

Preliminary Survey Report

on
Agricultural Development
in
Hilly Areas,
Janakpur Zone,
The Kingdom of Nepal

November, 1979

Japan International Cooperation Agency

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PREFACE

Upon the request of His Majesty's Government of Nepal, the Government of Japan has cooperated in the implementation of agricultural development in Janakpur Zone since 1971.

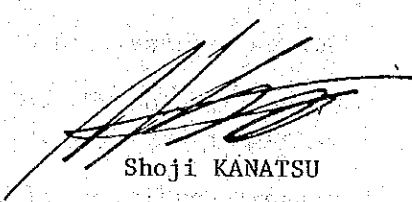
Under the agreement concluded between the two governments on November 7, 1974, the Japan International Cooperation Agency has sent experts, equipment and machines and other necessary resources to increase farmers' income and improve their standard of living in this region.

On November 25, 1977, the Project Centre, which would share one of the major activities of this project was established with the high expectations of the authorities concerned.

This project consists of some sub-projects including the Hardinath Agricultural Farm, extension activities in the Terai area of the Janakpur Zone and extension and other activities in the hilly area of the Janakpur Zone. I understand that the development of the hilly areas is one of the key factors for the socioeconomic development of the entire Janakpur Zone. From this point of view, the JICA sent the team, which successfully surveyed the various situations of the hilly area and worked out a development programme for this area. This report covers the findings of the team. According to this report, it appears that the development of the hilly area is in no way an easy task as it will be costly to develop the infrastructure, which includes roads and irrigation facilities. Therefore, I would think that instead of physical development, it would rather be advisable to provide advice and guidance primarily on the extension of proper agricultural techniques with the Sindhuli Subcenter as its base.

Last but not least, I sincerely appreciate the enormous efforts that were made by the team, the Nepalese and the Japanese members in materialising this report.

November 1979



Shoji KANATSU

Director
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Cooperation Agency

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FOREWORD

The mountainous areas which are not blessed with natural and social conditions are inhabited by about two-thirds of Nepal's population, but their arable land accounts for only one-third of Nepal's entire arable land. For this reason, the acreage of arable land per house is extremely small. According to the NPC survey (1978), the acreage is 0.56 ha. in the mountain areas and 0.74 ha. in the middle mountain areas whereas the Terai area (plain) which is blessed with favorable conditions of location registers 1.73 ha. Coupled with the inadequate conditions of communication caused by topographical restrictions, this condition gives rise to an insufficiency of food supply and demand. According to this survey, the per capital gross income stands at 0.67 RS/day in spite of the efforts made by the inhabitants, far less than the 0.99 RS/day marked in the Terai area.

Given this situation, the Government of Nepal is striving not only for the agricultural development of the valley areas but also for the formulation of measures for the areas which are overpopulated, and the Government's efforts are bearing fruit. But it is a fact that the progress of the development is behind the Terai area.

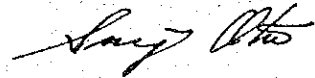
Thus, the development of middle mountain and mountain areas is of utmost importance to Nepal, and high priority is given to their development under the 6th five-year plan which is being prepared by the Government of Nepal. The middle mountain and mountain areas of the Janakpur Zone also have similar problems. The preparation of a programme for the development of the middle mountain in mountain areas is already incorporated in the agreement between the governments of Nepal and Japan on the Janakpur Agricultural Development Project (JADP).

This survey follows the several preliminary surveys which have been carried out since April 1978. In carrying out this survey, the Government of Nepal rendered cooperation in an extremely positive manner. After the arrival of Mr. Oikawa, the leader of the survey team, and other team members, several meetings held and a land survey was conducted by a joint Nepalese-Japanese team with a full mutual understanding. In order to conduct a careful survey of these remote areas, a helicopter was used to carry out the survey.

Availing myself of this opportunity, I should like to express my deep appreciation to Mr. Oikawa and his survey team as well as staff officials of the JADP, who were engaged in the surveys with a pioneer spirit, going over steep mountains and crossing rivers in spite of the inconveniences they had to encounter in their daily lives.

My deep appreciation is also due to the Government of Nepal and other Nepalese authorities concerned who rendered various forms of cooperation in the planning of the survey, preparation of programmes and collection of data. It is my sincere hope that this report will be of use not only for the regional development of the mountain areas of the Japampur Zone but for that of other Nepalese mountain areas as well.

November 1979



Saeji Ota

Project Manager

SUMMARY

1. General Conditions of Survey Area

(1) The Janakpur Zone measures 7,150 Km² (except Dolakha District) in area, sharing 5% of the national land of Nepal. Its population stands at 1,226,000, 11% of the national population.

The two districts of Sindhuli and Ramechhap which were designated as the survey area account in area for 40% of the zone but in population for 24%, the population density being relatively low in the zone.

(2) The survey area is 400 ~ 3,000 meters above sea level but its landform is extremely steep in general, constituting the greatest impeding factor for the development. Flatlands and moderate slopes exist only in extremely limited parts of the Sindhuli basin.

(3) In regard to industry, 98.6% of the population are engaged in agriculture and forestry, and no significant industries are observed other than agriculture.

(4) The arable land ratio is low with 6.7%, and the acreage of arable land per house is also low with 0.5 ha. The rate of land use is high. It stands at about 150% on the average according to the survey.

(5) The majority of the cultivated fields is terraced. Even steep slopes with an angle of even over 30° are cultivated.

(6) The main crops consist of maize, rice, wheat, millet and potato. But the productivity is low. There is a shortage of self-sufficient food in both districts. Particularly, the self-sustaining power of the Ramechhap District is low.

(7) In regard to the living environment, the roads are usable only in the dry season. From the highway which runs east to west, automobiles may reach Sindhulimali. Similar roads are also available from Mali to Ambot in the east and along some parts of the Malin River.

Water supply facilities are available only in the seats of government of both districts, but no electric power services are available.

The ratio of primary school graduates stands at 1.8% in the Sindhuli District and 1.7% in the Ramechhap District, far below the average percentage of 3.3% for the zone.

In regard to medical care facilities, a clinic is available in Sindhulimali. In addition, several health posts are established.

2. Classification of Types of Farming and Selection of Representative Survey Areas

The types of farming basically differ, depending on the height above sea level. Roughly, they may be classified as shown in the following table. To clarify the actual conditions of agriculture and the problems posed at present, a representative area was selected for each type of farming in carrying out the survey.

Table 1 Types of Farming

Type of farming	Altitude	Panchayat name	Village Panchayat
Paddy in low lands	Less than 700 m	Bhimeshwar Shasekushewar Dam	Khurkot Nepaltok
Paddy and other grains in middle mountain area	700 ~ 1,500 m	Tribho war Ratanchura	Ambot Nakajoli
Miscellaneous grain crops in mountain areas	1,500 ~ 2,500 m	Ramechhap	Ramechhap
Potatoes in high mountain areas	2,500 ~ 3,000 m	Rasnall	Rasnall

3. Actual Conditions of Agricultural Management

(1) In each Panchayat on which the survey was conducted, there are landless families with about 5% in the area. In the statistical classification of farm households, all the farm households are listed as being engaged in owner-farming. The persons who do not own any farmlands work as farm day workers, porters and others, some drifting to other areas for work.

(2) In regard to the conditions of cultivated lands under management, there is a dispersion of about five cultivated lands on the average. The greater the farm household is in scale, the smaller the dispersion of cultivated lands. In respect to the soil conditions, many responding farm households said that the soil is either good or normal. In an overall aspect, the cultivated fields are made up of steep slopes, and the terraces are great in number, with the result that the field conditions are not favorable.

(3) The scale of farm households under self-management (the farm households which live only on agricultural) may be classified for the survey area of Panchayat as follows with the family composition set at about six members:

- a. 10 Rapani (0.5 ha.) with full irrigation facilities available at nearby places.
- b. More than 40 Rapani (2.0 ha.) with no irrigation facilities (minim acreage).

(4) Water constitutes the primary factor to determine farm productivity. The paddy fields are high in productivity and stable both for first and second crops.

(5) The upland fields in which no water is available feature a cropping pattern with maize as its basic crop. The productivity is low and unstable.

(6) The planting pattern as classified by farming system is as follows:

Table 2 Farming Systems

Farming system	Low land Field							Upland Field							
	P+P+W	P+M	P+W	P+M	P+Pot	P+(F)	P+W+M	M+MIL	M+Soy	M+S+H	M+H	S+M+BW	W+Pot	Single crop	etc.
Paddy rice in low lands	⊙	△	○						△						⊙
Paddy and other grains in valley areas		○	⊙	△				⊙	△			△			○
Miscellaneous grain crops in mountain areas						⊙	○	⊙	△	○	△				
Potatoes in high mountain areas			⊙		○	△							⊙	○	△

(Note) ⊙ Great ○ Somewhat great △ Small

P = paddy, W = wheat, M = Maize, Mil = Millet (F) = Follow,
 Soy = Soybean, H = Horsegram, BW = Buckwheat, Pot = Potato

(7) The outline on the agricultural techniques for principal cereals is as follows:

1 Selection of Varieties

Varieties for short-period growth are for a system of three crops a year, whereas high-yield varieties are selected for a system of two crops a year. Incidentally, the extension of improved varieties is led by wheat, which is followed by paddy and maize.

2 Seed Preparation

At the farm households covered in the survey, no seed preparation is conducted other than the exclusion of insect-damaged maize seeds.

3 Seeding

Although line planting is conducted in some places, random planting is generally carried out for paddy. Broadcasting is done in many places for upland crops.

4 Manuring Control

For the cultivation of paddy and wheat in low lands with rice plantation, the basal application of chemical fertilizer (urea and composed fertilizer) and the additional application of urea are well extended in addition to manure.

In the hilly areas, only manure is used in almost every field. The application of manure is 180 ~ 360 kg per Rapani.

5 Relations between Fertilizer Application and Yield

a. For paddy, chemical fertilizer is considerably extended and the yield is high in the farming type of paddy in low lands. The application of compost is not so great as in the mountain areas. In the mountain areas, chemical fertilizer is not applied in almost every field, and the yield is small.

b. For maize, compost is applied in great quantities in the mountain areas but the yield is small. In the farming type of paddy in low lands, the application of compost is insignificant but the yield is relatively great. Presumably, the reason may be attributed to the difference in the water preserving power of soil and the residual effect of fertilizer application in wheat cultivation on paddy.

(8) In regard to fruits, citrus are planted by the greater number of farm households at a rate of several trees per farm household in their housing sites and in the field adjacent to their housing sites in the hilly areas, in the mountain areas and in the high mountain areas. At some farm households, the citrus constitutes a cash crop. Orchards are developed in Nakajori, Chapouli and Ramechap. The varieties include Sundra and Junar. Particularly, Junar is delicious.

(9) The greater the composition of a farm household, the greater the acreage of cultivated fields under management. Moreover the number of family members is greater in the farming type of paddy and other grain crops in middle mountain areas than in that of paddy in low lands.

(10) The number of persons engaged in farming work per household is one at the minimum and nine at the maximum. In respect to the ratio of farming work a year by farm households engaged only in agriculture, 90% is shared by work less than 180 days a year, indicating that the ratio is low. (However, the ratio does not include livestock control.)

Members of the small farm households are engaged in side jobs, such as porters.

(11) In regard to stock raising, buffaloes and cows are bred in each area. The number of heads is great in the farming type of paddy and other crops in middle mountain areas. The buffaloes constitute an important cash source, as their milk is sucked. Cows are bred for work and breeding. In addition, goats and chicken are bred in great numbers.

4. Problems Posed for Farm Management

(1) The ratio of use of arable land is raised by endeavours for farm management, but an improved cropping pattern encompassing second crops or inter-mixed cropping has not yet been established.

(2) Improved varieties are extended, but seeds are not supplied in sufficient quantities as hoped for by farm households.

(3) The application of compost is relatively great in quantity but there is room for an improvement of the application method (the application method to raise the water preserving power of soil). The additional application is not in practice.

(4) Protection of disease and insect is extended in lowlands with paddy plantation but not conducted practically in every other area.

(5) The cash revenue sources for farm households consist mainly of livestock products and, in part, of fruits, but there is much room for technical improvement.

(6) In general, the number of heads of cattle is excessive for raising, and the lack of feed is conspicuous. Problems are posed, such as the dilapidation of forests by the collection of feed and the difficulty of maintaining the land productivity as all straw is converted into feed.

(7) Opportune plantation is an important element for a stabilization of the yield, but the labour peak is high in this season.

(8) In relation to the foregoing, there is much room for an improvement of the farm implements (ploughs, threshing tools, etc.)

(9) In regard to the supply of farm-management materials, such as fertilizer and pesticides, the requirements of farm households are not fully satisfied. However, this problem entails the availability of funds on the part of farm households.

5. Improvement Measures

(1) Improvement of Farm Management

1 Improvement of Paddy Nursery Breeding and Planting Density of Paddy Field

In general, the nursery breeding and seeding densities are high. Additionally the seed are poor in quality, so there is a need to improve them to 1/2 ~ 1/3 the present status. It is also necessary to improve the planting density of paddy fields.

2 Improvement of Inter/Mixed Plantation

Broadcasting, line planting and seeding in hill have their own merits and demerits. But there is a need to establish tests and techniques of the kind which will facilitate the introduction of improvement techniques and in which priority will be given to line planting.

3 Breeding of Improved Varieties with Local Adaptability

There are some conventional varieties which are suitable for the conditions of mountain areas. It is important to work for improved varieties on the basis of such conventional varieties.

4 Seed Preparation and Plant Control

There is a need to conduct basic preparations, such as selection by specific gravity, seed disinfection and seed selection, for each crop variety. It is also necessary to extend the prevention and extermination of harmful insects with chemicals.

5 Improvement of Fertilizer Application Techniques

In case seeds are planted, it is necessary to apply compost under seeds in a line seeding method, raise the water reserve property and increase the effects of the fertilizer application. In entire spraying, the water reserve property would be insignificant. This is of particular importance, because water is the primary factor which determines productivity.

6 Improvement of Fruit Cultivation

At present, most of the fruit trees are dotted in courtyards and other places. As fruit plantation is a promising cash source for the future, it is necessary to develop exclusive orchards. Particularly, there is a need to improve and extend fruit cultivation in line with plans for belts of citrus plantation on a national level and plans for roads in the future (improvement of conditions for physical distribution in a nation-wide).

7 Improvement of Vegetable Cultivation

For an improvement of the farmers' diet, it is necessary to develop exclusive vegetable fields around their housing sites.

8 Raising of Cattle and Maintenance of Feed

There is a need to rationalise the number of heads of cattle for raising, conserve forests and streamline the production of feed. For the maintenance of the soil potential, it is necessary to revert as many straw to cultivated lands as practicable.

9 Crop Rotation with Irrigation

As water constitutes the primary factor to determine productivity, it is necessary to encourage irrigation on the basis of the findings of the survey.

10 Improvement of Farm Implements for Harvest Adjustment and Other Purposes

To raise the labor productivity, such as response to a labor peak, there is a need to improve farm implements (e.g., improvement of ploughs and threshers).

11 It seems effective to organise group operations for the promotion of timely planting.

12 Improvement of Use of Dykes

It appears that there is room for an improvement of the methods for the control and use of dykes in terraced fields from the standpoint of prevention of erosions and the use of dykes for green manure and feed sources.

13 Promotion of Sajha Programme and Strengthening of Guidance System

To work for the timely supply of seeds and other materials, the maintenance of inventories and compensate for the shortage of funds on the part of farm households, it is essential to strengthen and promote the Sajha Programme.

To provide guidance on the extension of new techniques, it is important to strengthen administrative organizations, such as Panchayat and agricultural committees.

(2) Development of Production Base and Living Environment

1 Irrigation

As elucidated earlier, water constitutes the primary factor to determine the agricultural productivity. As circumstances permit, therefore, it is necessary to explore water sources and facilitate irrigation.

At present, it is impossible to make use of the water of the Sunkosi and other large rivers, because (a) no energy for the pumping of water is available and (b) even if it was available, the areas for irrigation are small and spread over. For this reason, the water of small stream is used to considerably effective use at present. According to the findings of the latest survey, it has been found that there are 54 water sources in the Sindhuli District, each capable of irrigating more than 10 ha., for the irrigation of 2,446 ha. The Ramechhap District also has 14 new water sources for the irrigation of an area of 183 ha. (See 4-(2)-1))

There is a need for the systematical implementation of this development.

2 Water for Drinking and Miscellaneous Uses

On the basis of the findings of the latest survey, it was estimated that on the assumption that water sources capable of covering less than 10 ha. of irrigation, there would be 22 such sources in the Sindhuli District and nine such sources in the Ramechhap District. (See 4-(2)-2))

It is also necessary to promote the use of these sources.

3 Newly Developable Areas

The areas with an altitude of more than 400 meters have excessively turned into farmlands. There is no room for further clearing in the light of the necessity of protecting forests and nourishing water sources.

It would be possible to develop 10 areas with a total area of 2,829 ha. into farmlands on the beds of the Kamla Nadi and Marin Khola rivers. (See 4-(2)-3)) In this possibility, however, there would be a need to work out protective measures against floods.

4 Small-Scale Hydraulic Generation

When plans are formulated for hydraulic power generation, it is necessary to bear in mind to the following four points.

- (a) The water discharge will be stable throughout the year.
- (b) The sand and stones which will flow down will be small in quantity, and the catchment structures will be safe.
- (c) There will be an adequate head of water.
- (d) The distances for power distribution will be short and the users will be concentrated.

Power generation programmes have been worked out for two places in the Sindhuli District and one place in the Ramechhap District as cases which satisfy these conditions. (See 4-(2)-4))

(3) Concept of Long-term Development
- Programme for Trunk Roads for Regional Development -

In respect to the present situation of roads in the Janakpur Zone, the East-West Highway runs through the north of the three districts of Terai, and a motorway runs to India by way of Janakpur and Jaleswar. In the Dolakha District in the north, a road is under construction to link Kathomandu to Jiri.

As for the hilly areas of the two districts covered in the programme, there are some roads which use river-beds and which may be used by automobiles only in the dry season.

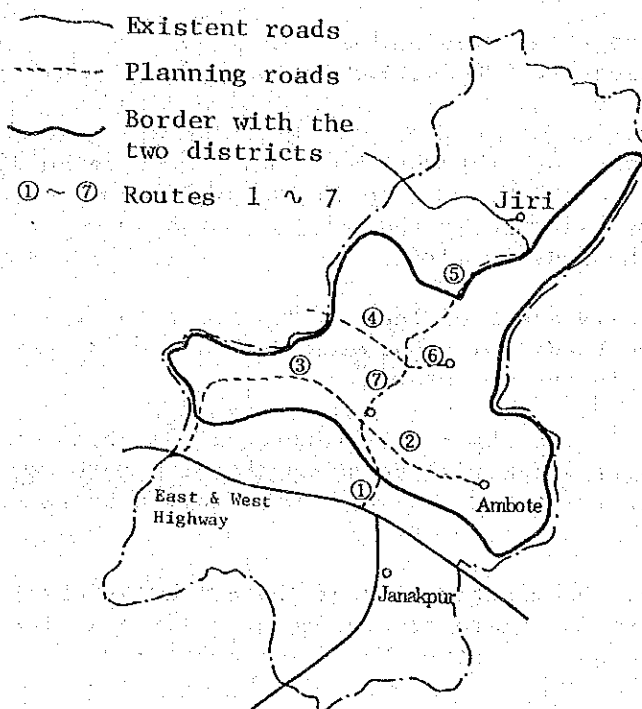
As indicated in the figure, therefore, plans have been worked out for seven routes which will be connected with motorways both under construction and in existence and which will form a basis for regional development.

Incidentally, the construction of the Sindhuli-Kurkot road will not be started in the immediate future, because difficulties will be involved as it runs across the steep Mahabarat mountains.

Table 3 Traffic System of Janakpur Zone

No. on Map	Route Section	Distance (km)	Estimated Construction Cost (million yen)
1	East-west Highway - Sindhulimali	39	1,400
2	Sindhulimali - Ambote	45	1,500
3	Sindhulimali - Karamaya	58	1,800
4	Drikel - Solpa Thana	90	3,200
5	Jiri - Kurkot	55	1,900
6	Bangeri - Kurkot	20	1,000
7	Kurkot - Sindhulimali	40	2,000

Programme for Trunk Roads
for Regional Development



- ① East-west Highway - Sindhulimali
- ② Sindhulimali - Ambote
- ③ Sindhulimali - Karamaya
- ④ Drikel - Solpa Thana
- ⑤ Jiri - Kurkot
- ⑥ Bangeri - Kurkot
- ⑦ Kurkot - Sindhulimali

6. Methods for Implementation of Improvement Measures

The main improvement and extension methods are enumerated below:

(1) Designation of Farm Households as Management Test Models

The farm management improvement programme worked for each crop will be translated into action. Enthusiastic and advanced farm households will be selected for extension to farmers. These farm households will be asked to implement the programme and given technical guidance on a priority basis as models for improvement.

(2) Implementation of Application Tests

It is necessary to verify the practicability of improvement techniques and carry out improvement tests. For this purpose, there is a need to make effective use of the Sindhuli farm and conduct application tests some of the fields of test farm houses when necessary.

(3) Construction of Rural Communication Facilities

For the promotion of extension projects, public-relations activities of the Government on its various administrative measures, farmers' healthy recreation and other purposes, it is advisable to establish a simple assembly hall at least for each Panchayat.

(4) Projects for Development of Water Utilization and the Environment

The programmes for water for drinking and domestic uses, farmland development and small-scale hydraulic power generation will be put into effect year by year on a priority basis.

(5) Experimental Implementation of Projects for Integrated Development Models for Village Control

In agricultural management in the mountain areas, farming, stock raising and forestry are closely related to one another and integrated for management. At present, however, the number of heads of cattle is excessive, with the consequence that there has emerged a vicious cycle, as is represented by the dilapidation of forests due to the exploitation of feed and by the degeneration of the soil potential due to the turning of all straw into feed. To cope with this situation, the stock raising sector will be made more efficient with an improvement of the cattle varieties, the number of heads of cattle for raising will be rationalised and the utilization of forests will be streamlined. And model projects for the integrated establishment of farm management techniques well balanced with the above two projects will be carried out on an experimental basis. The project scale will be one pachayat or a certain area of each pachayat, and control will be exercised by the pachayat. Incidentally, it is desirable to carry out the improvement of water utilization at the same time. Therefore, it would be the best thing to select areas where water sources may be developed.

7.

Effects of Development

The effects of the development will be far-reaching, such as an improvement of the living environment by the construction of roads and a spread of education by the upgrading of the economic power, in addition to a rise in the production of crops.

The effects of the development in this instance, however, are confined to those which will directly encourage a boost in the production of food, including (1) the effects from an improvement of the farm management techniques (extension of improved varieties and pest & disease control, etc.), (2) the effects from new irrigation facilities, and (3) the effects from the development of new farmlands.

Judging from the organizations for extension, educational level of farmers, funds for an improvement of the management, supply of equipment and materials and other factors at present, it is conceivable that it would take fairly many years to attain the programme to the full extent. For this reason, the effects have been computed on a trial basis for three phases - 30% of the attainment, 50% and 100%. The results of this trial computation are summarised in the following table.

Incidentally, the areas where new farmlands may be developed are concentrated on the beds of big rivers, and their development would be practicable only when a large-scale riparian repair work project was simultaneously carried out by the State. For this reason, their development has not been incorporated in the trial computation.

Table 4 Trial Computation of Crop Production

Classification	Rice	Wheat	Maize	Barnyard millet	Barley
Present amount	29,271t	2,526t	36,300t	5,350t	299t
30% attainment	Improvement of farm management techniques	3,021	41,699	5,772	326
	New irrigation	3,061	Δ1,656	-	-
50% attainment	Total	37,801	40,043	5,772	326
	Improvement of farm management techniques	38,397	45,221	6,060	342
100% attainment	New irrigation	5,101	Δ2,760	-	-
	Total	43,498	42,461	6,060	342
Production growth rate	Improvement of farm management techniques	47,536	54,149	6,780	386
	New irrigation	10,199	5,517	-	-
In case the development of new farmlands is included	Total	57,735	48,632	6,780	386
	30% attainment	129.1%	173.1%	110.3%	107.9%
	50% attainment	148.6	221.7	117.0	113.3
Production growth rate in the above case	100% attainment	197.2	343.2	134.0	126.7
	In case the development of new farmlands is included	68,627t	13,479t		
Production growth rate in the above case	234.5%	533.6%			

Note: The production decrease (marked with a triangle) of maize in the line for new irrigation represents the decrease in the output of the upland fields which are converted into paddy fields with the construction of new irrigation facilities. Consequently, the area for this portion represents the increase of "paddy rice → wheat".

1. General Conditions of Survey Area

(1) Location

The Kingdom of Nepal is situated from lat. $26^{\circ}20'$ to $30^{\circ}10'$ N, and long. $80^{\circ}15'$ to $88^{\circ}15'$, measuring 880 km from east to west and about 190 km on the average from north to south with an area of 144,000 km².

Being an inland country, Nepal borders China in the north at the Himalayan mountains and India in the south. It also borders India at the Mechi River and the Singlia mountains in the east and again India in the west at the Mahakari River.

Nepal is an alpine country with 82% of its entire national land made up of mountains and hills. The only low flatland it has is the Terai plains which are connected with the Indian plains in the south. This flatland accounts in area for only 18%.

The altitudes range from 100 ~ 300 m at Terai in the south to over 7,000 m at the Himalayan mountains in the north, indicating that there is a big difference in altitude over a distance of about 190 km between the north and the south. In general, the national land slopes down from north to south with a repetition of undulations.

Situated in the east of Nepal, the Jankpur Zone measures about 160 km from north to south and 39 ~ 81 km from east to west. It borders India in the south and Tibet in the north with a total area of 9,760 km² (6.9% of the national land). This zone is made up of six districts, which are classified into three areas, depending on the topographical features. They include the Terai lowland area in the south with the districts of Danusha, Mahottari and Sarlahi, hilly area in the center with the district of Sindhuli and Ramechap, and northern mountain area with the Dolakha district.

In this survey, it was decided to formulate a regional agricultural development programme for the two districts of the central hilly area with a total area of 39.6 km² (40.6% of the area of the zone). (See Fig. 2)

Fig. 1 Location of Janakpur Zone

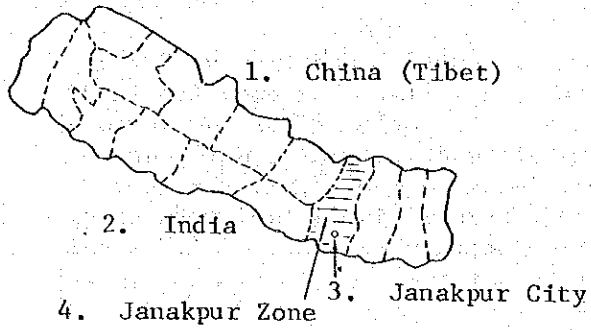
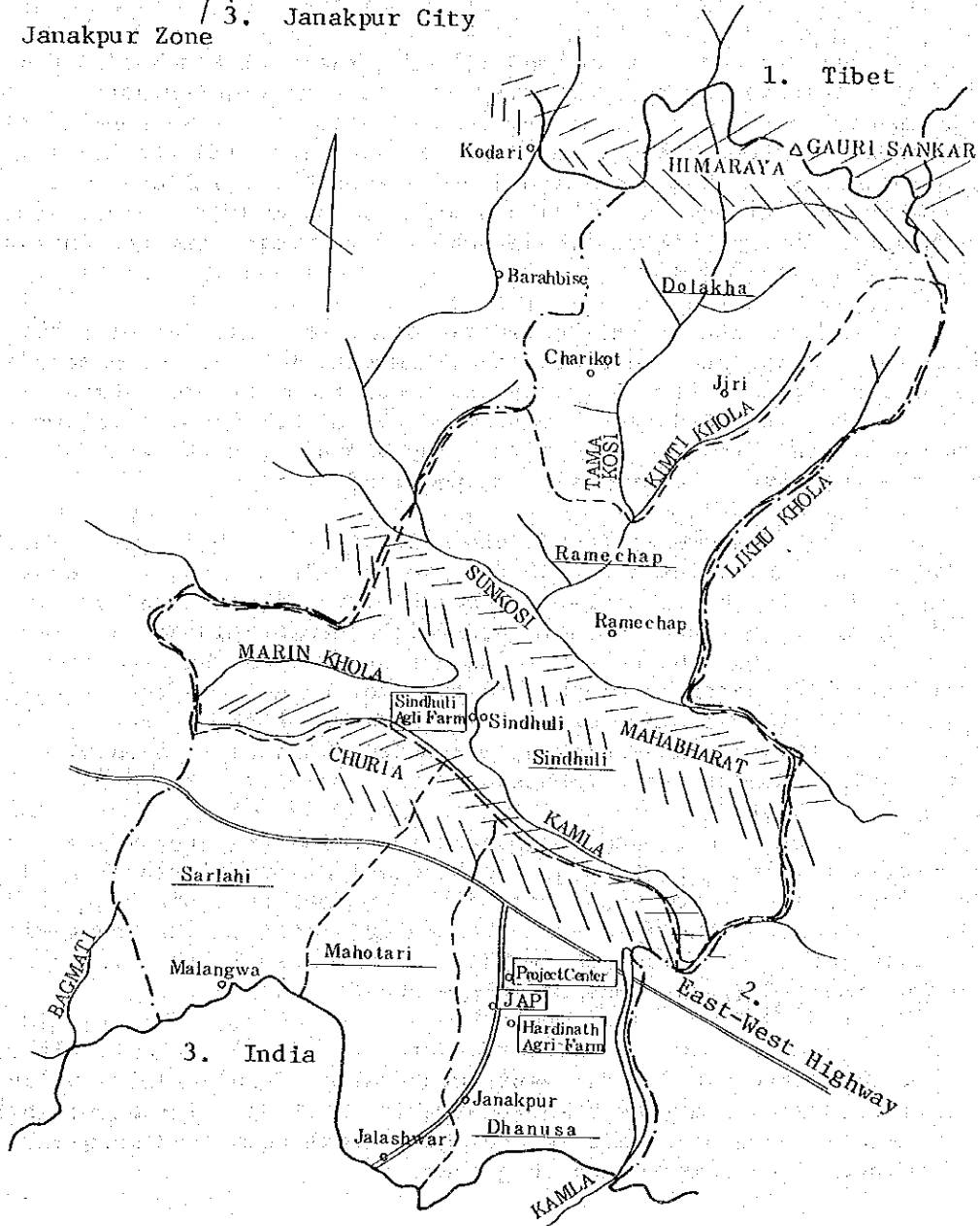


Fig. 2 Survey Area



(2) Natural Conditions

1) Topography

As stated earlier, Nepal is a mountain country and 82% of the national land consists of mountains and hills. The only flatland of Nepal is the Terai area, which accounts for only 18% of the national land (including Inner Terai, to which reference will be made later). The altitudes range from 100~300 m at Terai to over 7,000 m at the Himalayan mountains. The national land of Nepal is divided into three regions: (1) Himalayan Region, (2) Mid-mountain Region, and (3) Terai Region.

In this report in which the districts of Sindhuli and Ramechhap were taken up as the survey subject, the greater part of the Mid-mountain Region in (2), above, according to the above general classification. Further, this area may be divided into (a) Mhabharat Lekh, (b) Nepal Midlands (the area sandwiched between the Himalayan mountains and the Mahabharat mountains), (c) Churia Hills, and (d) Inner Terai (the area sandwiched between the Mahabharat mountains and the Churia hills). (See Fig 2)

According to this classification, the district of Sindhuli belong (b) and (d) and the district of Ramechhap to (b). In general, this midland's land form is steep and consists of U- or V-shaped valleys. The Sunkosi River along the border of both districts, which shapes a typical V-shaped land form. Incidentally, Rapti and Kathmandu are representative of a typical U-shaped land form.

One feature of the Sindhuli District's land form is that the Mahabharat mountains run from east to west in the north, the area of which accounts for more than 40% of this district's total area, including the mountains' northern and southern slopes. Another feature of this area is that the peaks are almost 3,000 m on the average, and the northern and southern slopes are extremely steep, macroscopically with angles of 15~30° in most places. Because of this steepness, there are relatively many forests, which are extremely eroded by water flowing down from the mountains.

The south of the Mahabharat mountains is Inner Terai, which shares a fairly large portion of the Sindhuli District's total area (about 40%). The altitudes of this district are less than 500 m, and it is an outcome of the upheaval of the Churia hills. The banks of the Kamala Nadi which flows eastwards and the Marin Khola which runs westwards and the Sindhuli basin are generally flat.

Situated at the southern most part of the Sindhuli District, or the border with three Terai districts are the Churia hills, which are narrow in area and less than 1,000 m in altitude. The Churia hills are extremely poor in geological and agronomical terms and unsuitable for farming. They feature sparse groves.

Practically the entire part of the Ramechhap District falls under the classification of the Nepal Midlands. Being 500 ~ 3,000 m in altitude, this district consists entirely of mountains.

Topographically, the northern bank of the Sunkosi River, which has created valleys and runs from west to east, and the Tamakosi Khola, which is a tributary of the Sunkosi River and runs from north to south in the center of this district, are as extremely steep as the northern and southern slopes of the Mahabharat mountains with their slopes generally ranging from 20° to 30°. And a large number of valleys, different in form and size, intertwine one another, and the banks of both rivers are extremely steep. Given such steep slopes, relatively moderately sloping ridges are used to carefully develop terraced fields, and this landscape constitutes a feature of this district.

2) Geological Features

The Himalayan mountains are relatively new. History has it that there were seabed upheavals some 70,000,000 years ago and reached the present altitudes 60,000,000 years ago (the Mesozoic). According to the theories on the formation of the globe, the area which is not occupied by the existing Himalayan mountains was a vast expanse of water linked to the Mediterranean. (This expanse of water is known as the Himalayan Sea or generally called Tethys.)

Tony Hogen et al. (Modern Geography of Nepal, 1968) argue that the diastrophism which originated in the north was hampered by Decan blocks in the south, and the Tethys' deposits were compressed, thus leading to the formation of the Himalayan mountains. On the other hand, the orogenic movements of the Mahabharat mountains belonged to those of the Himalayan mountains, and it is conceived that they made their appearance as low folds.

It is said that the remainder of the Tethys - that is, the southern part of the Mahabharat mountains - was not conspicuously influenced by orogenic movements in the Mesozoic and remained a shallow sea as it was. With the advent of the Tertiary period, the sea was buried with alluvial deposits, thus forming the vast Indo-Ganges plains including the Terai area of Nepal. In the Quarternary period (600,000 years ago), small-scale diastrophism, or fold orogenesis, took place, thus forming the Simaliks hills as seen today.

Fig. 3 shows the Geological Map of Nepal, 1978. According to this map, the geological groups of Nepal are divided into eight. The districts of Sindhuli and Ramechhap the survey of which was planned belong to four of the eight groups - that is, (1) the Siwaliks sedimentary rock group, (2) the Mahabharat midland metasediment group, (3) the young sediment group, and (4) the Himalayan genesis group.

The Sinhduli District extends over the Siwalik hills and the Mahabharat mountains. The southern part of the district belong to the Siwalik group and its base consists of the sediment rocks which originated from deposits in the shallow sea of the Tertiary period - that is, sandstone, conglomerate, limestone, etc. The northern part of this district is the Mahabharat mountains which belong to the midland meta-sediment group. The peaks of these mountains are made up of gneissose granite, and the layers, or the mountain slopes are made up of midland meta-sediments and rich in mica. Sporadically, limestone, granite and iron compounds are interposed.

The district of Ramechhap is situated in the big fold which extends between the Himalayan and Mahabharat mountains and made up of midland meta-sediments, as in the case of the aforementioned Mahabharat group. However, this area is different in geology from Sinhduli, because the base is interposed with basicigneous rocks and tuffs. The substratum of the central part of this district is made up of gneisses, which belong to the Himalayan group, consisting mainly of feldspar porphyrablastic gneisses and mica gneisses. In the area situated in the fold valley in the north, the denuded sediments moved in from the periphery are thick, covering the substratus of mica gneisses.

In the foregoing, an attempt has been made to provide a broad outline on the geological features. When the geological features are taken into consideration as land resources from the viewpoint of regional economic development, the two districts covered in the survey feature an extremely steep land form as a result of the fold orogenesis, and there is a lack of developable mining resources. There is the potentiality of exploiting limestone, mica, etc., in some parts, but the prospects for their development are not bright because there are no means of communication.

In regard to the construction of hydraulic power generation and irrigation facilities, the geological features are favorable for their foundations and construction materials, but the functional efficiency of various facilities is considered low in terms of preserve property and durability.

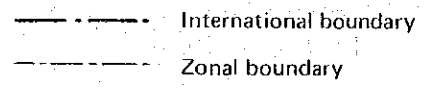
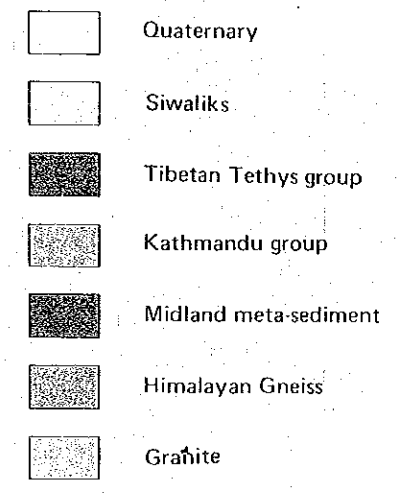
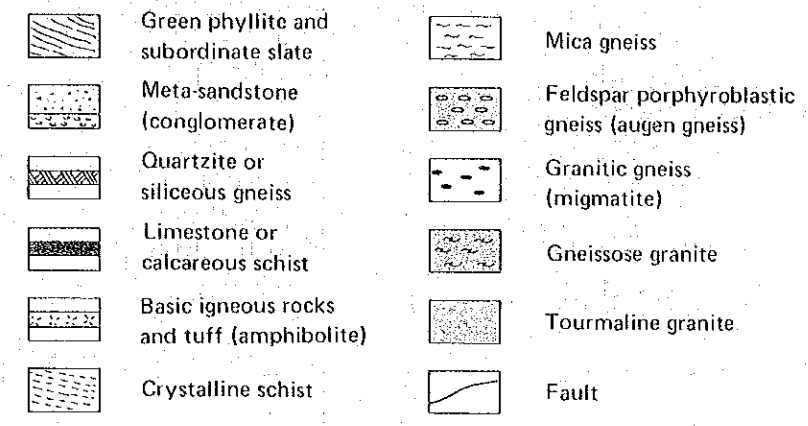
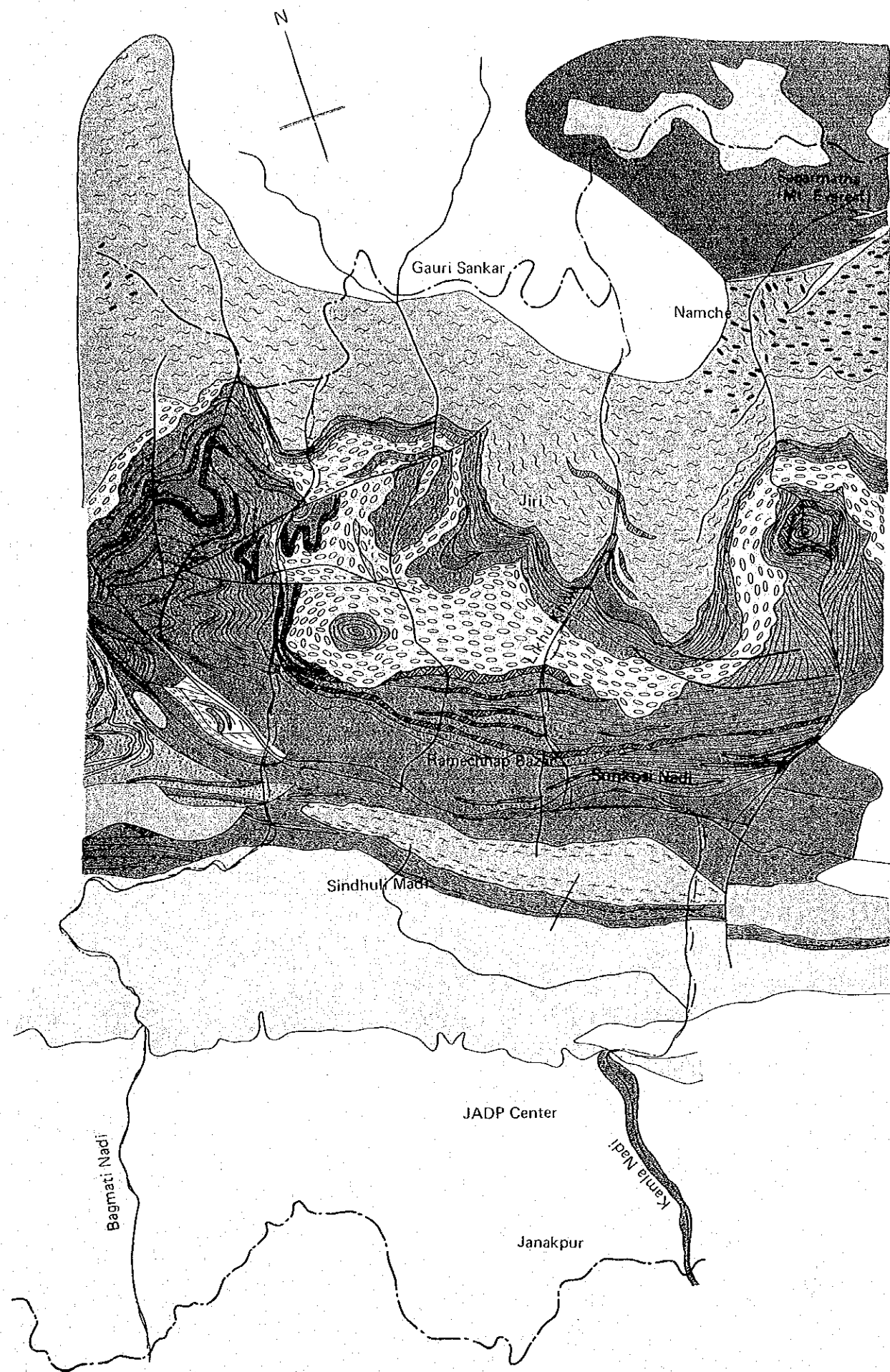


Fig. 3 Geological Map of Janakpur Zone

3) Soil

The agronomical features of the survey area on the basis of the findings of a soil reconnaissance and a soil test are enumerated in Table 5 (see the Table of Soil Surveys).

The soil of the survey area has as its parent materials genesis, granites, midland meta-sediments, etc., the substratum of which constitutes mica, feldspar, etc., as stated in the preceding section. In general, it consists of a coarse soil which retains much of the base of the parent materials. These soils may be roughly classified into (1) sedimentary soil at the slopes, (2) colluvial soil in the alluvial cones, and (3) alluvial soil in the terraces. However, they are humus soil in a monsoon climate and acid soil with a small content of base and the physicochemical properties are generally common without any significant difference.

Some of the soils in the paddy field where terrace farming is conducted and also in the upland fields are influenced by an eluviation for which the reserve of irrigation water and the coarse soil texture with a marked permeability, with the consequence that there is a conspicuous drop in the soil productivity of the top soil. Given this phenomenon, farmers are using a farming method in which an attempt is made to excoriate and discard the eluviated surface soil and make use of accumulated layers in the lower strata.

In order to boost the production of farm products in the future under the aforementioned agronomical conditions, there is a need to improve the following physicochemical properties - that is, (1) application of coarse organic matter, such as manure and green manure and application of fertilizer for the upgrading of the soil productivity, (2) improvement of the cropping pattern (crop rotation, mixed cropping, etc.), and (3) holding of water and conservation of the surface soil with the introduction of mulching and deep plowing.

Table 5 Table of Soil Surveys

Outline of Soil Features Surveyed	Soil colour	Soil texture	Corrosion	Gravel	Viscosity	pH		Exchangeable lime	Effective phosphate	Remarks
						H ₂ O	KCl			
Sindhuli Mali (Paddy fields)	Dull reddish brown	Sil	Practically no	5 ~ 10 m/m 2%	Weak	7.0	5.6	None	Slightly contained	
Sindhuli Mali (Maize fields)	Dark reddish brown	Sil	Practically no	None	Weak	5.5	5.0	Contained	Slightly contained	Laterite
Ramechhap (Maize fields)	Red	CL	Small quantity	10 ~ 15 cm 30%	Weak	6.0	5.5	Contained	Contained	Laterite
Ramechhap (Maize fields)	Brown	Sil	Slightly	1 ~ 10 cm 30%	None	6.5	6.0	Rich	Very rich	Laterite
Jiri (Forests)	Reddish black	CL	Slightly	1 ~ 15 cm 30%	None	6.5	5.5	Contained	Contained	
Jiri (Potato fields)	Black	LiC	Corroded	1 ~ 5 cm 2%	None	6.5	6.0	Contained	Rich	Jiri farm
Charicot (Maize fields)	Reddish brown	Sil	Corroded	0.5 ~ 2 cm 2%	Weak	5.5	4.5	None	Contained	Laterite
Charicot (Paddy fields)	Grayish yellow brown	SiCL	Corroded	1 ~ 2 cm 2%	Weak	6.0	5.0	None	Contained	

Soil Colour: Based on the "Book of Standard Soil Colours"
Supervised by the Secretariat, Agricultural, Forestry and Fisheries Technical
Council, Ministry of Agriculture, Forestry and Fisheries, and Japan Colour
Research Institute

Soil Texture: Based on the Chart for Soil Surveys contained in the "Book of Standard Soil
Colours".

pH: Based on the Simplified Soil Tests of the Fujihira Industry Co., Ltd.

Exchangeable Lime: Ditto

Effective Phosphate: Ditto

4) Climate

The entire land of Nepal belongs to the monsoon zone. But the climate greatly differs, depending on the districts, because its national land stretches long from east to west and there are great differences in altitude.

The climate of Nepal - particularly, its precipitation and temperature - in the summer season is in sharp contrast to that of the inter season.

Speaking of the precipitation, the summer season which extends from June to September registers almost 90% of the annual precipitation due to the influences of the monsoon which blow in from the Indian Ocean. The moisture in the eastern part is more conspicuous than in the western part, and the rainfall decreases from east to west. There is much more rain in the southern slopes of the Mahabharat mountains than in the Terai Region. In the mountains, there are signs that the higher the altitude, the greater the precipitation, and this tendency holds true up until a certain altitude. In the winter season, on the other hand, the monsoons blow in from the arid zone on the opposite side (northwesterlies in broad terms), so that there is little rain. At any rate, it is a general tendency that there is little rain in areas less than 3,000 m in altitude north of Mahabharat.

There are few rainfall observation stations in the districts of Sindhuli and Ramechhap, making it difficult to indicate the precipitation as classified by altitude, but the annual tendency is indicated in Fig. 4. The figure suggests that there is some rain in March and April, 90% of the rainfall being concentrated in the period of May through September. With heavy rainfalls in July and August, the danger of a landslide in the mountains is great. Particularly, care must be exercised about the steeply sloping mountains of both districts which belong to the eastern part.

It would be difficult to cultivate crops in the season of November through April when there is little rain, unless the large quantities of rainwater brought in during the summer season were reserved and effective irrigation measures were instituted. Judging from these points, the upbrining of forests in the mountains - although it would run counter to an expansion of arable lands - is of importance to the cultivation of water sources and the prevention from erosions.

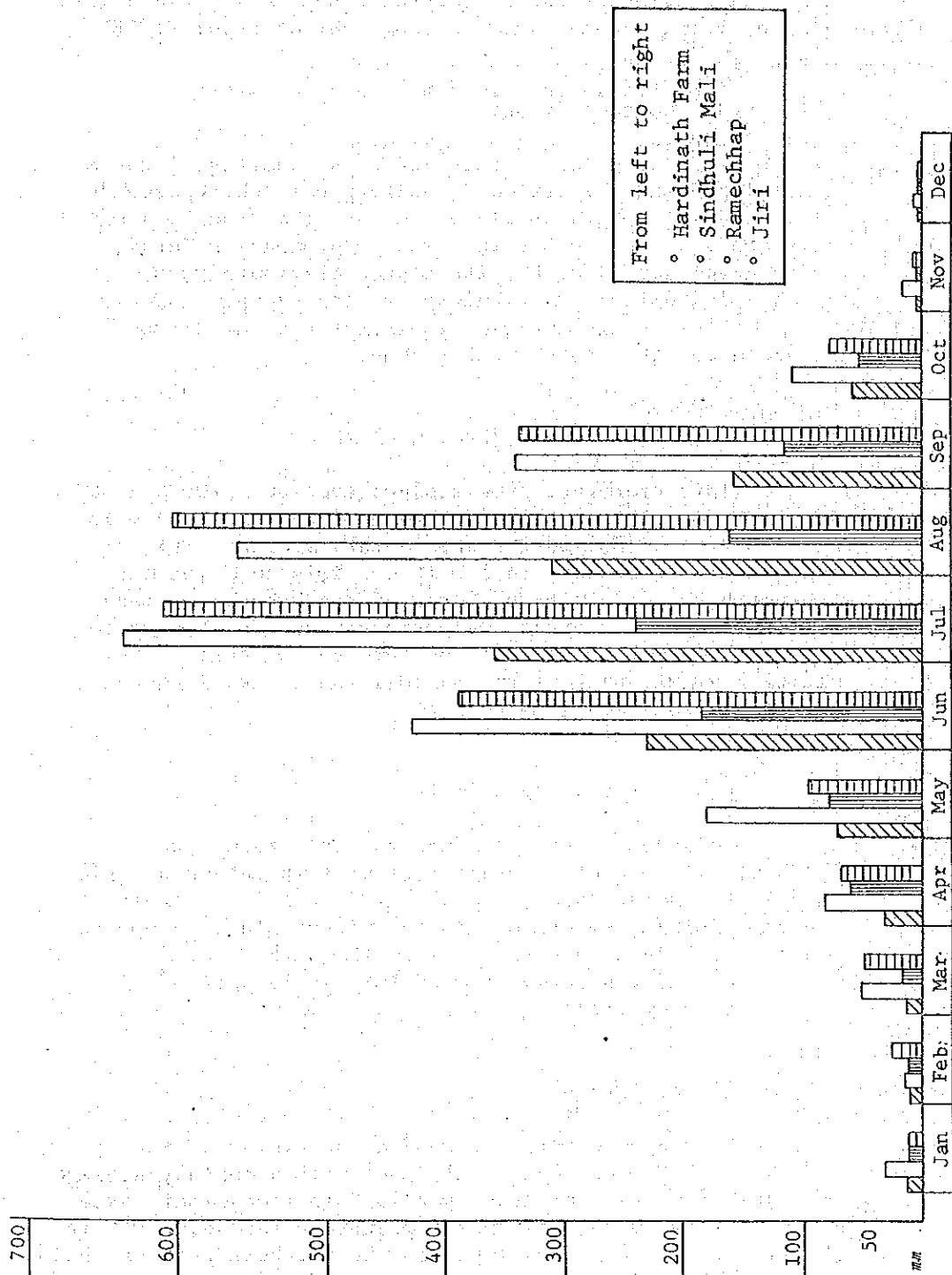


Fig. 4 Monthly Precipitation

Next, talking about the temperature, Nepal is divided into the following five climate zones (Modern Geography of Nepal, 1978).

(1) Hot Monsoon Climate

This zone is the area which is less than 1,200 m in altitude and the maximum temperature of which exceeds 38° - the area which is hit by hot waves of the kind which is known as "Loo" in Nepalese. It encompasses Terai, Inner Terai and Siwalik. Therefore, the southern part of the Sindhuli District belongs to this zone. However, the monthly average minimum temperature in the winter season drops 10 ~ 15°C in this zone.

(2) Warm Temperature Monsoon Climate

This represents the midland section 1,200 ~ 2,000 m in altitude. The monthly average maximum temperature in July is 27 ~ 32°C, whereas the monthly average minimum temperature in January is 5 ~ 10°C. This zone includes the northern and southern slopes of the Mahabharat mountains except their peaks and peripheries. It also encompasses the southern part of the Ramechhap District. Low-altitude areas, such as the Sunkosi and Tamakosi Rivers are also classified into this zone.

(3) Cool Temperature Climate

This zone represents the mountain zone 2,000 ~ 3,300 m. The monthly average maximum temperature of this zone in the summer season is 22 ~ 23°C but its monthly average minimum temperature in the winter season drops to nearly 0°C. This zone encompasses the peak of Mt. Mahabharat and its periphery and the middle part of the Ramechhap District.

(4) Alpin Climate

This zone covers the foot of mountains in the Himalaya 3,300 ~ 4,800 m in altitude with a monthly average maximum temperature or less than 15°C in the summer season and a monthly average minimum temperature far below 0°C in the winter season. The ridges in the northern part of the Ramechhap District are situated in this zone.

(5) Tundra Climate (over 4,800 m in altitude)

In terms of meteorology, topography and soil property, this area is not suitable for agriculture.

As there are few temperature observation stations in the districts of Sindhuli and Remapchhap, it is difficult to accurately show the annual temperature by altitude. On the basis of the records of other zones the land form and altitude are the same as both districts, the annual tendency may be roughly estimated as indicated in Figs. 5 and 6. For the formulation of a farm management programme, attention ought to be paid these date.

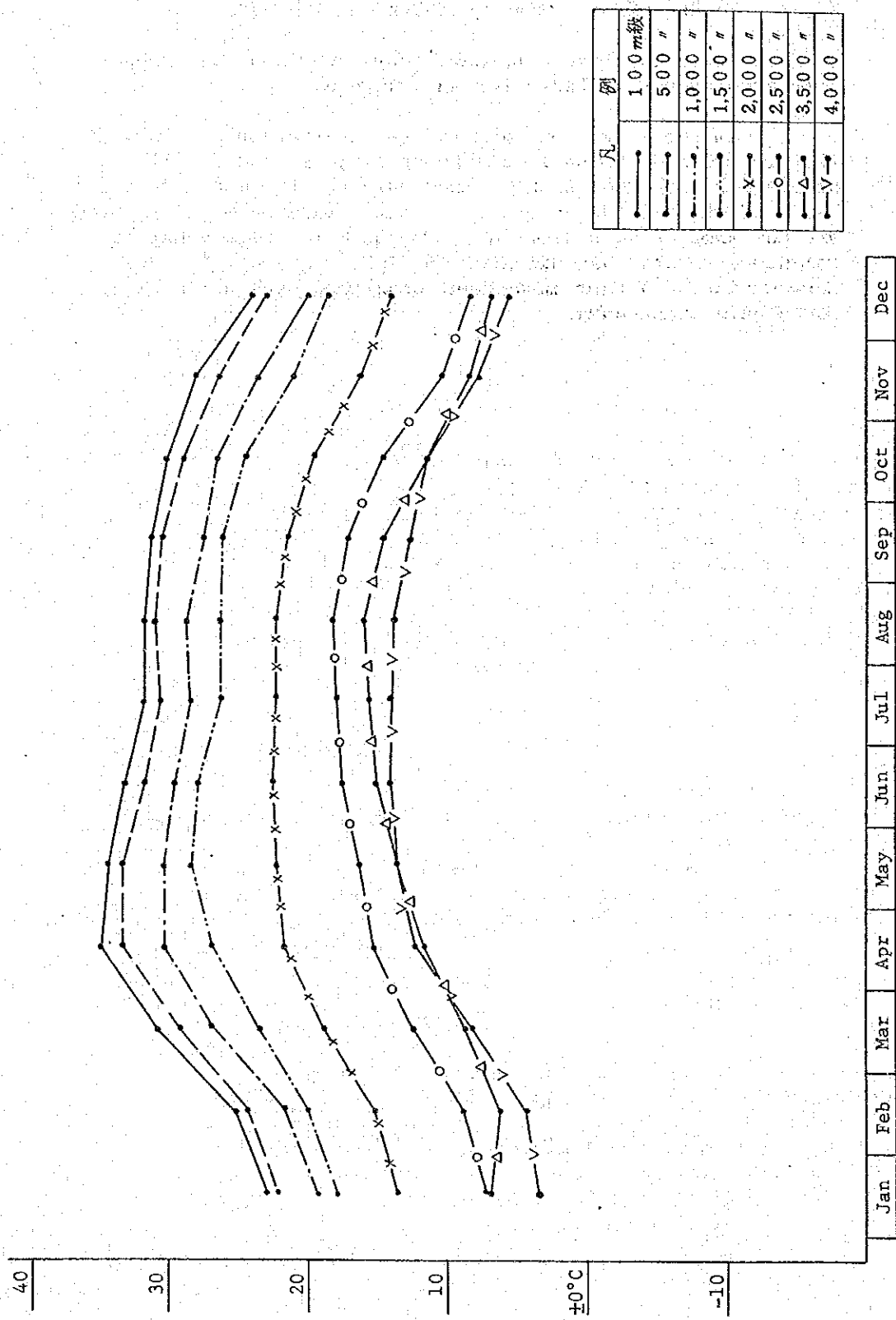


Fig. 5 Monthly Average Maximum Temperature

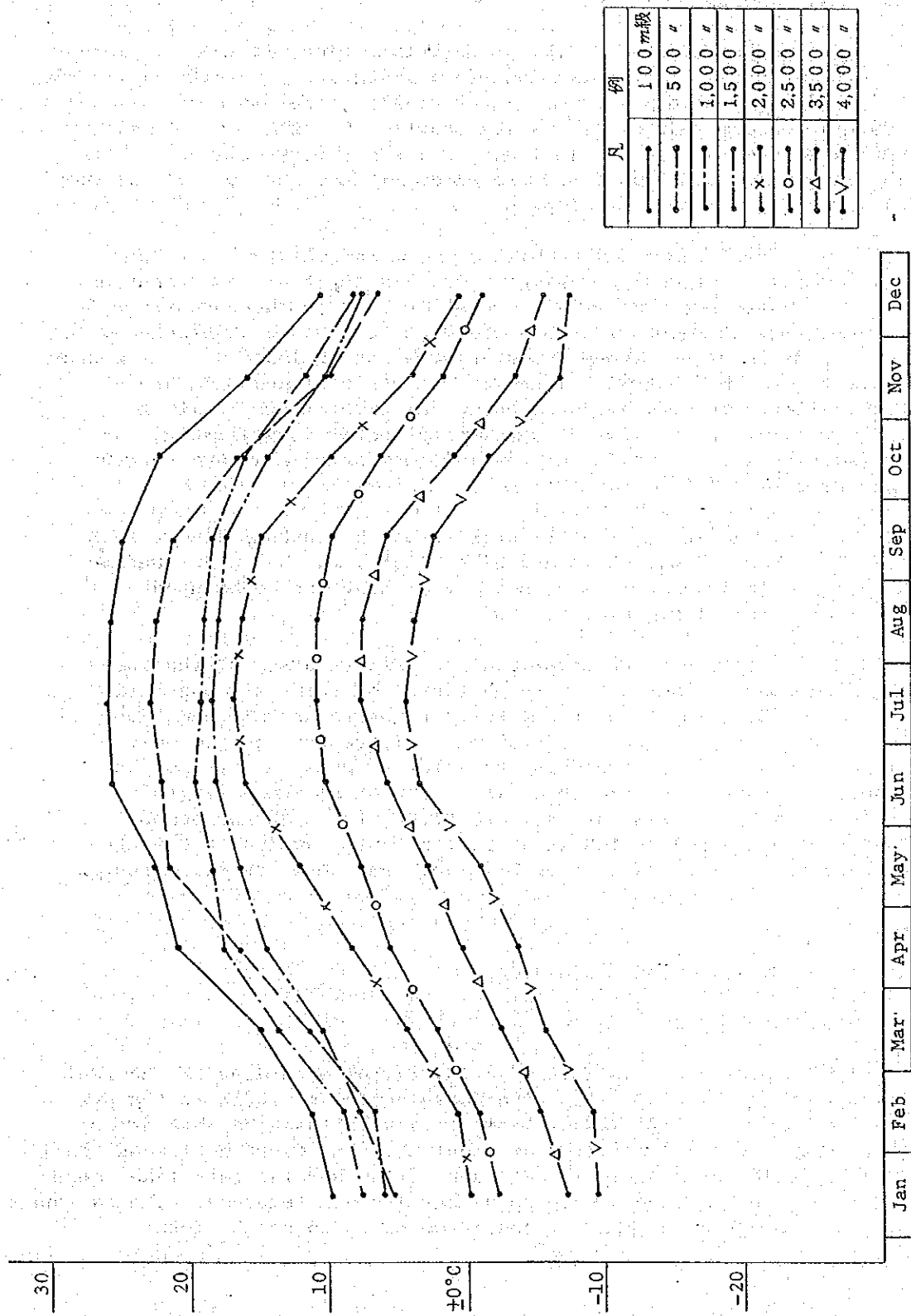


Fig. 6 Monthly Average Minimum Temperature

5) Rivers

As elucidated in the preceding section, it is necessary to take serious note of the conditions for irrigation particularly during the dry winter season. Throughout the country, there are more than 6,000 rivers from which water may be caught. Of them, more than 960 rivers are 10 km and longer in length. These rivers originate from mountains in the hinterland and are of importance for hydraulic power generation and economic development.

The Sunkosi is the biggest river of the Janakpur Zone features Nepal's biggest discharge. Originating from Tibet and the Himalayan mountains, it flows from west to east on the northern side of the Mahabharat mountains. One would be tempted to think that this river would become a valuable water source for irrigation to farmlands in valleys of the Sindhuli and Ramechhap districts' mountain areas, but two difficult conditions are posed for this river - that is, (1) the water level is low and no pumping energy is available, (2) effective irrigation is not feasible as farm fields are sporadically situated.

In addition, the tributaries of the Sunkosi River, such as the Tama Kosi, Kimit Khola and Likhu Khola, may be enumerated as big rivers. Their banks are so steep that they cannot be used as water sources for irrigation.

The rest is unexceptionally small rivers, but the Kamla Nadi which runs in the east of the Sindhuli District and the Marin Khola which flows in its west may be cited as relatively big rivers. Both rivers have a discharge of 150 ~ 200 litres/sec in the most droughty season and are promising as water sources for irrigation. In addition, there are countless rills, but those whose length exceeds 10 km total less than 30. Particularly in the Ramechhap District, the areas in which water is constantly available throughout the year are limited in quantity, because there are few forests.

(3) Socioeconomic Conditions

1) Population

Nepal had a population of 9,387,661 according to the 1961 Census, whereas the 1971 Census indicates a rise of 23.1% in the preceding 10 years to 11,555,983. It is estimated that the population will increase at an annual rate of about 2%. The distribution of the national population indicates that each of the several belt-like zones parallel to the Himalaya's main spine has its own tendency. The national land, in this sense, may be divided, from south to north, into:

(1) the Terai plains' zone, (2) the Inner Terai zone between the Siwalik hills and the Lesser Himalayan mountains, (3) the zone covering the mountain areas, basins and valleys between the Lesser and Greater Himalayan mountains, and (4) the zone encompassing the highlands at the foot of the Greater Himalayan mountains' main ridges and in its periphery. Although there is a difference between the wet eastern part and the dry western section, but in the order of population density, (1) Terai comes on top of the list, and it is followed by (3) hills, (2) Inner Terai and (4) mountains.

The Janakpur Zone had a population of 1,265,755 according to the 1971, accounting for 11% of the national population. By district, the population of the districts of Dhanusa and Mohatari in the Terai region is great. In regard to the districts of Sindhuli and Ramechhap, which are the survey area, the Sindhuli District is great in area but as the Inner Terai Zone (2) occupies most of this district, the population stands at less than 50% of that of the two districts in the Terai region. On the other hand, the Ramechhap District has a relatively big population. This is because populations have concentrated in this hilly zone which is less affected by floods, malaria and other factors, whose living environment is favourable and the productivity of which is relatively high.

However, ever since malaria was exterminated in the lowlands (Sindhuli Mali and other places), populations have been drifting from the hilly zone to the Inner Terai zone. The Dolakha District, situated in the northern-most part of Nepal, has the smallest population, as its productivity is low and its living environment is severe with the high and cold Himalayan mountains situated behind.

The national average population density stands at 83 persons/km², whereas that of the Janakpur zone is high with 130 persons/km². By district, the districts of Mahatari and Dhanusa turn out to be predominantly population-concentrated areas with 260 ~ 278 persons/km². In the same Terai zone, the less developed Sarlahi District has a population density of 127 persons/km².

As for the hilly areas, the population density stands at 115 persons/km² in the Ramechhap District, where the risk of malaria and other diseases is insignificant and the living environment is considered favourable. In the Dolakha District the living environment of which is severe and the Sindhuli District in which Inner Terai, an area for the outbreak of malaria, is situated, on the other hand, the population density stands at about 50% of the average population density of the Janakpur zone, evidently reflecting the quality of the living environment.

In regard to family composition, there are 2,084,062 households in the nation and the number of members per family stands at 5.53. In the Janakpur zone, the number of households is 239,567 (11.5%) and that of members per family is 5.3 (95.5%). The number of households in this zone is 0.5% greater than its share (11.0%) in the national population and the number of members per family is about 5% lower.

By district, the Sindhuli District comes on top of the list with 5.9 persons and is followed by the Ramechhap District with 5.4 persons. The number of members per family in the two districts exceeds the average figure of the Janakpur zone, indicating that the number of members per family is greater in both districts. The remaining four districts are similar to one another with the number registered at 5.1-2.

Presumably, this is due to the fact that the division of families is in progress in the three Terai districts and the natural conditions are severe in the Dolakha District, thus checking a swelling of the population.

Table 6 Population and Number of Family Members

Area	Classification	Acreage	Population	Number of households	Number of family members	Population density
National		km ²	persons	households	persons	km ² /persons
		140,800	11,555,983	2,084,062	5.5	82
Janakpur Zone		9,760	1,265,755	40,306	5.3	130
Dolakha District		1,980	130,022	25,094	5.2	66
Ramechhap District		1,370	157,349	29,106	5.4	115
Sindhuli District		2,590	147,409	24,895	5.9	57
Sarlahi District		1,380	175,543	33,539	5.2	127
Mahottari District		1,250	324,831	63,003	5.2	260
Dhanusa District		1,190	330,601	64,669	5.1	278

(Agricultural Census and Population Census, 1971 ~ 72)

2) Industry, Working Population and Tendency

Nepal's industry and economy features the fact that agriculture is overwhelmingly dominating. Therefore, the secondary and tertiary industries have yet to be developed and as things now stand, they are not likely to become the prime driving power for its economic development. Another thing is that the agricultural productivity of the central mountain area which has a great impact in political and social terms has almost reached its limit, being no longer able to sustain an increase in population. In the Terai region, a grain belt, on the other hand, the pressure for consumption is on the upturn due to an increase in population, with the consequence that its reserve power for production is gradually decreasing. Given this situation, the Gross National Product in the last 10 years since 1965 has increased at a real rate of 2.2% on the average, but when the population growth rate which is estimated to be a little more than 2% is taken into consideration, it is conceivable that the real GNP per person is practically leveling off.

The development outlays which were initiated in the 1950s have as a matter of course evolved primarily around public facilities. The development outlays in 1963~64 stood at only 144,700,000 RS but soared to 925,900,000 RS in 1974~75, registering a remarkable six-fold rise in 12 years, and most of these development outlays were set aside for the development of the infrastructure, including roads, electric power and irrigation.

In terms of the GNP composition ratio, there has not been any significant change in the last 10 years, but the percentage of the manufacturing industry and the transportation and communications sectors has increased from the 1% level to that of 3%, indicating that efforts have been concentrated on the development of their infrastructure.

The percentage of industrial production stands at only 3%, but a check of the past growth rates indicates that there are signs of a greater rise than in the cottage industries. One unique feature of Nepal's industry is that it evolved primarily around the processing of farm products. It is oriented in exportation, rather than domestic consumption. The rice polishing and lumbering industries divert their products to the Indian markets, whereas the jute industry exports its products to countries other than India. The textile and tobacco industries are of an import substitute type. These features have made their appearance, because the domestic purchasing power is small and dispersed and the functions for the marketing of products are extremely underdeveloped due to the less development of roads and other facilities. However, there exist potential sources to vitalize industry, such as water, forests, manpower and tourism, and it is essential that these resources should be put to effective use.

Next, a check of the working population (10 years old and over) according to the 1971 Population Census by industry suggests that the persons engaged in agriculture, forestry and fisheries are overwhelmingly great in percentage, 94.4% (of the national total). In the Janakpur zone, the percentage goes beyond this ratio, reaching 95.6%. This indicates that there are no industries worth mentioning other than agriculture, forestry and fisheries. Zone-wise, there is some difference between zones. In the hilly areas of the Sindhuli and Ramechhap districts, which are the survey area, the degree of dependence on agriculture, forestry and fisheries is high with 98% (the same thing may be said of the Dolakha District). Statistically, it might be said that the majority of the working population is engaged in agriculture, forestry and fisheries (here, practically everyone may be considered to be engaged in agriculture). Due to the introduction of the monetary economy in recent years, many farmers have been no longer able to cope with the situation with which they were once accustomed to on a barter system. As a means to earn cash, many work as porters or drift to other areas for a job.

Other than agriculture, there exist only the minimum lines of industry, such as commerce, which are indispensable for the maintenance of the daily lives in this zone.

In the capitals of the Sindhuli and Ramechhap districts, a bazar is opened every week, selling general merchandise, cloth, ornaments, condiments, dinnerware, etc. Commodities are brought in by peddlers who make a tour of bazars in various places. Crops are distributed within the zone. Vegetables are distributed from mountain areas to flatlands or in the flow opposite to rice.

Trucks are passable as far as Sindhuli Mali in the dry season, so that commodities are available in abundance and the prices are relatively low. Beyond Sindhuli Mali, commodities are transported on man's back, so that they are sold for considerably high prices (10~40% higher). Taking advantage of a bazar, inhabitants purchase whatever they think is necessary. As there exists at least one general merchandise shop in one Panchayat, inhabitants would not have a sense of inconvenience in buying daily necessities, as long as they were not choosy.

Some farm households engaged in cattle raising on a large scale and in need of salt in large quantities hire porters and send them for commodities at lower prices, such as direct purchases down in Sindhuli Mali. Attention must be paid to this point in working out measures on prices and distribution in the future.

In regard to the improvement of distribution, plans are already afoot for the development of a road. The plans are envisaging the construction of a road leading to Ramechhap, which will benefit the three mountain districts. As it is estimated that this road will transport 216,000 tons of commodities a year, the construction of this road will be of significance as a base for regional development, such as the transportation of livelihood commodities enough for about 200,000 people and also that of sick people.

Table 7 Industrial Structure (Percentage of Domestic Gross Product Composition)

Year Classification	1965/66	1970/71	1973/74
Agriculture	69.1%	66.5%	69.1%
Manufacturing	1.4	2.8	3.0
Construction	1.6	2.3	1.7
Transportation and communications	1.3	2.6	3.2
Cottage industries	6.9	6.7	6.9
Financing	1.2	1.5	1.4
Service	2.6	3.1	3.5
Others	15.9	14.5	11.2
Total	100.0	100.0	100.0

Source: Central Statistics Bureau

Table 8 Population by Industry (10 Years Old and Over)

(persons)

By district Classification	National	Janakpur Zone							
		Zone total	Dolakha District	Ramechhap District	Sindhuli District	Dhanusa District	Mohattari District	Sarlahi District	
Total population	11,555,983	1,265,755	130,022	157,349	147,409	330,601	324,831	175,543	
Agriculture, forestry and fisheries	4,579,552	466,405	68,535	79,873	63,799	95,428	98,523	60,247	
Mining and quarrying	36	3	-	-	2	1	-	-	
Manufacturing	51,902	3,131	133	138	153	1,594	729	384	
Electricity, gas and water	1,596	58	1	-	1	47	2	7	
Construction	5,016	-376	6	2	5	290	49	24	
Commerce	63,560	6,141	49	112	183	2,987	1,694	1,116	
Transportation and communications	9,637	695	10	33	18	452	136	46	
Financing	3,466	230	2	15	17	111	74	11	
Service	137,759	10,696	487	775	548	4,555	2,466	1,865	
Total	4,852,524	487,735	69,223	80,948	64,726	105,465	103,673	63,700	

Source: Population Census, 1971 ~ 72

Table 9 Permanently Established Stores in Sindhuli Mali

Business	Number of stores	Business	Number of stores	Business	Number of stores
Salt	1	Hardware	2	Restaurants	9
Salt and tobacco	2	Hardware and cereals	2	Barbershop	1
Salt and general merchandise	1	Hardware and cloth	2	Metalware	3
General merchandise	11	Cloth	7	Dressmakers	9
General merchandise and food	11	Cloth and timepieces	1	Tobacco (leaves)	3
General merchandise and cloth	1	Pharmaceuticals and timepieces	1	Tobacco and hardware	1
General merchandise and timepieces	1	Pharmaceuticals	1	Photography	1
General merchandise and hardware	5	Food	3	Physician	1

Total: 80

Surveyed by Mr. Tsuboi, the expert.

3) Land Utilization

The national land of Nepal covers an area of 14,080,000 ha. In terms of land utilization, its use as forests is greatest with 31.8%. The unusable areas which are situated in the snowy districts of the Himalayan mountains and the barren lands with little rain account for 28.2%, the jungles, flatland forests and other areas which are usable but not developed 18.2%, and the arable lands only 14.1%. The percentage of other lands stands at 7.7%.

The acreage of arable lands is 14.1% (1,980,000 ha.), smaller as against the national land. The form of their utilization gives the impression that people "plow up toward the Heaven". Even in steep mountain areas, there exist terraced farms. The findings of an on-the-spot survey also suggests that practical every piece of usable land has been developed. In recent years, however, forests have been nationalized and conserved as a means to prevent a diaplidation of the national land and work for forest conservancy and flood control, thus disabling farmers to develop hills and jungles with negligence of ecologic system. To cope with this situation, farmers are striving to raise the rate of utilization of arable lands.

For this reason, the cropping ratio as against the acreage of arable lands stands at 112.7% on the average, the maximum percentage reaching 300% with three crops a year.

The Janakpur zone has an area of 976,000 ha., or 6.9% of the national land, suggesting that its share in the national land is smaller than other zones, but the percentage of utilization of arable lands - particularly, that of farmlands - is as high as 28.4%, double that of the nation.

The topographical features of this zone broadly vary, between the north and the south. The southern part constitutes the Terai plains, whereas the northern section consists of hills and mountains, including the Inner Terai area. Particularly, the development of the plains started so many years ago, and the ratio at which lands are turned into arable lands is high. By district, the ratio registered by the Dhanusa District is highest with 84.2%. The average percentage of the three Terai districts is also extremely high with 51.3%. In the survey area, the Sindhuli District marks 5.4% and the Ramechhap District 9.1%. Furthermore, the Dolakha District registers only 3.0%.

According to an on-the-spot survey, the cropping ratio of the seven Panchayats averages 147.7% with the highest percentage standing at 213.0%. By area, Rasnall in the northern part of the Ramechhap district marks 88.3 ~ 100% with the adoption of a one-crop-a-year system, whereas the average percentage of the Ramechhap District is 110.5%. The Sindhuli District averages 175.5%. Thus, the land utilization is in the hilly areas is conducted in a highly intensive manner.

As for new land development, there are few areas suitable for development, and it is difficult to do so in the light of the national policy of forest conservancy and flood control. Due to the increased availability of medicines in recent years, the living environment of the flatlands has been improved, there is a need to work out long-range plans for the afforestation of mountain areas as well as the simultaneous utilization of vast river beds and other places.

In regard to the land ownership system, the 1961 Agricultural Census says that 23% of all farmlands are cultivated by tenant farmers. By district, there are many tenant farmers in the Terai area but few in the hilly areas.

Later, a farmland reform was carried out, and the 1971~62 Agricultural Census does not contain statistical data on the number of tenant farmers. The farm households which own less than one hectare of arable land account for 53.5% in number, with 10.5% in acreage have been established. By area, the farm households possessed of 5~10 ha. register the highest percentage of 21.0% in acreage, and it is conceivable that the group of core farm households is of this scale. Under the land reform, the ownership is restricted to 96 Ropani (about 4.8 ha.) for farmlands and 16 Ropani (about 0.8 ha.) for forests, but the fact is that wealthy farmers are described as existing in the Terai area even at present. In the hilly areas, farmers have become day-workers and seasonal labourers, and the existent form of tenant farming seems to have disappeared. Incidentally, in an on-the-spot survey of two districts and an interview with the representatives of six Panchayats, the existence of tenant farm households was not ascertained, and many of those who sold their farmlands due to diseases, debts, incidental expenses or some other reasons have drifted from the hilly areas to cities and rural villages in the Terai area, and turn to be day-workers.

Table 10 Ratio of Farm Households by Scale
of Cultivated Land under Management

Classification	Acreage	Ratio
Forests	4,475 km ²	31.8%
Snowy areas	2,112	15.0
Undeveloped areas	2,566	18.2
Barren areas	1,860	13.2
Others	1,087	7.7
Cultivated areas	1,980	14.1
Total	14,080	100.0

1970/71 Census

Table 11 Stratified Farm Households

Ownership scale	Ratio of farm households	Ratio of acreage
1 ha. max.	53.5%	10.5%
1 ~ 3 ha.	19.5	18.0
3 ~ 5	7.1	12.0
5 ~ 10	5.8	21.0
10 ~ 15	2.1	11.0
15 ~ 20	0.9	7.0
20 ~ 30	0.5	5.5
30 ha. min.	0.6	15.0
Total	100.0	100.0

1970/71 Census

Table 12 Population of Graduates (1971)

(persons)

School Area	Total (6 years old and over)	No school	Primary school	Middle	High school and higher institution
National	8,851,696 persons	8,558,857	144,778	58,126	89,935
Ramechhap District	125,228	123,156	1,427	304	341
Sindhuli District	113,724	111,629	1,489	216	390

4) General Conditions of Agriculture

Worthy of note as features of Nepal's agriculture are (1) that the acreage of arable lands is only 14% as 86% of the national land constitutes deep mountains, (2) that the patterns of farm work and crops are basically determined by the altitude, and (3) that the density of cattle raising is high.

The total heads of animals including cows, buffaloes, sheep and goats are estimated 14,000,000. Internationally, Nepal is one of the greater animal raising nations in terms of heads.

With the income of all the agriculture sector at 100, cereals and other cultivated crops account for 60, cattle raising at 22 and other farm products at 18, suggesting that the gravity of the livestock industry is great. In terms of heads of cattle raised, however, the income of the cattle raising industry does not seem so great. This is because the cows, the main domestic animal, are given a multipurpose role. First, the cows are used for plowing and transport and milked for a animal protein source, and cow dung is used for many purposes, such as manure and fuel. In spite of the fact that the livestock industry is of importance in agriculture, it has become a serious problem for the Nepales livestock industry that the existing varieties have degenerated due to a lack of feed, underdeveloped measures against diseases and parasites and underdeveloped breeding of excellent varieties.

Given this situation, the milk output per head is less than one-tenth of that of advanced countries.

The agricultural production of Nepal reflects its self-sufficient economy. So, crops used for food account for 75%, cattle breeding 3% and industrial materials 3%.

In regard to main crops, a check of the acreage of cropping in 1976~77 with the acreage of 1964~65 at 100 indicates that rice stands at 114.6, maize 101.8, wheat 348.0, millet 127.0, barley 103.6, potatoes 182.8, oil seeds 99.7, sugar canes 155.6, jute 103.1 and tobacco 87.5. It is seen from these figures that in the production activities of farmers and in the tests, surveys and extension projects of the Government, priority has been given to the increased production of edible food.

Rice turns out to be a principal crop, as its production accounts for over 60% of the cereal output. Its yield exceeds 2,400,000 tons (hulled), and rice is followed by maize with 800,000 tons and wheat with 360,000 tons. They are followed by millet, barley, potatoes, oil seeds, sugar canes, jute and tobacco. Some of rice and jute products are diverted to foreign countries, most being consumed at home.

When the acreage of cropping of principal crops in the Janakpur zone is compared between 1976~77 and 1970~71, rice stood at 100.4, maize at 107.1, wheat 272.2, millet 112.8, barley 110.4, potatoes 135.2, oil seeds 95.1, sugar canes 433.9, jute 34.0 and tobacco 66.8, suggesting that the increase in the cropping of wheat is remarkable with the cropping of sugar canes marking the highest rise.

A check of the two districts covered in the survey reveals that the cropping pattern is similar to that of the entire Janakpur Zone. The rises in the cropping of rice and potatoes in the Ramechhap District are conspicuous whereas the cropping of other crops are leveling off. In the Sindhuli District, on the other hand, a comparison between 1970~71 and 1976~77 reveals that wheat, barley and tobacco stand at 797.8, 567.8 and 2,236.4, respectively, registering marked increases. The shares of these crops in the total value of the Janakpur zone in terms of the acreage of cropping in 1976~77 were 9.8% for rice, 43.8% for maize, 5.6% for wheat, 45.9% for millet, 27.8% for barley, 50.2% for potatoes and 5.6% for sugar canes, indicating that the shares of upland crops, such as potatoes, millet and maize, are notably high. In regard to fruit plantation, 330 ha. (1,090 tons) is planted in the two districts in 1977~78. The fruits center around citruses on the hills, which are followed by subtropical fruits (bananas, mangoes, papayas, etc.). Particularly, the attention of advanced farmers is focused on citruses (Jiknar and Suntara) as cash crops. There are signs of an increase in their output and agricultural banks take up these fruits for loans.

The vegetables are mostly self-consumed, and the surpluses, if any, are put on sale. There are signs of a rise in the cropping acreage (190 ha. in the two districts in 1977~78).

Next, in regard to cattle raising, there were 15,200,000 cows and buffaloes throughout Nepal in 1975, producing 23,000 tons of beef and 500,000 tons of milk. There are signs that both the number of cows and buffaloes raised and the output are marking slight rises. A similar tendency is also observed in the Janakpur Zone.

When the agricultural products of the Janakpur zone are viewed in terms of food supply, it might be said that the food supply is excessive for the entire zone. By district, however, there are surpluses in the three Terai districts, whereas there is a shortage in the three mountain districts.

As for the percentage of staple food production, the percentage of rice accounts for 80% in the three Terai districts. In the Ramechhap and Sindhuli districts and other mountain areas, the percentage of maize and miscellaneous cereals is great. Particularly in the Dolakha and Ramechhap districts, the ratio exceeds 50%.

A check of the actual conditions of physical distribution, which compensates for surplus and shortage, indicates that surplus rice in Terai and other places constitutes surpluses flowed in considerable quantities from the Sindhuli District, instead of being flowed to mountain areas short of rice. Thus, it is pointed out that there is a lack of purchasing power in the mountain areas and that the network of physical distribution has yet to be developed.

A check of the ratio of paddy fields in the two districts covered in the survey reveals that those Panchyats in the Sindhuli and Ramechhap districts the paddy field ratio of which exceeds 30% consist of two in the Ramechhap District and 12 in the Sindhuli District. There are also three Panchayats in the former and 22 in the latter with a paddy field ratio of upwards of 20%.

With 1973~74 as the standard year, a check of the supply of equipment and materials for agricultural production reveals that fertilizer (primarily, urea) stands at 379.5%, seeds (improved rice and wheat varieties) 267.5%, farm implements 227.4% and pesticides 476.6%, suggesting that their supply is on the increase. A check of the two districts covered in the survey shows that considerably utilization and consumption are made by farm households situated close to an Agricultural Inputs Corporation (AIC), far more than in the Terai area where means of transport, technical guidance and extension are less developed and there is a shortage of cash. The findings of an on-the-spot survey indicates, incidentally, that pesticides are used by 18% of the farm households.

The Government of Nepal is stepping up the Sajha Programme to encourage the advance of loans, supply of farm equipment and materials and distribution of daily necessities for a smooth improvement of agriculture. The programme is designed to establish Sajha Sanstha in rural communities, the business line of which includes (1) the advance of loans for the production and lives of members, (2) distribution of agricultural equipment and materials, (3) distribution of daily necessities, and (4) operation of deposits by members.

Table 13 Changes in Acreage of Cropping and Output
by Area and Cropping

(Units: ha, % and tons)

Classi- fication	Crop	Acreage of cropping						Output						
		Actual figure			Ratio			Actual figure			Ratio			
		1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77
	Rice	1,182,470	1,227,027	1,261,619	104	107	2,304,204	2,416,054	2,386,272	105	104			
	Maize	445,750	453,312	445,850	102	100	833,318	813,583	798,389	98	96			
	Wheat	228,400	273,925	348,280	120	152	193,360	308,389	361,853	159	187			
	Barnyard millet	114,795	125,179	121,794	109	106	129,310	141,879	138,037	110	107			
	Barley	27,296	27,549	24,869	101	91	25,301	25,626	20,595	101	81			
	Potato	48,750	53,131	52,587	109	108	272,491	304,191	269,025	112	99			
	Vegetable for oil	105,505	113,919	107,746	108	102	54,905	63,621	61,382	116	112			
	Sugar cane	14,385	15,869	13,990	110	97	235,611	266,755	311,194	113	132			
	Jute	550,000	33,097	-	6	-	52,995	40,136	-	76	-			
	Tobacco	8,716	5,422	6,964	62	80	6,859	3,750	5,132	55	75			

(Units: ha, % and tons)

Classi- fication	Crop	Acreage of cropping				Output					
		Actual figure		Ratio		Actual figure		Ratio			
		1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77	1973/74	76/77
Janakpur Zone	Rice	176,880	178,100	177,552	101	100	321,940	324,767	271,766	101	84
	Maize	36,850	37,550	39,470	102	107	64,380	60,647	64,649	94	100
	Wheat	15,950	26,641	43,412	167	272	9,943	34,585	44,174	348	444
	Barnyard millet	8,720	9,853	9,840	113	113	7,939	9,868	9,883	124	124
	Barley	1,085	1,090	1,198	100	110	882	909	986	103	112
	Potato	3,680	5,485	4,976	149	135	21,360	27,282	27,956	128	131
	Vegetable for oil	11,260	13,410	10,708	119	95	5,078	7,051	4,344	139	86
	Sugar cane	322	697	1,397	216	434	5,099	11,479	21,269	225	417
	Jute	165	160	-	97	-	129	145	-	112	-
	Tobacco	4,880	1,808	3,260	37	67	3,870	1,142	2,626	30	68

(Units: ha, % and tons)

Classi- fication	Crop	Acreage of cropping						Output						
		Actual figure			Ratio			Actual figure			Ratio			
		1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77
	Rice	6,000	6,000	8,147	100	136	14,400	13,200	19,471	92	135			
	Maize	7,350	9,500	9,600	129	131	12,863	18,050	19,980	140	155			
	Wheat	1,750	1,000	1,596	57	91	1,540	1,200	1,577	78	102			
	Barnyard millet	1,670	2,200	2,150	132	129	1,837	2,442	2,500	133	136			
	Barley	55	65	255	118	464	49	59	229	120	467			
	Potato	600	800	900	133	150	3,600	4,880	4,860	136	135			
	Vegetable for oil	4,100	5,010	2,916	122	71	2,747	2,981	1,166	109	41			
	Sugar cane	85	80	70	94	82	1,148	1,081	1,008	94	88			
	Jute	30	25	-	83	-	20	21	-	95	-			
	Tobacco	55	55	40	100	73	38	39	30	103	79			

(Units: ha, % and tons)

Classi- fication	Crop	Acreage of cropping						Output					
		Actual figure			Ratio			Actual figure			Ratio		
		1970/71	73/74	76/77	1973/74	76/77	1970/71	73/74	76/77	1973/74	76/77	Ratio	
	Rice	4,000	4,100	4,200	103	105	10,200	9,430	9,800	92	96		
	Maize	7,800	8,500	7,700	109	99	16,146	14,450	16,820	89	104		
	Wheat	650	700	855	108	132	552	602	949	109	172		
	Barnyard millet	2,000	2,500	2,370	125	119	2,000	3,000	2,850	150	143		
	Barley	50	80	78	160	156	50	80	70	160	140		
	Potato	800	1,000	1,600	125	200	4,640	5,050	8,079	109	174		
	Vegetable for oil	210	185	210	88	100	100	64	86	64	86		
	Sugar cane	10	12	8	120	80	120	144	112	120	93		
	Jute	-	-	-	-	-	-	-	-	-	-		
	Tobacco	10	10	8	100	80	6	6	6	100	100		

Table 14 Distribution of Chemical Fertilizer and Other Materials

	1969/70	1970/71	1971/72	1972/73	1973/74
Fertilizer (t)	636.6	833.0	1,231.0	1,839.0	2,416.0
Seed (t)	55.1	67.6	90.0	122.3	147.4
Farm implement (RS)	237,039.0	30,812.0	157,614.0	84,540.0	53,896.0
Pesticide (RS)	12,464.0	17,743.0	21,306.0	24,179.0	59,405.0

(Dealt with by AIC)

Table 15 Estimated Production Targets of Livestock

Classification	Year	1975	1980	1985	1990
	Buffalo cows (1,000 head)		1,520	1,640	1,800
Buffalo meat (t)		23,000	82,000	180,000	300,000
Buffalo milk (t)		500,000	891,000	1,440,000	2,000,000

A check of the self-sufficiency of cereals in the two districts covered in the survey reveals that the daily calory intake (Table 16) stands at 1,468 calory in the Sindhuli District and that of the Ramechap District stands at 1,202 calory, 27% lower than in the Sindhuli District (with the cereal consumption per day standing at 401 g) in terms of the output of five cereals in the two districts (with the average value in five years from 1972~73 to 1976~77 as a stable value), suggesting that the conditions of the nutrition intake are poor.

The average daily calory intake of the three districts (Mhotari, Sarlahi and Dhanusa) of the Jankpur Zone is high with 2,212 calory, featuring the paddy rice-oriented flatland area where the five cereals account for 73% of the total calory.

On the basis of the estimated value of 2,200 calory per day (2,225 calory according to the Bench Mark and Interim Assessment and Survey Report, 1972, associated with the agricultural development programme of the Janakpur Zone), the required minimum standard may be estimated from Table 16 as shown in Table 17. It is estimated that there is a lack of 10,060 tons of edible cereals in the Sindhuli District and 19,120 tons in the Ramechap District.

Table 16 Output of Cereals and Calory Intake
in Janakpur Zone by District

District	Cereal	Output	Ratio	Quantity of cereals for food production	Kcal/kg	In terms of total calory	Ratio of 7	Popu- lation	Calory intake a day per person	Cereal consumption a day per person
1	2	3	4	5	6	7	8	9	10	11
		t	%	t		1,000Kcal	%	persons	cal	g
Sindhuli District	Rice	14,250	76.0	10,830	2.1	22,743	25.7			
	Maize	18,875	85.3	16,100	3.5	56,350	63.5			
	Wheat	1,251	78.3	980	3.3	3,234	3.6			
	Barnyard millet	2,434	83.5	2,032	3.0	6,096	6.9			
	Barley	88	78.2	69	3.3	228	0.3			
	Total	36,898		30,011		88,651	100.0	147,400	1,648	558

District	Cereal	Output	Ratio	Quantity	Kcal/kg	In terms	Ratio	Popu-	Calory intake	Cereal
1	2	3	4	5	6	7	8	9	10	11
		t	%	t		1,000Kcal	%	persons	cal	g
Ramechhap District	Rice	9,683	76.0	7,359	2.1	15,454	22.4			
	Maize	14,863	85.3	12,678	3.5	44,373	64.3			
	Wheat	743	78.3	582	3.3	1,921	2.8			
	Barnyard millet	2,832	83.5	2,365	3.0	7,095	10.3			
	Barley	79	71.4	56	3.3	185	0.2			
	Total	28,200		23,040		69,028	100.0	157,300	1,202	401
Terai Region in Janakpur Zone	Rice	271,648	86.0	233,617	2.1	490,596	73.1			
	Maize	23,440	85.3	19,994	3.5	69,979	10.4			
	Wheat	36,946	82.6	30,517	3.3	100,706	15.0			
	Barnyard millet	3,179	83.4	2,651	3.0	7,953	1.2			
	Barley	646	78.5	507	3.3	1,673	0.3			
	Total	335,859		287,286		670,907	100.0	831,000	2,212	947

Notes: 1. Districts of Sarlahi, Mahottari and Dhanusa are included in the Terai Region of the Janakpur Zone.

2. For the output in 5, reference was made to the Agricultural Statistics of Nepal 1977. The average values of five years from 1972-73 to 1976-77 are given.

3. For the Ratio in 4, reference was made to the White Paper on Agriculture in Nepal 1977. Marketing losses and seeds are deducted. Used by district.

4. For Kcal/kg in 6, reference was made to Nobuhiro Tsuboi's "Agriculture and Distribution on Farm Products in Janakpur Zone, Nepal" Vol.3.

5. For the population, reference was made to the 1971 Population Census.

Table 17 Shortage of Cereals in Hilly Areas (Estimated)

District	Cereals for food production	Estimated total quantity	Required minimum standard calory per day	Population	Required total calory (a year)	In terms of edible cereals	Surplus/ shortage	Remarks
	1	2	3	4	5	6	7	
	t	1,000Kcal	cal	persons	1,000 Kcal	t	t	
Sindhuli	30,011	88,651	2,200	147,400	118,362	40,069	Δ10,058	
Ramechhap	23,040	69,028	2,200	157,300	126,312	42,160	Δ19,120	

Notes: 1. Reference was made to Table 6.

2. For the required minimum standard calory per day, reference was made to the Bench Mark and Interim Assessment and Survey Report associated with the Janakpur Agricultural Development Project.

3. For the surplus/shortage, five cereals are included.

5) Social Environment

The races of which Nepal is made up may roughly be classified into people of Indian ethnic and those of Chinese ethnic, but the composition of the people is considerably complicated due partly to historical circumstances. Roughly the people may be classified into (1) Hindus, (2) Lamas, (3) mountain people other than those mentioned above, and (4) Newals.

The Hindus are distributed mostly from the lowland areas to Terai. Many of them are distributed in areas up to 1,200 meters in altitude or the border area for rice plantation. The Hindus constitutes the largest portion of the population.

The Lamas are distributed in areas close to the Tibetan highlands, and (3) and (4) inhabit the mid-mountains and lowlands. However, the mixed living of various races has become all the more encouraged due to the development of a barter economy and the migration which results from an increase in population.

In regard to education, which is the primary task for modernization, the Ministry of Education was established in 1952. In the literacy survey conducted in 1962, the illiteracy rate was found to be 91%. Later, education facilities were rapidly replenished, but the 1971 Population Census reveals that the percentage of primary school graduates stood at only 3.3%. In the Sindhuli and Ramechhap districts covered in the survey area, the ratio was 1.8% and 1.7%, respectively. This holds true primarily in cities, and the ratio in the countryside stood at 1%.

The construction of roads and their investment are not developed, either. The only roads available in the Janakpur Zone are the East-West Highway, which runs between Terai and the hills and the route which extends to India.

In the survey area, automobiles are passable on a river bed from the East-West Highway to Sindhuli Mali in the Sindhuli District in the dry season. Recently, roads have been completed, enabling jeeps as far as Sindhuli Mali along the Maru River and as far as Anpote in the east only in the dry season, but the conditions are extremely poor.

In the capital of the zone, hospital facilities are available, and there exists a clinic in Sindhuli Mali, capital of the Sindhuli district. Elsewhere, there are several health posts with male health care workers. The deeper the mountain area, the severer the natural, social and living conditions. Therefore, the living standards also become proportionally worse.

Electric power is not available even in the zone capitals. Water facilities are available only in the zone capitals. For housewives, it is an important task to carry drinking water from fountains.

Table 18 Population of Graduates (1971)

(persons)

School Area	Total (6 years old and over)	No school	Primary school	Middle	High school and higher instution
National	8,851,696	8,558,857	144,778	58,126	89,935
Ramechap District	125,228	123,156	1,427	304	341
Sindhuli District	113,724	111,629	1,489	216	390