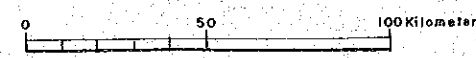
TRANSMISSION LINES		
	UNDER CONSTRUCTION OR PROPOSED	EXISTING
11KV LINE	-----	=====
33KV LINE	- - - - -	=====
66KV LINE	o o o o o o o o	=====
132KV LINE	-----	=====



**LEGEND**

- International Boundary
- - - - - Zonal Boundary
- District Head Quarter
- Important Places
- ~~~~~ River

SCALE: 1 : 2000000





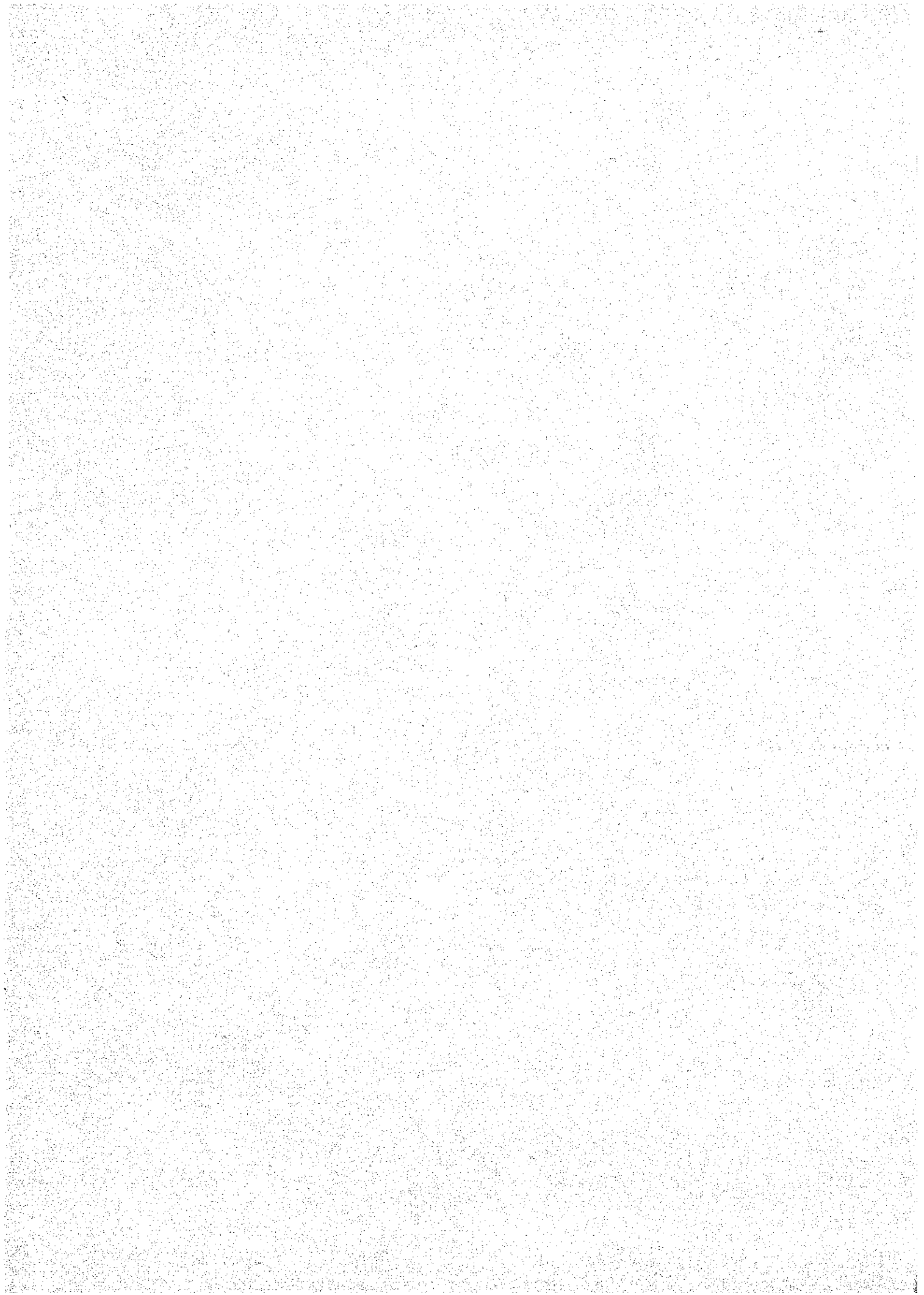
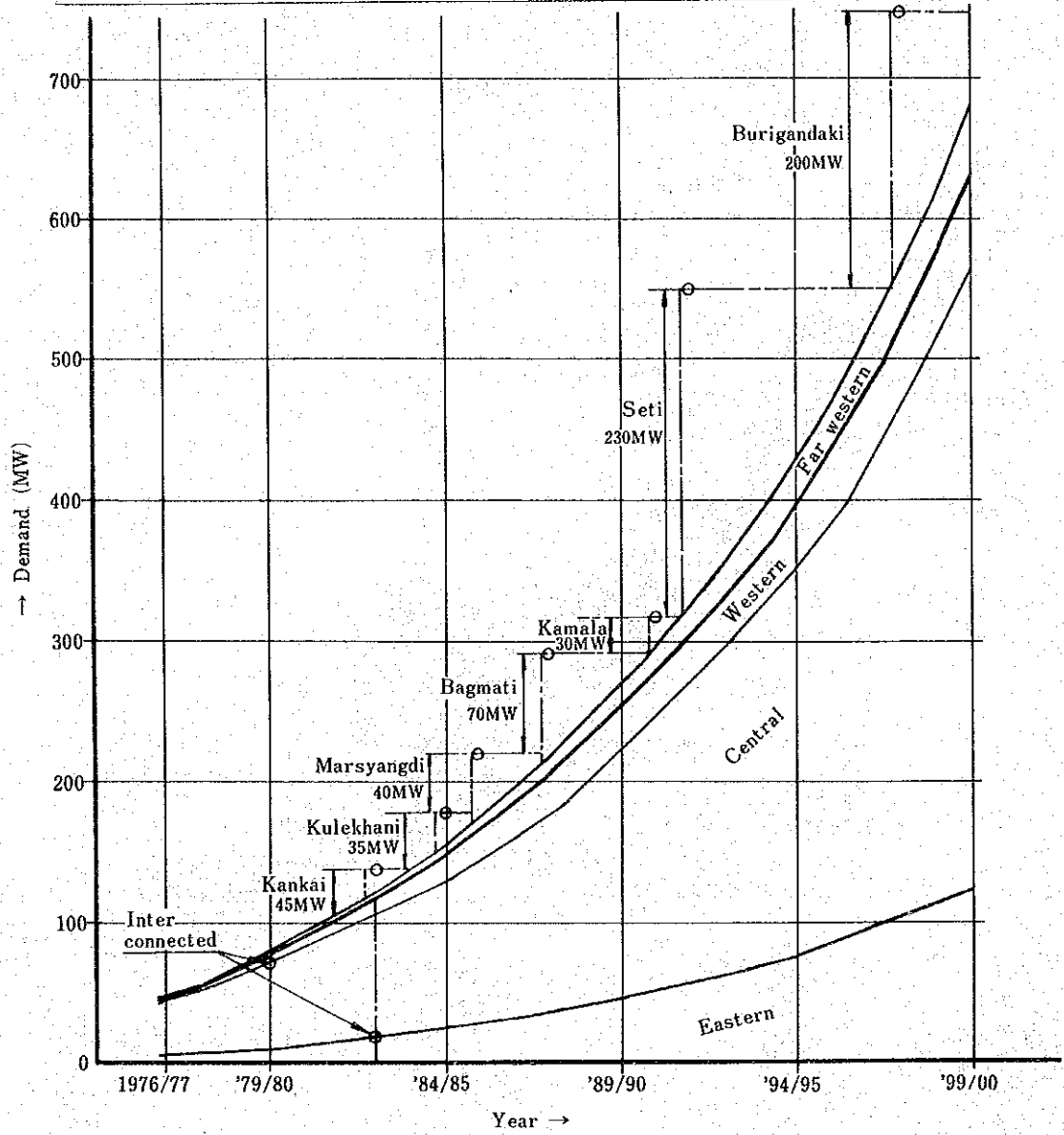


Fig.2-2-4 Regional Electrical Load Forecast by Region



Source : Regional power demand forecast  
by Dept. of Electricity



(3) Human resources

(i) Population

According to the census in 1971, the total population in Nepal was 11,560,000. The population growth in past and future estimation is shown in Table 2-2-7 and 2-2-8 respectively.

Table 2-2-7 Population Growth in Past

Year	Population	Yearly growth ratio (%)	Density (persons/km <sup>2</sup> )
1909	5,638,749	-	38.78
1920	5,573,788	- 0.11	38.33
1930	5,532,574	- 0.07	38.05
1942	6,283,649	1.07	43.22
1952	8,473,476	3.04	58.28
1961	9,412,996	1.18	64.74
1971	11,553,983	2.07	79.48

Table 2-2-8 Population Estimate in Future

Year	Population	Yearly growth ratio (%)	Density (persons/km <sup>2</sup> )
1971	11,555,983		79.48
1976	12,857,243	2.16	88.43
1981	14,314,980	2.18	98.45
1986	16,050,031	2.30	110.39

The population growth rate is considered to exceed 2 % at present. The population growth started in around 1930 and for past 40 years the population has shown about 2.1 times of increase.

In general the people marry young in Nepal and therefore the birth ratio is considered high.

If the death rate will decrease due to the improvement of sanitary conditions, the population will increase remarkably in future.

The economically active population by industries is shown in Table 2-2-9. The table shows that the population engaged in the agriculture sector is overwhelmingly large (94.4 %) and the employment opportunities in other industries than agriculture is insufficient.

Table 2-2-9 Population by Major Industries in 1971  
(Over 10 Years)

Industries	Population	%
Agriculture, forestry and fishing	4,579,552	94.4
Personal and community service	137,759	2.8
Commerce	63,560	1.3
Manufacturing	51,902	1.1
Transportation and communication	9,637	0.2
Construction	5,016	0.1
Finance and business	3,466	0.07
Electricity, gas and water	1,596	0.03
Others	36	0.00
Total	4,852,524	100.0

The population density by region and by development region is shown in Table 2-2-10 and 2-2-11 respectively.

Table 2-2-10 Population Density by Region in 1971

(person/km <sup>2</sup> )			
Region	Density	Region	Density
Eastern mountainous region	85.9	Far western mountainous region	45.9
Eastern inner Terai	49.9	Mid inner Terai	78.2
Eastern Terai plain	199.6	Western Terai plain	139.6
Kathmandu valley	976.5	Western inner Terai	66.9
Western region	70.4	Far western Terai plain	44.3

Table 2-2-11 Population and Density by Development Region in 1977

Development region	Population	Density (person/km <sup>2</sup> )
Eastern	3,141,754	111.40
Central	4,413,718	156.24
Western	2,758,432	98.07
Far western	2,823,333	46.49
Total	13,137,237	90.4

According to two tables mentioned above, the population density generally higher in the southern region than the northern region.

Among the development region, the population density is highest in the central region in which Kathmandu and Hetauda are located and then decreases in order of the eastern region, western region and far western region.

Average family size in Nepal was 5.53 in 1971.

(ii) Employment

In Nepal the agricultural sector plays a dominant role in the economy and more than 90 % of population are making a living at agriculture. The cultivated area occupies only 14 % of the country land and the composition of population by age is estimated to be biased to the young.

Under such circumstances the rate of unemployment and latent unemployment are considerably high. Besides, taking the situation in which the increase of employment opportunities are hardly expected in the secondary and tertiary industries such as manufacturing, transportation, communication and commerce etc. due to their early development stage into consideration this tendency will be still more.

(4) Language

About 17 languages are spoken in Nepal in addition to several local languages.

More than 50 % of the population use Nepali and the rest use various languages shown in Table 2-2-12.

English is used considerably in the cities and in the central and local government offices especially in the higher classes.

Illiterate rate in Nepal was 86.1 % 1971 out of which the rate of illiterate male and female is 76.4 % and 96.1 % respectively.

Table 2-2-12 Languages in Nepal and Population (1971)

Languages	Population	%
Nepali	6,060,758	52.4
Maithali	1,327,242	11.5
Bhojpur	806,480	7.0
Tamang	555,056	4.8
Abadhi	316,950	2.7
Tharu	495,881	4.3
Newari	454,979	3.9
Magar	288,383	2.5
Raj Kirati	232,264	2.0
Gurung	171,609	1.5
Limbu	170,787	1.5
Bhote Sherpa	79,218	0.7
Rajbani	55,124	0.5
Satar	20,660	0.2
Sunuwar	20,380	0.2
Danuwar	9,959	0.1
Santhali	3,193	0.0
Local District Languages	394,374	3.4
Other Languages	92,686	0.8
Total	11,555,983	100.0

(5) Religion

Religions and their population in Nepal are shown in Table 2-2-13.

Table 2-2-13. Religions and Population in 1971

Religion	Population	%
Hinduism	10,329,000	89.4
Buddhism	866,000	7.5
Islam	350,000	3.0
Jainsim	2,000	0.02
Other religion	6,000	0.05
Total	11,553,000	100.0

The population of Hinduism which is national religion reaches as much as about 90 % and has a big lead on Buddhism (7.5 %) and others.

(6) Health and sanitary

The facilities of health and sanitary in Nepal fall behind as compared with other countries both in quality and quantity and besides those facilities are unevenly distributed regionally.

The main facilities of health and sanitary as well as number of doctors by development region in the last year (1974/75) of the Fourth Five Year Plan is shown in Table 2-2-14 and 2-2-15 respectively.

Table 2-2-14 Main Facilities of Health and Sanitary in 1974/75

Facilities	Quantity
Zonal public health office	7
District public health office	7
Health post	351
Health center	37
Number of hospital	60
Number of bed	2,133
Family planning district office	36
Family planning center	264

Table 2-2-15 Number of Doctors and Population in 1974/75

Development region	Estimated population	Numbers of doctors	Doctor Population
Eastern	3,020,000	42	1 : 71,904
Central	4,230,000	207	1 : 20,434
Western	2,677,000	34	1 : 78,735
Far western	2,659,000	29	1 : 91,689
Total	12,586,000	312	1 : 40,339