AGRICULTURAL DEVELOPMENT PLAN
FOR
JANAKPUR ZONE AND CHITWAN DIST.
IN
NEPAL

MAY 1971

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

海外技術協力事業団
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FOREWORD

Japan's technical cooperation for agricultural development in Nepal, so far limited to preliminary survey, has now proceeded to the stage for selecting project areas and mapping out development plans for such areas. The present survey has revealed that Japan's cooperation in future will prove most effective and useful if it is concentrated in the area embracing Janakpur Zone that extends from Tarai Plain to the hilly area as well as Chitwan District in Inner Tarai which was disclosed to be favourably conditioned for development by the preliminary survey.

It is my belief that if comprehensive introduction of improved agriculture is to be attained in Nepal through extension and guidance efforts, it will call not only for the services of experts but also for the mutual confidence and trust of farmers and experts which should be established by their close personal contact through the extension organization of the HMG of Nepal.

It is my ardent desire that the agricultural development in Nepal through such extension efforts and personal contact will be embarked upon and set in the smooth course of progress at the earliest possible time.

On behalf of the Survey Mission, I wish to express my heartfelt gratitude to all competent officials of the HMG of Nepal who extended kind assistance and cooperation during the survey.

May 1971

Hitoshi Fukuda,
Leader,
Japanese Agricultural Survey
Mission in Nepal

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CHAPTER I INTRODUCTION

1.1 Purpose of the Report

The present report deals with both the analytical study of the current situations prevailing in the agricultural development project in Nepal and the feasibility of zonal development programme to be implemented in Janakpur Zone and Chitwan District of Narayani Zone for six weeks from November to December 1970.

The Mission comprised eight experts deputated from Japan carried out its activities with the participation of Mr. Teruo Shimada, a Colombo Plan expert, and the staffs of Rapti Experiment and Model Farm of Tokyo University of Agriculture (Messrs. Tsuboi, Maeda, Hamada and Shimizu) who joined the Mission in Nepal, and in cooperation with the counterpart party of the HMG of Nepal.

The Mission's reconnaissance chiefly covered the southern Tarai Plain in Janakpur Zone. The limited time allowed for the survey made it difficult to cover the hilly area of the zone, though the agricultural development in the hilly and mountainous areas is no less important than that in Tarai Plain. Accordingly, the present report gives special attention to the eastern part of Tarai Plain in Janakpur Zone, and at the same time deals with the agricultural development cooperation in Chitwan area around TUA Rapti Model Farm requested earlier by the HMG of Nepal.

The report has been drafted on the responsibility of the Mission and compiled by the Overseas Technical Cooperation Agency for presentation to the HMG of Nepal and Japan. This report is meant for acrutinzing by the governments of Japan and Nepal; upon their approval, necessary actions will follow to materialize the project on the general lines as here in proposed.

1.2 Background of Development Cooperation

Technical intercourse between Nepal and Japan in the past has been conducted through Colombo Plan. Most of such intercourse was realized in the form of deputate of individual Japanese experts to Nepal and acceptance of individual Nepalese trainees in Japan, and no attempt was for a systematic government-level cooperation.

The first approach by the HMG of Nepal for agricultural development cooperation was made in December 1966 through a note verbale from the Nepalese Ambassador in Tokyo to the Japanese Foreign Minister. This was ensued by a number of negotiations through the diplomatic channel, but it was not before March 1969 that the unified request of the Ministry of Food and Agriculture, the HMG of Nepal was transmitted to the Japanese Government.

The said request contained the following:

1) Establishment of experiment and demonstration farms
   - Cooperation in the establishment of experiment and demonstration farms at three places in the hilly area and three places in the Tarai area.
2) Regional agricultural development
   - Cooperation in the comprehensive agricultural development in Mahakali and Mechi areas.
3) Deputation of Japanese experts specialized in different fields
   - Cooperation in the improvement of farming implements and equipment, improvement of paddy seeds, storage of grains, and control of diseases and pests.

The above request was further followed by another request for Japan's cooperation in the development of irrigation facilities in Chitwan area.

Upon receipt of this request, the Japanese Government reviewed the justifiability of agricultural development cooperation in Nepal, and formulated a fundamental policy for offering project cooperation, incorporating in it the request of the HMG. of Nepal. Based on this fundamental policy, the Japanese Government deputated the preliminary (1st phase) agricultural survey mission to Nepal over the period from March to April 1970.

The first Mission studied the feasbility of project cooperation in and around Narayani Zone, and prepared its report.

The second Mission, which is the present Mission, tredded in the steps of the first Mission and revised the basic development plan with due regard given to the intensions and requirements of the HMG of Nepal, selected the project area, and formulated detailed plans for cooperation in the selected area on the basis of its findings.

The HMG of Nepal expressed to the second Mission its keen desire for Japan's cooperation in the agricultural development in the whole Janakpur Zone.

At present, agricultural development cooperation is extended to Nepal by many countries of the world. The HMG of Nepal is therefore giving its careful consideration to preventing the cooperation of two or more countries from being effected in a single zone. It is believed that the request of the HMG of Nepal for Japan's cooperation was affected by such consideration. When compared with Mahakali and Mechi areas which were included in the initial request for development cooperation, Janakpur Zone is easy of access and favourably conditioned for areawise development, and also has Hardinath Pilot Farm which was established and is being operated by the technical assistance of FAO with the participation of the Nippon Koeki Consultants group. In view of these advantages, it was considered that the proposed Japan's cooperation in the development of Nepalese agriculture will prove effective if it is implemented in Janakpur Zone.

It may as well be added that the second Mission has agreed to undertake, in parallel with the development of Janakpur Zone, the agricultural extension requested to be effected in the area surrounding TUA Rapti Model Farm in Narayani Zone which has contributed to the agricultural development in the neibouring areas over the past eight years.

CHAPTER II GENERAL APPROCH TO AGRICULTURAL EXTENSION

Strictly speaking, dissemination of techniques cannot be attained by the extension of techniques alone, and this is no exception with agricultural technicues. The inherent synthesim of techniques entails the interaction of techniques and affiliated economic and social conditions. Such interaction is needed to incite farmers to take interest in new techniques and to stimulate their volition to apply them for practical purposes.

2.1 Fundamental Approach

Since agricultural extension is to be carried out through personal contact with individual farmers, better effects can be achieved if the extension technicians seek more opportunities to get in touch with them and establish closer mutual understanding with them. Extension technicians are required to extend the improved techniques best suited for farmers while taking advantage of the merits of the conventional farming techniques. The technicians referred to here involve all Nepalese and Japanese technicians who come in frequent contact with farmers. It is hoped that the current Japanese agricultural development cooperation involving the expert services will be ensued in future by uninterrupted extension activities of Nepalese engineers and technicians who will exert their utmost in successively propagating improved techniques among as many farmers as possible. For the extension of agricultural techniques, the mere size of project area is not a serious question. What is more problematic is the possible discrpancy in agricultural development between the project area and the surrounding areas. The Mission therefore believes that the project areas should be very flexible in various aspects and there should be drawn no hard and fast demarcation line.

The Mission is fully aware that certain types of development project, such as irrigation and drainage schemes which generally call for a huge capital input or introduction of advanced farming techniques, cover a more or less limited area due to their nature, the need for water control in particular, and therefore demand the establishment of hard border line.

In the western desert area of the United States, one often witnesses green fields created by water supply adjoin devastated wasteland. This is one of the instances of hard border lines.

In Asia covering the monsoon area, however, there already exist conventional farming techniques cultivated over many years in the past which are to be improved for production increase and better livelihood of the nation. The introduction of irrigation facilities is therefore required primarily to assure stable water supply to every field and is not demanded to be effected to the extent that facilities incorporating the latest irrigation techniques are constructed from the beginning. Nor is an ideal and systematically designed canal network is required to be created from the beginning, but canals are to be improved to meet the existing figures of farm land. The Mission is of the opinion that farmers should be guided to digest higher irrigation techniques with their gradual introduction of irrigation farming. It is the common practice in agricultural development that the introduction of irrigation and drainage facilities is preceded by the improvement of cultural practice through utilization of well water and small stream.

Fundamentally, approach to agricultural development in Nepal should be made by balanced improvement of various factors, which is to be promoted step by step for coverall development.

2.2 Detailed Development Strategy

To ensure smooth extension activities for agricultural development, it is essential, as already described, to create no developmental discrepancies between the project area and its surrounding areas and to study, at the same time, the existing state and future course of development of agriculture in the project area so as not to introduce a drastic improvement which is difficult for farmers to follow.

It is expected that the extension farms and extension plots reported by the first Mission will display their function to the maximum extent and that extension plots will prove to be the strategic centre of extension activities.

Soil productivity is largely affected by the geological features. Geological features are the natural conditions that reject artificial modification, whereas the improved farming techniques involving fertilization, breeding and plant protection are the artificial effect given on soil productivity. Since the latter is less influential than the former, regulation of natural conditions is beyond human power. For this reason, it is desirable to establish extension farms at points presenting physical conditions typical of respective geological systems.

Soil productivity in a geological system varies by the past history of land use which is an artificial effect. Since this effect is less influential on soil productivity than the likewise artificial effect of combined application of cultural techniques such as fertilization and cultivation of improved varieties, land use established by historical practice can be regulated by such major effect. Establishment of many extension plots is needed for this reason. In these extension plots, agricultural engineers, particularly extension workers, will carry out trial cultivation of crops with the cooperation of progressive farmers. It is expected that the achievements at the extension plots will draw the attention of farmers in the neighbourhood.

Extension farms play the role of promoting highly efficient extension activities through the close contact and cooperation of technicians and farmers at extension plots. As stated in the report of the first Mission, extension farms also serve to solve problems arising from the activities in the extension plots and to train technicians and engineers.

1) Chitwan District

As already described, Chitwan District is favourably conditioned for the extension of improved farming techniques. The district, however, is not favoured with stable supply of irrigation water, and availability of groundwater source is practically hopeless. Improved agriculture in the district must therefore resort to water to be supplied by the construction of headworks and canals some rivers or to water to be pumped up from the

Narayani. Water is supplied to a limited area under Upper Khagari Canal Project and Lower Khagari Canal Project, but water from these canals does not reach TUA Rapti Model Farm. The Mission therefore drafted a plan for pumping up a limited quantity of water from the Narayani and supplying it to the farm, with consideration given to the water distribution to the farm land extending along the proposed canal from the Narayani to the farm.

TUA Rapti Model Farm is situated on a relatively sandy river terrace. It is quite feasible that the functions of the farm as an extension farm and the extension activities in the near-by extension plots will become one of the central figures of Japan's agricultural cooperation. It goes without saying that the farm's activities should be carried out in close cooperation with Rapti Agricultural Station and Rapti Horticultural Centre as well as with the extension activities of the United States.

2) Janakpur Zone

Major irrigation development projects such as Sun Kosi and Kamra have been formulated in Janakpur Zone and their early materialization is hoped for. In the greater part of Tarai Plain, rain-fed farming resorting to monsoon prevails, though irrigation using small reservoirs and groundwater is observed in some parts in addition to minor irrigation. Shortage of irrigation water generally observed in the plain has been impeding the introduction of improved varieties and application of chemical fertilizers. In the north of Tarai Plain, there extends a strip of land where rich availability of groundwater is expected. Based on the survey of this area by experts, the Mission prepared a tube well irrigation scheme in which many extension plots are planned to be established within each irrigation area covered by respective wells so as to accelerate the extension of improved techniques for irrigation farming. In areas not covered by the said scheme, it is hoped that tube wells will be dug through the financial measures of the HMG of Nepal. This, however, will be preceded by the activities for extending improved techniques of non-irrigation farming for some time to come. Extension plots will also be established in minor irrigation areas where pumps having a small lift are used for drawing water from small tanks. Thus, efforts will be made to minimize the development difference between the scheme area and the surrounding areas.

In the initial stage of Japan's agricultural cooperation, locations of tube wells will be sought in the area which is not only rich in artesian water and easy of access, but also promises a large demonstration effect, and is further provided with favourable social and economic conditions. Selection of such an area is required because the accessibility to the scheme area throughout the year is more important than the year-round irrigation farming which will be realized by the construction of tube wells.

It is expected that a suitable scheme area will be found along Mahendra Nagar Highway which runs northwards from Janakpur City and joins East-Weat Highway.

In Janakpur Zone, the aforementioned Hardinath Pilot Farm of FAO will serve as an extension centre. Established in 1968, this farm covers an area of approximately 40 ha, of which about half is sandy land and the other half is composed of clayey soil. It has an excellent irrigation and drainage system which is supported by a daily yield of about 2, 500 m^3 of groundwater provided by one tube well. The farm is close to Janakpur City and only 1. 5 km apart from Mahendar Nagar Highway. If a metallic roadway is constructed to cover this 1. 5 km distance, less than a 30-minute jeep drive will suffice to get to the form from Janakpur.

The Mission is of the opinion that for some years to come, the centre should take an important part in the extension activities and should refrain from conducting detailed experiments or research works until some future date when the improved capabilities of farmers call for the development of higher or new techniques or for the cooperation with the government experiment stations.

Functions expected to be performed by this centre are as given below.

a. Extension and demonstration with practical training

The centre is expected to cultivate paddy, wheat, cash crops, fruit trees and all other crops, covering the full farming process from sowing to harvesting. This will serve not only for the demonstration of improved techniques but for the training of Nepalese and Japanese experts, particularly for the training of young Nepalese extension workers (Junior Technical Assistance, JTA).

b. Trial

The centre is also expected to deal with and bring solution to the problems arising at respective extension plots, to make studies on questions which are clarified to some extent and which are related to different soil condition and fertilizer dosages at extension plots, and to apply the achievements of government agricultural and horiticultural experiment stations in the zone for the extensive agricultural extension activities. In the strict sense of the term, the above function comes midway between experiments and trials.

c. Training and extension

The Mission considers it necessary to include a training programme in the systematic cultivation of different crops mentioned in item a. above. It is necessary that a certain fixed number of extension workers stationed in Janakpur Zone be sent successively to the centre for a fixed period of training. For this purpose, the centre will have to be provided with the dormitory of trainees, lecture rooms and other facilities.

d. Seed multiplication

The centre will produce seeds of improved varieties of various crops and distribute them among farmers for extension of improved farming techniques. It deserves attention that seeds of improved varieties of wheat were produced at this centre to meet the strong requirements of farmers. Raising off ruit tree seedlings will also be counted as one of important functions of the centre.

The extension centre should in principle be operated by the joint efforts of Nepalese and Japanese experts and JTA. As described above, the prime objective of the extension centre lies in the improvement of technical level of both Nepalese and Japanese experts, training of as many JTA's as possible, and collection of data needed for guiding farmers.

In the initial stage of development, introduction of improved farm machinery and equipment in the extension activities should be primarily intended, as stated in the report of the first Mission, for expediting the collection of data needed by the experts of both countries, and the demonstration effects of such machinery and equipment on farmers should be construed as a secondary purpose. Introduction of polishing, milling and oil expression equipment should also be intended for the same purpose.

Improvement of conventional farming implements and animal-driven farm equipment, and intensified production increase of self-supplying manure are a matter that bears closely upon the future development of Nepalese agriculture. It is hoped that engineers and technicians will direct their attention to the necessity of such improvement and production increase. For the maintenance and management of new and traditional farming equipment, a workshop will have to be established within the centre.

2.3 Cooperation System for Development

It has already been discussed that the extension plots are the strategic centre of agricultural extension activities. In these extension plots, JTAs are serving as the backbone of activities. There are about 700 JTAs in Nepal at present, and about 100 young men are being trained each year to secure a total of 1,400 JTAs in future.

In requesting Japan's cooperation in the agricultural development of Janakpur Zone, the HMG of Nepal expressed the desire that the regional extension activities in the zone will be brought to a success by following the pattern of West German agricultural cooperation now in progress in Gandaki Zone where 70 JTAs are stationed. Gandaki Project Area, now covering apprixmately 80 thousand ha, has no definite boundaries and is expected to expand according to the need and practicability. It is considered preferable that the extension activities in the said project area be carried out by the mutual cooperation of JTA, JT (Junior Technician) and DADO (District Agricultural Development Officer). In other words, extension activities under Gandaki Project are hoped to be pushed forward in a pattern compatible with the administrative system of the HMG of Nepal

For the agricultural development of Janakpur Zone, arrangements should be made to recruit Nepalese experts equivalent in number to Japanese experts and to secure the services of many JTAs. It is expected that some members of Japanese junior expert will participate in this agricultural development project.

At present, the Mission chiefly envisages the cooperation of Japanese experts for Janakpur Zone and that of the jnnior exports for Chitwan District. Acceptace of the jnnior experts is naturally left to the discretion of the HMG of Nepal. The Mission hopes that the HMG of Nepal will show full understanding of the long-standing management policy of TUA Rapti Pilot Farm and that the extension activities of the junior experts under such policy will prove most fruitful.

It is believed quite useful to dispatch a chief adviser to Nepal who will be stationed at the Ministry of Food and Agriculture of the HMG of Nepal or other Nepalese pertinent government office. The HMG of Nepal fully approves of this idea and expects that the agricultural cooperation will be carried out smoothly through the offices of such an adviser. It is considered that the services of the said adviser will be frequently called for to bring solution to the problem of charting the future course of cooperation, problems raised by individual Nepalese and Japanese experts as well as problems mutually affecting the experts of the two countries.

In conclusion of this chapter, the Mission wishes to express its ardent desire that Japan's technical cooperation will prove fruitful in both agricultural development and elevation of living standard in Janakpur Zone.

CHAPTER III JANAKPUR ZONE

3.1 General Description of Project Area

3.1.1 Natural Conditions

3.1.1-1 Location

As shown in Fig. 3.1-1, Janakpur Zone is situated in the eastern part of Nepal, and covers an area of 9,769 km^2. The zone can be topographically divided into the hilly area, Inner Tarai and Tarai Plain, and consists of six administrative districts. The administrative division of the zone is shown in Fig. 3.1-1 and the acreage of respective districts is indicated in Table 3.1-1 below.

Table 3.1-1 Acreage of Districts

District	Acreage (km^2)
Dolakha	1,976
Ramechhap	1,378
Sindhuli	2,590
Sarlahi	1,383
Mahotari	1,251
Dhanukha	1,191
Total	9,769

The three areas into which the zone can be topographically divided are featured by the following characteristics.

Hilly Area:

The hilly area constitutes part of the Himalaya Mountains whose elevation ranges from 3,000 m to 8,900 m, and embraces many portions which are covered by perpetual snow. Air temperature is generally very low in this area. Forests extend up to an elevation of about 4,200 m, beyond which is found the so-called Himalayan mountain area. Agriculture is conducted in the lowland and stepped paddy fields on the mountain slope for production of paddy and millets, but it is in an extremely undeveloped

Fig. 3.1-1 ZONES AND DISTRICTS IN NEPAL

state due to the severity of natural conditions. It can be said that stock-farming is more active than agriculture in this area.

Inner Tarai:

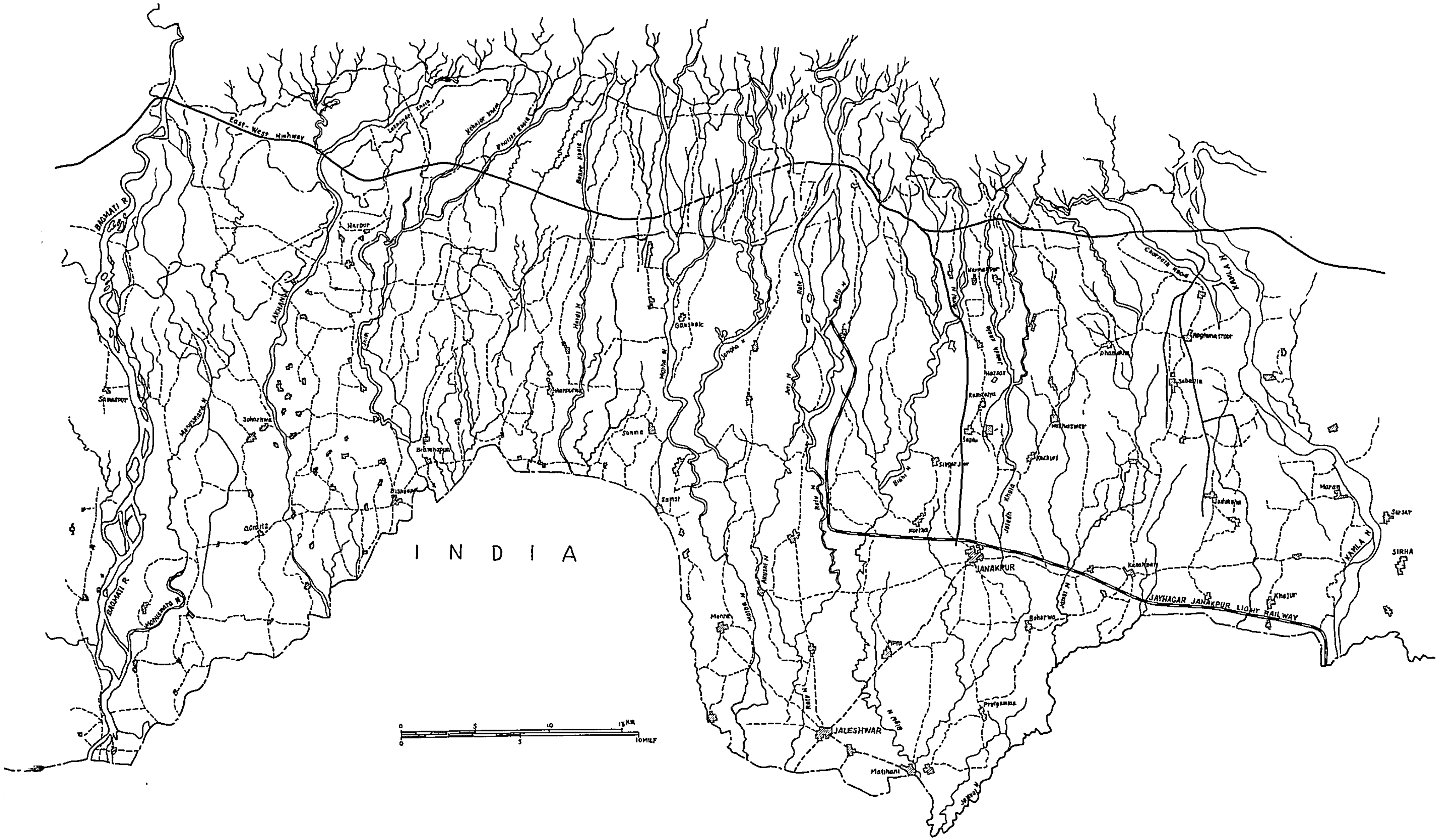
Inner Tarai is the area situated between the hilly area and Tarai Plain and has an elevation of up to 3, 000 m. This area embraces a number of balley including Sindhuli Mali. Cultivation of paddy, potato and miscellaneous cereals is actively carried out in these valleys because of their favourable climatic conditions and substantial availability of fertile land. However, the poor road condition is impeding the smooth shipment of these agricultural products, which is considered one of the major causes of the retarded farm management in the area.

Tarai Plain

Tarai plain is a narrow, long strip of land extending from east to west along the borders on India in the southern part of Nepal. Its southern part is the flat land area and its northern part forms a plateau covered with forests. The greater part of the southern flat land area has long been cultivated for production of paddy, wheat, pulses and mustard. However, due to the delayed development of irrigation facilities, the land productivity in this area is extremely low as compared with that in the neighbouring countries.

The road condition in Tarai Plain is much better than in hilly area or Inner Tarai. In the wet season, however, even the passage of bullock carts is made impossible by the flooding of rivers and inundation of paddy field area. (See Fig. 3.1-2)

Fig. 3.1-2 LOCATION MAP OF TARAI PLAIN



3.1.1-2 Climate

3.1.1-2.1 Air Temperature

As already stated, Janakpur Zone extends from the Himalaya Mountains in the north to the southern subtropical zone bordering on India. Climatic conditions in the zone are therefore quite diversified. Diversity of climatic conditions is indicated particularly by the air temperature variation by elevation and latitude.

Table 3.1-2 shows the maximum, minimum and annual mean temperature at various places in Nepal. As is clear in the table, the air temperature varies largely by latitude and elevation.

Table 3.1-2 Maximum, Minimum and Annual Mean Temperature by Altitude

Observatory	Elevation (m)	Annual Mean Temperature (°C)	Max. Temperature (°C)	Min. Temperature (°C)	Latitude (N)
Wallung Chung Gola	3,048	7.4	21.0	-9.55	27°-41'
Jomosom	2,800	12.2	30.5	-8.5	28°-47'
Okhaldunga	2,121	16.0	28.1	0.0	27°-19'
Sallyan	1,660	18.6	35.6	2.3	28°-23'
Kathmandu	1,288	18.1	36.1	-3.9	27°-42'
Pokhara	833	20.8	37.0	3.0	28°-11'
Butwal	263	25.8	44.9	4.3	27°-42'
Barakshetra	146	24.4	40.0	4.9	26°-52'
Biratnagar	76	24.5	-	-	26°-28'

Table 3.1-3 shows the monthly mean air temperature at Kathmandu, the capital city of Nepal, and at three places in Tarai Plain. Although these three places, Biratnagar, Parwanipur and Barakshetra, are not located within Janakpur Zone, temperature records at these places are given in the said table as being generally indicative of the air temperature in Tarai Plain.

Table 3.1-3 Monthly Mean Air Temperature in Nepal (°C)

Name of Place	Kathmandu	Biratnagar	Parwanipur	Barakshetra
Latitude (N)	27°-42'	26°-28'	27°-04'	26°-52'
Longitude (E)	85°-20'	87°-17'	84°-58'	87°-10'
Altitude (m)	1,288	76	100	146
Jan.	9.8	17.1	16.0	16.9
Feb.	12.2	19.3	17.8	19.8
Mar.	15.2	23.8	23.1	23.8
Apr.	19.0	28.0	28.4	27.8
May	22.1	28.8	30.3	28.4
Jun.	24.2	28.6	30.1	28.9
Jul.	24.0	27.9	30.2	27.7
Aug.	23.7	27.7	29.5	27.2
Sep.	22.7	27.4	29.6	27.0
Oct.	18.7	25.2	26.0	25.2
Nov.	14.4	21.4	21.2	21.5
Dec.	10.6	18.3	17.4	18.3
Annual Mean	18.1	24.5	25.0	24.4

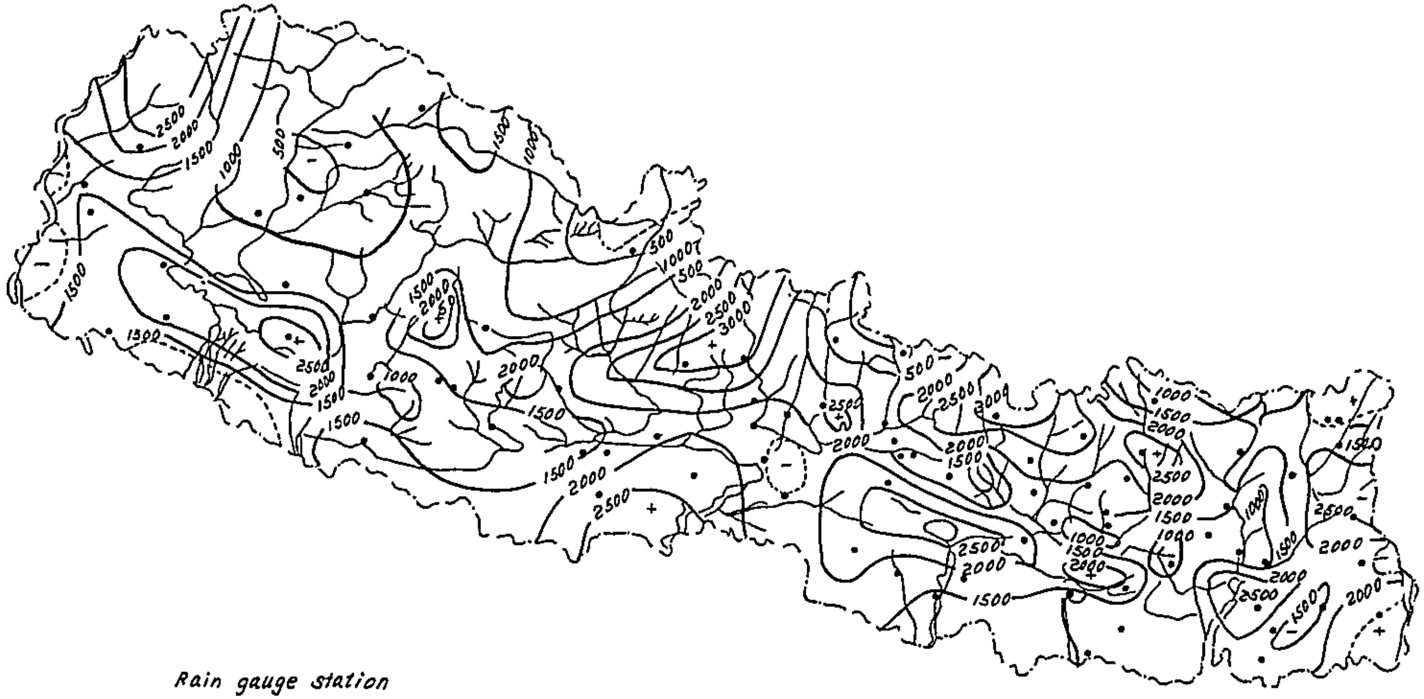
3.1.1-2.2 Rainfall

Temperature and rainfall are the largest factors that affect the crop growing in this zone. Table 3.1-4 shows the monthly distribution of rainfall in Nepal, and Fig. 3.1-3 is a graph showing the average annual rainfall in the country.

Table 3.1-4 Normal Rainfall of Nepal* (mm)

Location	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Amlekhganj	15.1	5.8	22.4	31.3	105.1	377.5	579.1	584.3	343.1	75.7	13.4	2.4	2154.9
Barahkshetre	22.7	18.7	16.7	76.0	133.6	323.7	733.1	629.1	512.5	113.7	12.7	3.0	2589.5
Bhojpur	22.3	15.9	22.5	54.1	120.0	217.7	266.4	246.7	174.0	37.8	13.0	2.0	1192.4
Biratnagar	21.8	5.4	10.6	34.4	113.6	295.9	472.8	414.5	300.1	100.8	3.5	10.0	1778.4
Butwal	18.8	16.2	17.3	28.5	58.8	444.2	743.5	940.6	296.8	47.7	16.5	3.5	2632.4
Dadcidhura	68.0	58.6	70.3	39.4	54.3	170.3	410.2	326.7	170.3	80.4	8.8	39.0	1466.3
Dailekh	19.7	29.5	20.2	24.3	50.2	174.3	411.7	453.4	78.8	59.9	8.5	6.2	1336.7
Dhangadi	32.3	16.5	23.5	1.8	29.3	213.0	532.9	401.7	277.5	110.9	4.8	9.5	1653.7
Gorkha	14.5	9.9	23.5	64.9	183.8	300.6	447.2	468.9	163.5	47.7	37.0	1.6	1763.1
Gularia	35.2	20.6	32.6	10.4	30.0	120.9	312.5	360.2	191.5	84.5	2.0	11.1	1211.5
Hlam	14.0	9.2	13.9	43.3	139.0	275.7	326.8	323.0	201.7	64.0	6.3	2.0	1418.9
Jomsom	32.1	22.2	33.9	21.9	13.0	10.9	43.3	44.0	32.2	158.4	9.8	18.9	440.6
Kathmandu	18.1	19.0	25.0	52.3	62.0	249.0	339.9	337.4	166.6	27.0	15.0	1.7	1253.0
Okhaldhunga	24.5	15.4	25.4	54.8	102.9	341.2	487.4	369.0	192.2	70.5	10.0	2.7	1696.0
Pokhara	22.2	45.0	48.4	82.3	233.5	668.2	893.8	869.2	475.2	149.3	15.9	8.8	3511.8
Sailyan	32.7	30.2	33.8	15.0	31.9	209.1	246.6	286.7	87.0	72.2	0.4	45.3	1090.9
Taplejung	18.3	19.2	68.6	115.8	210.5	431.9	397.3	413.7	258.9	53.0	28.5	3.4	2019.1
Timure	26.2	36.1	64.3	30.9	32.1	143.0	269.2	242.0	146.3	45.4	3.9	9.0	1043.4

Source: Meteorological Service, HMG



Rain gauge station

Unit : mm

FIG. 3.1-3 ANNUAL AVERAGE RAINFALL IN NEPAL

As is clear from the above table, rainfall varies largely by place. In Janakpur Zone, annual rainfall averages approximately 1,200 mm in Tarai Plain, 2,500 mm in the hilly area excepting a few places where more than 3,000 mm of rainfall is observed, and 2,300 mm in Inner Tarai excepting a few places where the rainfall does not even reach the 1,000 level.

3.1.1-2.3 Sunshine

As in other tropical and subtropical zones, the duration of sunshine in Tarai Plain is generally considerably long. At Parwanipur located in Tarai Plain, the per day duration of sunshine reaches 9.86 hours in May as shown in Table 3.1-5 below. However, it decreases substantially during the peak period of wet season, dropping to as short as 5.10 hours per day in July.

At Chialsa located in Inner Tarai, on the other hand, the longest duration of sunshine is recorded in May, but the per day duration in May is no longer than 7.39 hours. The sunshine at this place decreases to 3.02 hours per day in July, the peak period wet season.

As described above, there is a large difference in sunshine duration between Inner Tarai and Tarai Plain.

Table 3.1-5 Monthly Mean Sunshine Records (Hrs)

Name of Place	Parwanipur	Chialsa
Latitude (N)	27°-04'	27°-29'
Longitude (E)	84°-58'	86°-36'
Altitude (m)	100	2,750
Recorded Period	1967 - 68	1967 - 68
Jan.	8.05	6.92
Feb.	8.82	6.92
Mar.	7.81	6.04
May	9.86	7.39
Jun.	5.22	3.27
Jul.	5.10	3.02
Aug.	6.41	3.90
Sep.	6.94	3.51
Oct.	9.12	7.28
Nov.	9.18	6.36
Dec.	7.41	7.18
Annual Mean	7.74	5.65

3.1.1-2.4 Humidity

Humidity naturally rises in the wet season and decreases in the dry season. As shown in Table 3.1-6, the relative humidity at Parwanipur as revealed by the observation at 8:40 a.m. shows the highest value of 81.0% in Auguest and the lowest value of 63.9% in March. At Kathmandu located in Inner Tarai, on the other hand, the highest relative humidity of 93.2% is recorded in December and the lowest value of 62.1% in April. As will be clear from Table 3.1-6, the pattern of humidity change throughout the year in Tarai Plain is somewhat different from that in Inner Tarai.

Table 3.1-6 Monthly Mean Relative Humidity (%)

Name of Place	Kathmandu		Biratnagar		Parwanipur
Latitude (N)	27°-42'		26°-28'		27°-04'
Longitude (E)	85°-20'		87°-17'		84°-58'
Altitude (m)	1,288		76		100
Record Period	1949-64		1947-64		1958-62, 67-68
Observed Time	8.40	17.40	8.00	17.00	8.40 AM
Jan.	92.9	63.9	80.7	72.0	71.6
Feb.	86.6	55.4	73.0	59.5	71.0
Mar.	74.0	48.1	53.4	41.6	63.9
Apr.	62.1	43.6	47.9	38.2	65.7
May	63.4	53.6	63.0	57.5	64.3
Jun.	76.4	69.4	80.3	76.5	75.4
Jul.	81.9	80.4	86.9	84.0	74.8
Aug.	83.7	82.2	87.2	86.0	81.0
Sep.	82.9	81.1	85.2	87.0	78.1
Oct.	83.3	73.4	79.2	84.7	76.6
Nov.	88.6	69.7	76.6	80.7	72.3
Dec.	93.2	67.1	79.5	79.0	79.1
Annual Mean	80.8	65.7	74.4	70.6	72.8

3.1.1-2.5 Climatic Conditions at Hardinath

Table 3.1-7 shows the climatic data recorded at Hardinath Pilot Farm which is being managed under the control of FAO.

This table covers only about one year and does not therefore provide sufficient data for mapping out a long range plan. It is given below, however, because the data included in it are considered useful in drawing up plans for the proposed Extension Service Project.

Table 3.1-7 Monthly Weather at Hardinath Pilot Farm

(April 1969 - May 1970)

		1969 Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	1970 Jan.	Feb.	Mar.	Apr.	May	
Day length		12.50	13.31	13.54	13.42	13.08	12.19	11.31	10.47	10.25	10.36	11.12	12.01	12.50	13.31	hr
Sunshine hour		9.07	9.14	6.50	6.31	5.35	5.50	9.23	8.23	8.24	8.19	8.05	8.22	9.11	9.15	hr
S/D		71	68	58	48	42	47	82	73	81	78	72	70	72	68	%
Max temperature		40.2	41.0	39.8	35.3	34.9	34.5	33.0	32.5	26.5	25.8	28.8	37.1	39.4	41.8	°C
Mean max tem.		35.5	35.5	33.9	33.1	31.9	31.7	31.1	26.2	25.1	23.3	25.1	31.2	35.2	36.7	°C
Mean temperature		28.1	30.2	29.3	29.6	28.4	38.3	26.7	21.4	18. 4	14.1	15.7	22.6	28.3	30.9	°C
Mean min tem.		22.9	22.9	25.6	25.8	24.3	21.1	20.7	15.5	10.7	9.4	10.9	15.4	19.9	24.8	°C
Min temperature		17.3	16.6	20.0	24.1	15.0	12.0	12.6	8.5	7.5	7.0	5.8	10.7	11.8	20.0	°C
Earth tem. 8.40	5cm	23.3	29.2	30.2	30.4	28.5	28.3	25.5	18.8	14.8	13.5	14.7	20.4	28.9	29.4	°C
	30cm	27.2	29.9	30.7	30.4	29.9	30.0	27.8	25.3	19.9	18.0	19.0	22.9	27.0	30.0	°C
14.40	5cm	32.2	35.4	35.0	35.3	34.2	33.5	31.3	28.4	21.1	20.1	22.4	29.0	33.6	37.7	°C
	30cm	27.4	30.1	31.0	31;0	30.3	30.0	28.3	28.8	18.8	17.9	18.0	23.0	27.5	32.5	°C
Relative 8	40	46	31	77	79	84	83	74	78	81	83	79	56	50	60	%
humidity 14	40	32	46	57	55	73	73	55	45	43	45	44	32	32	40	%
Daily evapalation		8.82	7.15	5.45	4.79	4.38	3.87	3.78	3.07	2.34	2.31	2.77	5.70	7.35	7.53	mm
Monthly rainfall		40.2	38.5	240.5	83.4	251.4	123.0	16.5	15	0	11.6	19.0	20.0	38.3	65.8	mm
Rainy days		4	2	12	14	22	10	2	1	0	5	4	1	3	5	

3.1.1-3 Geology and Soil Conditions

There is a marked difference in geological and soil conditions between the hilly area, Inner Tarai and Tarai Plain. Fig. 3.1-4 shows the schematic geologic profile of Janakpur Zone in north to south direction prepared by FAO. As is clear in the figure, the upper stratum of Tarai Plain is composed of alluvium which covers the whole of the flat land area near India, with relatively high terrace deposit found in the area near the forests.

Due to such geological features, hydromorphic gley soils prevail in the southern part of Tarai Plain, with brown forest soils extending in the northern part and rezosols found near rivers. Soil distribution in Tarai Plain is shown in Fig. 3.1-5.

Fig. 3.1-6 shows the classification of land capability prepared on the basis of the above-mentioned data. As is clear in this figure, the greater part of the Tube Well Scheme Area situated to the north of Janakpur City is graded at Class III and is evaluated to be suitable for irrigation farming.

3.1.1-4 Hydrology

As already described, Nepal is favoured with an annual mean rainfall of 1,500 mm. However, rainfall in this country is subject to an extreme seasonal fluctuation. At Hardinath, for instance, monthly rainfall reaches as much as 250 mm in August but drops to virtual zero in December during the dry season as shown in Fig. 3.1-8. In Inner Tarai and hilly area, the seasonal fluctuation of rainfall becomes even larger. This extreme seasonal fluctuation of rainfall is heavily affecting the run-off of rivers. As is clear in Table 3.1-8 which has been prepared by integrating data on surface water resources in Nepal, the annual run-off of the Bagmati and the Kamla, which are both related to the development of Janakpur Zone, is estimated to be 200 m^3/s and 75 m^3/s respectively by trial calculation.

It has long been known among farmers that groundwater can be readily obtained in Tarai Plain. Farmers in Tarai Plain used to resort to shallow wells chiefly to obtain drinking water. Groundwater drawn from such shallow wells is also used for irrigation in some parts of the plain.

After the termination of World War II, surveys were conducted in Bihar State of India for full-scale utilization of deep-seated groundwater, which

Table 3.1-8 Weight and Scale of Surface Water Resources in Nepal

Category	Name of River	Length (km)	Catchment Area (km^2)	(%)	Annual Run-off (m^3/sec)	(%)
I.	1. Sapt Kosi	513	60,400	31.6	1,564	23.9
	* 1-A, Sun Kosi	(334)	(18,000)	(9.4)	(710)	(10.9)
	* 1-B. Arun	(513)	(34,000)	(17.8)	(530)	(8.1)
	* 1-C. Tamur	(198)	(5,900)	(3.1)	(300)	(4.6)
	2. Gandaki	332	34,960	18.3	1,713	26.2
	3. Karnali	507	44,000	23.0	1,316	20.1
	4. Kahakali ** (Sarda)	223	15,260	8.0	844	12.9
	Subtotal	-	154,620	80.9	5,437	83.1
II.	5. Babai	190	3,270	1.7	65	1.0
	6. West Rapti	257	6,500	3.4	113	1.7
	7. Bagmati	163	3,610	1.9	200	3.1
	8. Kamla	117	2,160	1.2	75	1.2
	9. Kanaki Mai	108	1,575	0.8	64	1.0
	Subtotal	-	17,115	9.0	517	8.0
III.	Other small river	-	19,272	10.1	578	8.9
Total		-	191,007	100.0	6,532	100.0

* : Branch streams of Sapt Kosi.

**: Called Sarda River in India, and flows just on the extremely western border line between Nepal and India.

Fig. 3.1-4 SCHEMATIC GEOLOGIC PROFILE (CHANDAHA K.-RANIBAS-HARDINATH- JANAKPUR)

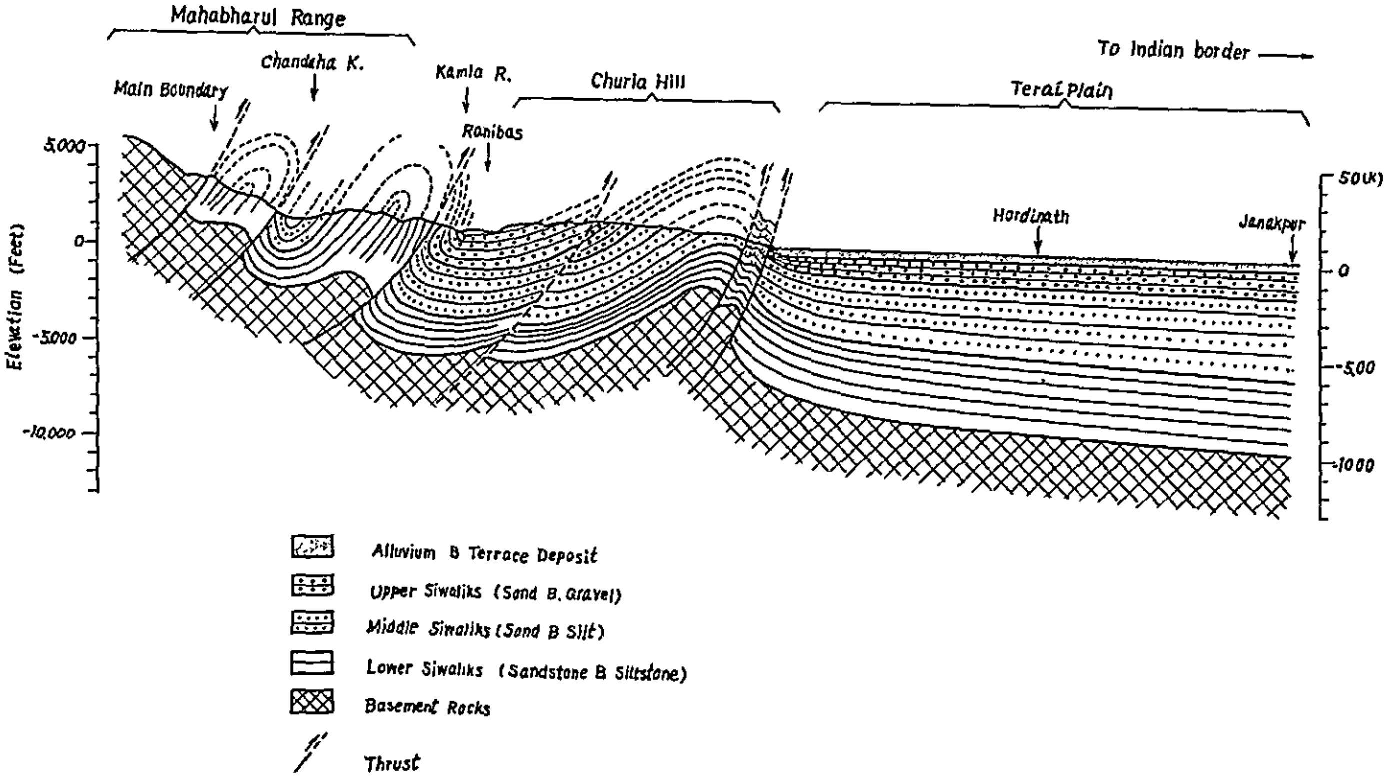


Fig.3.1-5 SOIL MAP

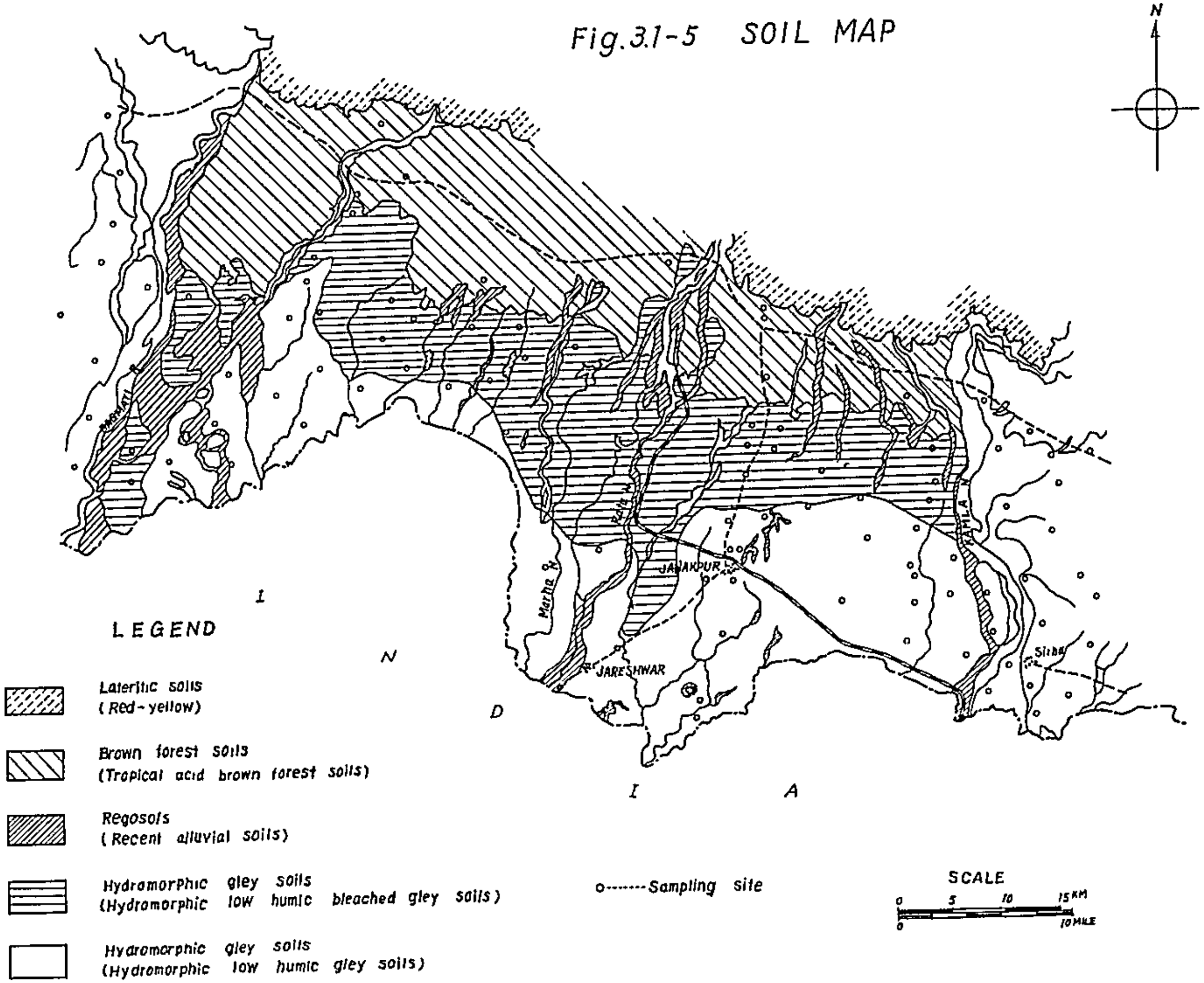
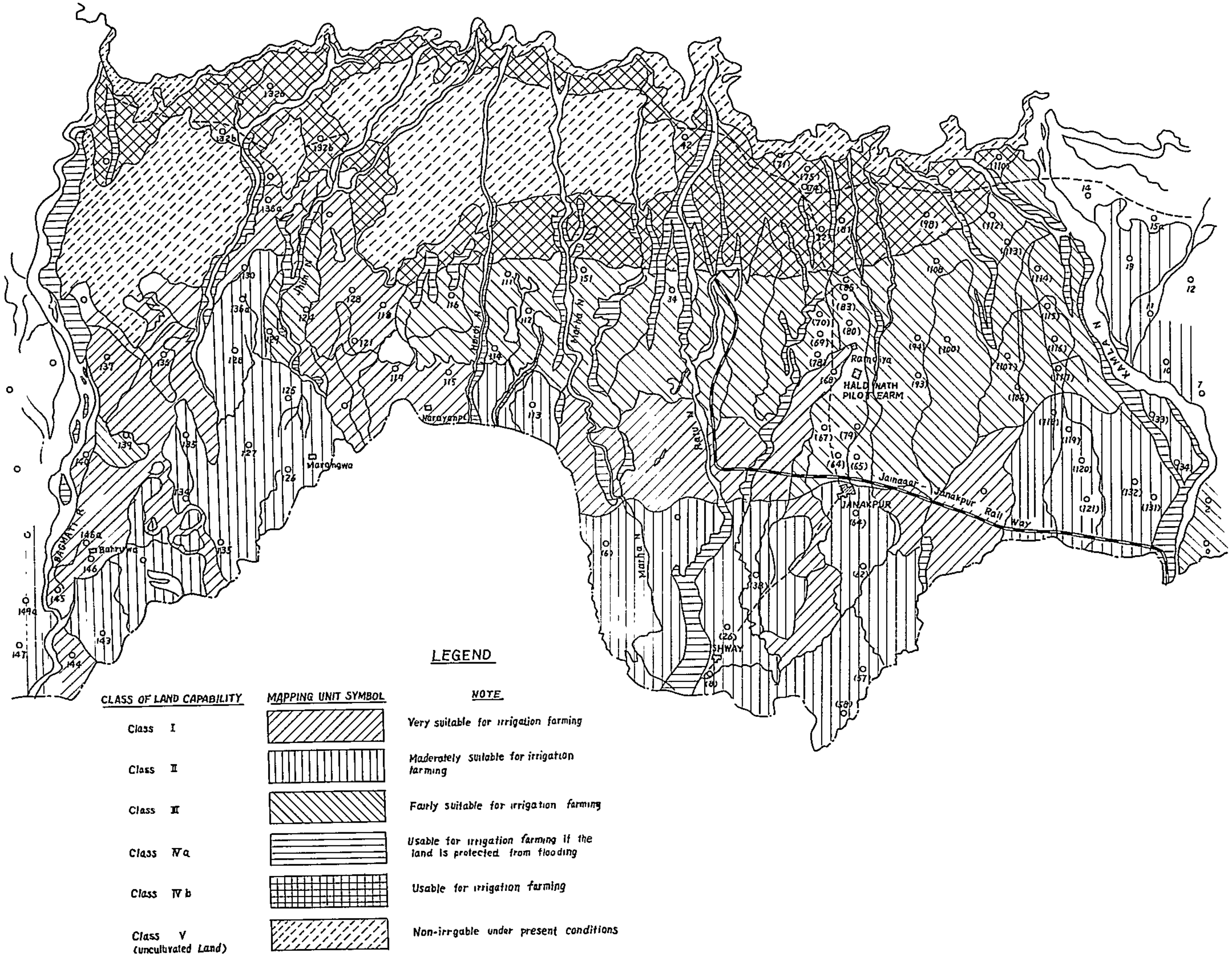


Fig. 3.1-6 LAND CAPABILITY MAP



was eventually ensued by the actual use of such groundwater for large-scale irrigation. This has attracted the attention of both the Government and farmers of Nepal and resulted in the active survey on groundwater resources which has been carried out over 10 years in the past in Tarai Plain.

As stated in Section 3. 2 "Infrastructural Improvement Plan, "the sources of groundwater in Tarai Plain are found in the area south of Churia Hill. The availability of groundwater is affected by the distribution of annual rainfall, and its volume increases substantially in the wet season and decreases in the dry season.

Fig. 3. 1-7 shows the hydrogeologic conditions in the eastern part of Tarai Plain in Janakpur Zone. As is clear in this figure, a flowing well zone extends from east to west in the west of the line connecting Janakpur and a point approximately 20 km north of it.

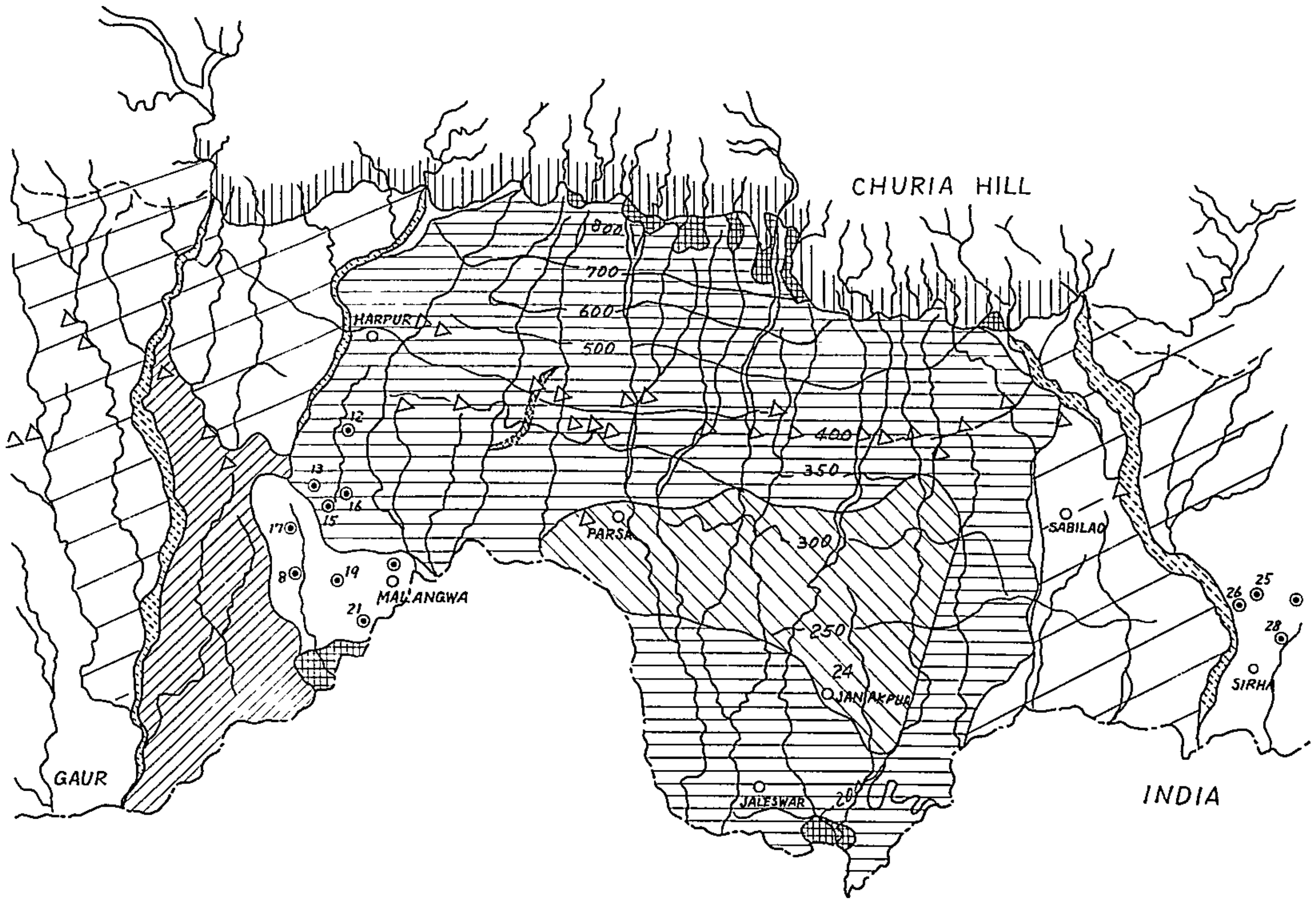
In addition to the above-mentioned flowing well zone, there is a district, in the vicinity of Malangwa in the west, where deepseated groundwater can be readily obtained. A number of tube wells have already been drilled by the Government in this area for irrigation.

Fig. 3. 1-8 shows the well logs in Janakpur Zone, and Table 3. 1-9 shows the data on tube wells in Nepal and Bihar State of India.

Table 3.1-9 Groundwater Yield of Tube Wells in Project Area

Location	Static water table from surface (ft)	Pumping discharge (GPH)	Drawdown (ft)	Depth (ft)
Kalia	14	45,600	23	360
Parwanipur	15	45,000	18	420
Gilpur	15	40,200	33	200
Pachaukhe	13	46,800	14	350
Chainpur	16	47,000	13.5	330
Ramporatokni	28	48,000	17	460
Passoni	24	48,000	13.5	390
Khutwa	22	48,000	13	390
Chosni	11	43,500	20	230
Brewa	22	42,000	18	430
Birnagar	21	54,725	11	252
Shirnagar	11	56,409	10	240
Chainpur	20	58,000	12	320
Salimpur	30	41,946	16	324
Lakshmipur	9	62,696	10	350
Kaurena	14	54,405	10	330
Bishampur	24	35,000	18	340
Khutauna	14	52,000	12	330
Simra	7	61,186	10	350
Average	17.2	48,970	15.4	

Fig. 3.1-7 GEOMORPHOLOGIC AND HYDROGEOLOGIC MAP



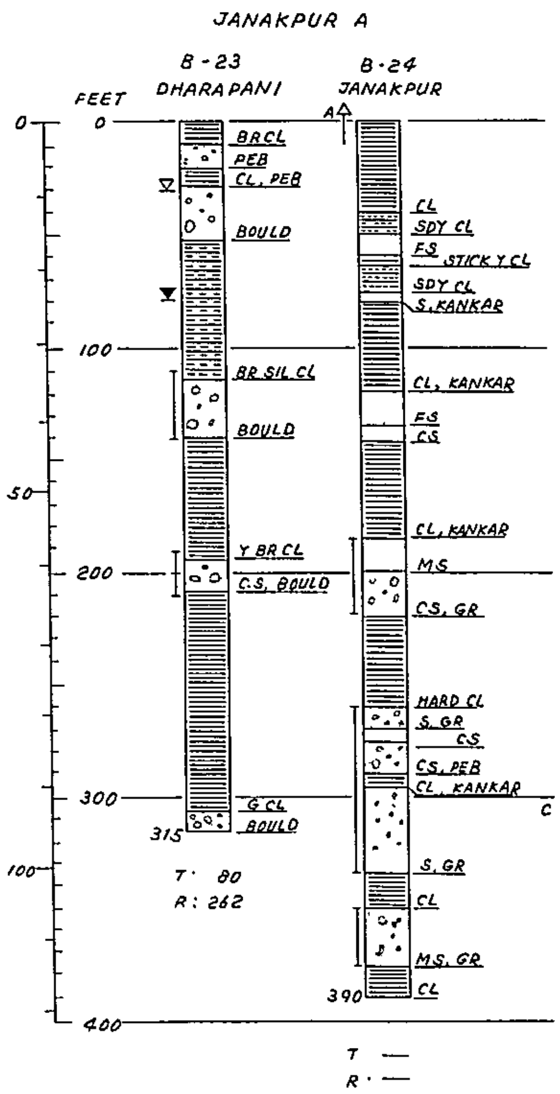
REMARKS

- FOMER RIVER BED
- FLOOD PLAIN
- ALLUVIAL FAN (LOWER TERRACE)
- ALLUVIAL FAN (MIDDLE TERRACE)
- HIGHER TERRACE
- HILL
- △ SPRING AND SEEP
- ⊙ DEEP WELL FOR IRRIGATION
- ○ DEEP WELL FOR WATER SUPPLY
- ZONE OF ARTESIAN TUBE WELLS
- —200— COUNTOUR OF GROUND SURFACE IN FEET

SCALE

0 5 10 20 30 MILES

FIG. 3.1-8 WELL LOGS



3.1.1-5 Land Use

As shown in Table 3.1-10 below, Tarai Plain has the largest cultivated area in the zone, followed by Inner Tarai.

Table 3.1-10 Land Use of Janakpur Zone

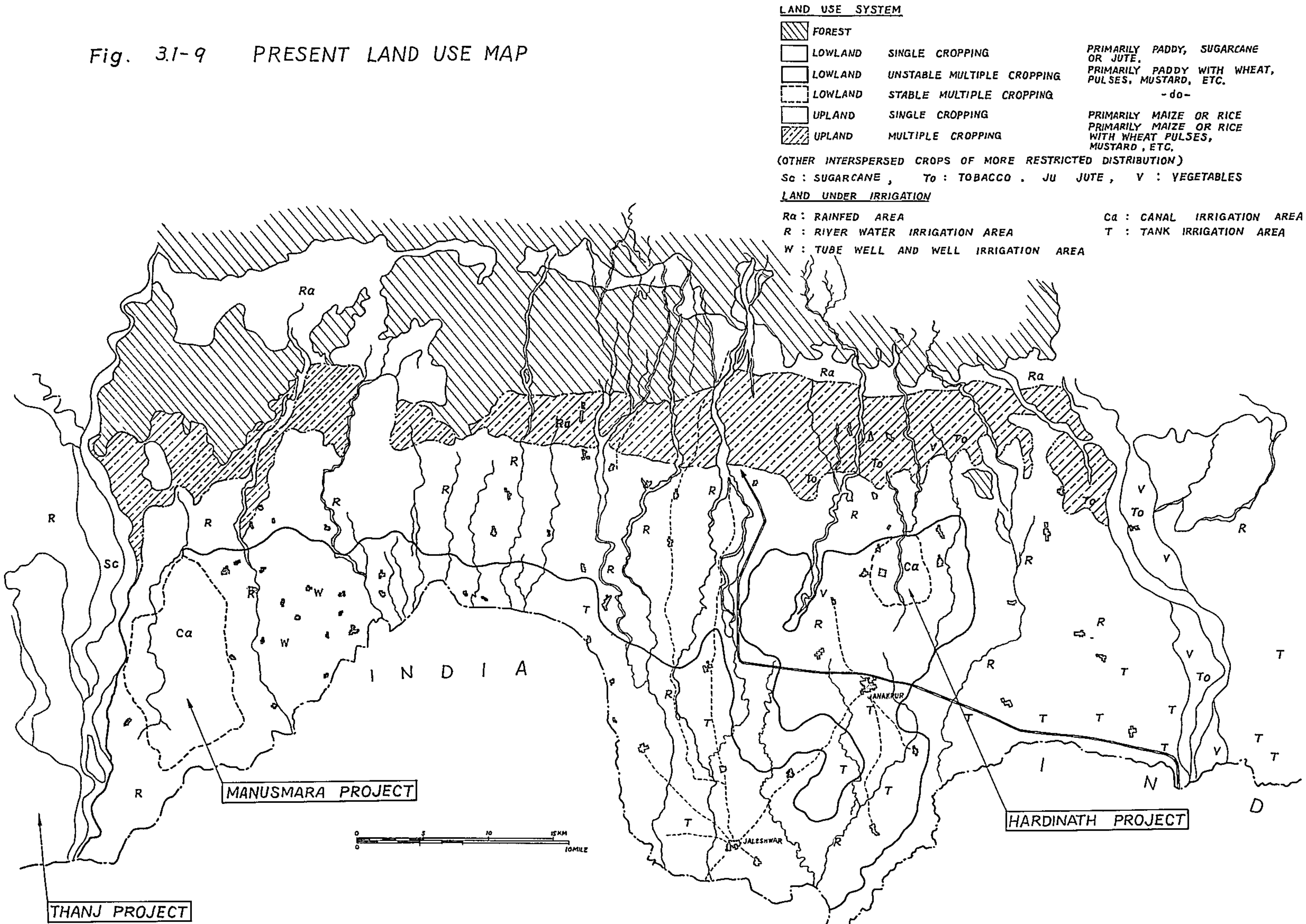
District	Total Area (km^2)	Cultivated Area (ha)	Waste Land (km^2)	Forest (km^2)
Dolakha	1,976	6,000		
Ramechhap	1,378	12,500		
Sindhuli	2,950	14,000		
Sarlahi	1,383	60,000		
Mahotari	1,251	58,000		
Danukha	1,191	70,000		
Total	9,769	219,500	(2,000)	(5,574)

: Estimated

As is clear in the above table, the cultivated area in the hilly area is rather small due to the severe climatic and topographic conditions. Wide-spread distribution of forests which are found is the hilly area up to an elevation of 4,200 m as well as in Inner Tarai characterizes the land use in these areas.

Fig. 3.1-9 shows the present land use in Tarai Plain. As shown in this figure, the area in the south of the forest zone is nearly all covered by the existing farm land, with paddy fields extending in the south and upland along the jungle and rivers.

Fig. 3.1-9 PRESENT LAND USE MAP



3.1.2 Socio-economic Conditions

3.1.2-1 Sample Survey and Its Background

General socio-economic characteristics of Janakpur Zone have already been given in the report on the previous survey. Description in this section is therefore intended, on the one hand, to clarify the fundamental characteristics of socio-economic structure of rural communities on the basis of the sample survey conducted in Ramdaiya Village, Dhanukha District, and to reach, on the other, a broader understanding of the agriculture in Janakpur Zone through comparison of Ramdaiya Village with such other villages as Saphie, Loharpatti, Kumraul, Aurhi, Haraiwa and Kalabanja which the mission visited during the present survey.

Groundwater utilization by tube wells is considered to be most effective in the area which lies in the south of the jungle extending on the skirt of Siwalik Hill. Communities in this area have a longer history and present a stronger Indian influence (from Bihar State) on every aspect of social life as their location becomes closer to the southern border. Contrariwise, as the distance to the jungle becomes shorter, the history of communities becomes likewise shorter, with their inhabitants showing a closer resemblance to those in Inner Tarai with respect to their anthropological features, farm management, religion and language. Configuration of villages also varies by whether they were originally established by Indian migrants or colonists from mountainous area. Villages established by migrants from India are collected with the residential site arranged at the centre of farm land, whereas those built by settlers from mountainous area are formed in the shape of long lines along valleys. Sakhuwa Bazal is situated just at the intermediate point between these two types of communities and provides the largest market in Janakpur Zone where the products of mountainous area are traded for the commodities imported from India.

In the area stretching westwards from Ramdaiya Village located to the south of Sakhuwa Village to Aurhi Village, rich resources of groundwater are available. The most influential caste in this area is Yadav, (their traditional occupation is milkman) who migrated from India about 200 to 300 years ago. And there still remain traces of the jungle in many uncultivated places in the area. The point first selected by the mission as being most suitable for tube-well irrigation is in the west of Ramdaiya Village (and on the west of the Mahendra Nagar Highway). Socio-economic survey was conducted in Ramdaiya Village by means of the questionaire shown in the appendix.

The mission selected from the voter's list, 203 farm households (including agricultural labourers) having any title or right to the cultivated land on the west of the said highway, from whom 30% or 61 farm households were drawn at random and interviewed.[1)] Since one of the 61 farm households failed to give satisfactory answers, the sample survey covered 60 farm households.

3.1.2-2 Classification of Village Households

Since the total population covered by the survey was 349, the number of family members averaged 5.8 per farm households, indicating the trend for transformation of family structure into the one composed of man and wife and their children. This trend was noted not only in Ramdaiya Village but in all other villages including Aurhi Village where the Hindu joint farmily system is still retained. It is considered that restrictions on the holding and registration of tenant right required by land reform are accelerating the transformation of family structure of landowners and tenants alike.

Stratification of the farm households based on their right to the lowland is as given below.

	Households	Average Operational Holding (Khari
i) Owner cultivator	23	1.5 bigha
ii) Owner-tenant	12	1.9 "
iii) Tenant-owner	10	2.4 "
iv) Tenant	4	1.0 "
v) Landless labourer	11	0 "

Absence of landlords is ascribable to the fact that the absentee landlords in Ramdaiya Village are the Ranas (ex-zamindar) living in Kathmandu and that many large landowners are found in the adjoining Bhabari Village whose residential area is adjacent to Ramdaiya.[2)] Average operational holding per farm household including upland field without counting farm labourers is about 2 bigha, which is approximately equal to the average size observed in Tarai Plain of Janakpur Zone. Of the total 60 farm households surveyed, 34 belong to Yadav, but the reamaining 26 are divided into small groups of less than three households excepting the five belonging to Mushar. Hence, there is no distinct relationship between the class stratification by holding and the caste system. It is evident, however, that the Mushar who are Harijan and the muslims are cultivating the most poorly conditioned land or constituting the majority of farm labourers.

By the above class stratification of farm households, it became clear that Ramdaiya Village is featured by the absence of a large difference in economic footing between owner farmers and owner-tenants or tenant-owners. It was noticed that the size of holding of the latter two classes is even larger than that of owner farmers, and this fact is considered to be closely related to the life cycle of the households engaged in agriculture. To be more precise, the per household number of family members of the aforementioned five classes is as given below, and the tenant-owners have the largest number of family members per household.

i)	Owner farmer	5.7 persons
ii)	Owner-tenant	6.0 "
iii)	Tenant-owner	8.2 "
iv)	Tenant	4.5 "
v)	Farm labourer	4.1 "

From the above fact, it may be said that farm households tend to obtain more tenant-land if they have a large number of family members and to decrease the size of their tenant-land with the aging of their labour force, though this is not acceptable as a generalized conclusion because the acquisition of tenant-land has become difficult after the land reform. At any rate, agricultural development will have to be planned with consideration given to the fact that the differential is not very large between classes operating on owned land but is conspicuous between such classes and the landless villagers.

3.1.2-3 Education

Primary school of the five grade system is usually found established in the residential site of large rural communities. However, it appeared that no satisfactory primary education is being provided due to its short history and unstable financial back-up. The mission noticed that many school buildings are not usable on rainy days and that the payment of wages to schoolteachers, which is partly borne by Panchayat, is often delayed in many villages.

Because of the considerable expenses which the parents must bear for schoolbooks and stationery and the prevailing habit of having children take care of cattle, pupils who attend school daily are generally limited to the sons of upper class farmers.

In the case of Sri Rashtriya Prathamik Pathshala School which covers the three villages of Ramdaiya, Bhabari and Kumraul (total population: approx. 4,300), the number of registered school children and that of actually attending children are as given in Table 3.1-11 below.

Table 3.1-11 Number of Primary School Children (Kumraul, Ramdaiya & Bhabari) (As of December 1970)

Grade	Registered Children		Attending Children		Total
	(M)	(F)	(M)	(F)	
1st Grade	17	1	10	1	11
2nd "	15	1	12	1	13
3rd "	20	1	14	1	15
4th "	14	0	11	0	11
5th "	9	1	8	1	9
Total	75	4	55	4	59

The survey conducted on 229 inhabitants of Ramdaiya Village who are more than 11 years of age revealed that 11 males and 3 females have received school education and that 12 males are literate though they have not attended school. These adult villagers with some education were found only among the upper class farmers, and none of agricultural labourers was found to have attended school or learned how to read and write.

3.1.2-4 Farm Management

Major crops in the survey area are paddy and wheat, followed by miscellaneous cereals and pulses. When asked which crop was most desirable for future production increase, 29 farm households named paddy and 24 gave wheat, and only one farm household expressed the hope for increased cultivation of other crops. Reasons given for the choice of paddy and wheat were (1) large yield (30 households), (2) good selling price (17 households), and (3) possibility of saving farm labour (8 households). Desired increase in the planting area was 48 bigha for improved varieties of paddy and 23 bigha for wheat, indicating that the farmers in the survey area are eager about increasing paddy production.

To the question what would be required for improving farm management, answers were given in the following order.

(1)	Improvement of irrigation facilities	31	households
(2)	Availability of farm cultivation funds	22	"
(3)	Introduction of improved varieties	12	"
(4)	Procurement of farm equipment	5	"
(5)	Introduction of advanced farming techniques	5	"
(6)	Stabilization of market price	4	"

Thus, it is clear that farmers are fully aware that the improvement of their farm management depends on the development of water utilization and availability of cultivation funds. It follows, therefore, that if agricultural development is ever to satisfy the farmer's expection, it will have to be planned to bring solution to these two problems.

As shown in Table 3.1-12, the stock farming centers on dairy cattle and bullocks, and poultry farming occupies an extremely small share for religious reasons. This trend is also noted in the farmer's future plan for purchasing livestock. For rearing of cattle, a contract system called Possia, which is considered to have originated from the share-cropping system, is in wide practice. Under this system, milk and newly born calves are equally divided between the cattle owner and the contract rearer.

Wages of farm labourers are usually paid in kind. Cash payment is not likely to become popularized so long as the price fluctuation of cereals remains large. There is no wage-disparity between male and female workers. The principle of the same wage for the same labour is strictly observed and constitutes one of the characteristics of the survey area. For female workers, however, labour in the field is limited to transplanting and reaping. The wage level appears to be stabilized over a considerably wide area, but is noted become gradually higher from the Indian border to the northern area.

Table 3.1-12 Livestock in Ramdaiya Dec. 1970

Land Tenure	Bullock	Cow(Calf)	She-Buffaloe(Calf)	Goat + Sheep	Poultry (Others)	Wanted to be reared
1. Owner cultivators (23)	28 m 1	19 (10)	13 (7) *3 m 3	18	6	3 she-buffaloes, 7 bullocks 1 cow, 1 he-bullow.
2. Partly owner cultivators (12)	21	24 (8)	5 (3) *1 m 1	11 m 2	0	4 she-buffaloes, 3 bullocks 2 cows.
3. Partly tenant cultivators (10)	12	12 (4)	2 (2) *3 m 1	5 m 3	0	4 she-buffaloes, 1 bullock, 2 cows.
4. Tenant cultivators (4)	4	4 (2)	0	1	0	2 she-buffaloes.
5. Landless labourers (11)	0	1 (1)	m 2	3 m 5	(1 horse)	1 she-buffaloe, 2 bullocks, 3 cows, 1 horse.
Total	65 m 1	60 (25)	20 (12)*7 m 7	38 m 10	6 (1 horse)	12 she-buffaloes, 13 bullocks, 3 cows, 1 he-buffaloes, 1 horse.

Notes. m : mohi rearer under Possia system

* : he-buffaloe

The difference is said to be 1 ser per day.

Wages are paid in the following three ways in Ramdaiya and surrounding area.

(1) Annual payment basis: This is adopted for payment to permanent farmhands and labourers who take care of cattle (called Charuwa). Payment is effected in cereals (mainly unhulled rice) varying from 5 to 20 maunds depending on the age of labourers. In addition, two meals a day, two dhotis, shirts, towels and underwears are supplied, with about Rs 25 of cash given at time of festivals.

(2) Daily payment basis: This is adopted for payment to labourers employed on a day contract basis who are called Jan. For a day's work from 7:00 a.m. to 5:00 p.m., 2.5 ser is paid with two meals and 4 ser without meals. If a labourer who uses two bullocks and plough of his own is employed for the said one day work, he is paid 5 ser with two meals.

(3) Piece-rate basis: This is adopted for payment to labourers employed for reaping during the harvesting season. The labourer receives one bundle of paddy for each 16 bundles he reaps, but meals are not provided. Unhulled rice worth about 8 to 10 ser can be obtained from one bundle of paddy, and 2 to 4 day labour is required to reap 16 bundles.

The survey disclosed that farmers operating on a small scale of less than 1 bigha resort to employed labour force. Selection of a farming system which dispenses with employed labour will therefore be quite important for the future improvement of farm management.

It is said that 50 to 75% of farmers in the flat land area of Janakpur Zone are suffering from debt in cash or kind. Debts in cash are incurred mostly by owner farmers and owner-tenants who obtain a loan from the Government financial organs or borrow money from merchants or money lenders. Debts in kind are mostly made by tenant farmers and agricultural labourers who borrow cereals from landowners or nearby farmers. Cash loans are appropriated either for productive purpose such as procurement of cattle and farm equipment or for such temporary large disbursement in the family budget as for marriage and funeral, and are provided at an interest rate of 10 to 25%. Loans in kind, on the other hand, are intended exclusively for a short-term makeshift in the household economy and are provided at a flat interest rate of 25%.

The mission noted that not a few farm household have made a loan in cereal during a slack season but being unable to pay it off before the advent of the following slack season, they are placed under the constant pressure of debt and interest. Loans provided by the Agricultural Cooperative society or the Land Reform Saving Corporation are not serving to relieve farmers from the pressure of debt because they are limited in amount and cannot be appropriated for the living funds which are most badly needed by lower class farmers. It is therefore considered a matter of pressing need to establish, in parallel with the setting up of a financing organ for agricultural development, an organ which would provide loans for improving farmer's livelihood.

3.1.2-5 Marketing of Farm Products

Selling cereals and purchasing living necessaries with the proceeds obtained is the principle of farm economy. Marketing of farm products carries a significant weight in this connection. In actuality, however, there are few farmers who carry their products to the market in Janakpur or Sakhuwa, and most of them sell farm products to the grain brokers in respective villages. These brokers carry the collected farm products to the market by bullock carts.

Figs. 3.1-10～12 show the monthly market price fluctuation of major agricultural commodities in Janakpur, Sakhuwa and Ramdaiya. The difference between the ex-farmhouse prices and the market prices in cities can be obtained from these figures. Also, from the price fluctuation through the year which is shown in these figures for respective crops, it will be understood that farmers can enjoy by far the larger profit than at present if they do not rush on the sale but wait for the price increase. For this purpose, however, storehouses, transport means to the market and living funds should be made available. If these minimum requirements are satisfied by the mutual cooperation of farmers, they are certain to be freed from the burden of debt from grain brolers and money lenders.

FIG. 3.1-10 MARKET PRICE OF JANAKPUR

FIG. 3.1 - 11 SAKHUWA MARKET PRICE OF SOME AGRICULTURAL COMMODITIES , MONTHLY VARIATION

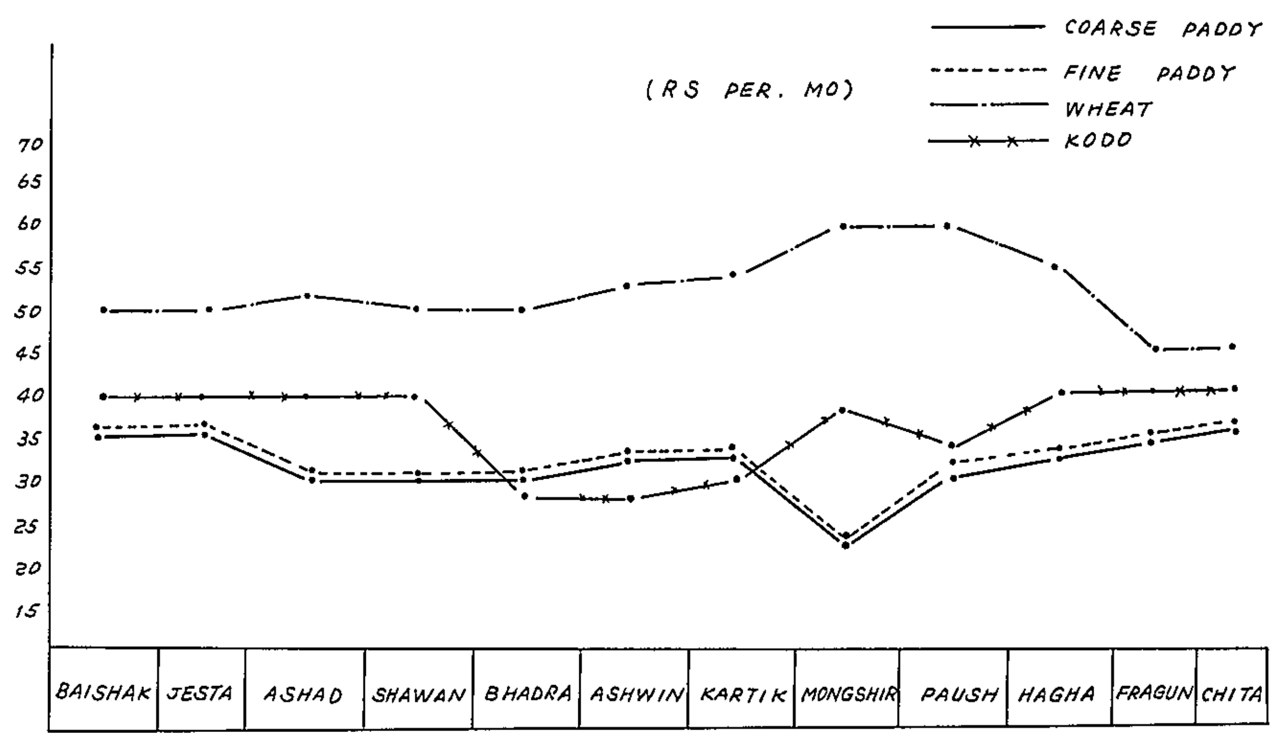
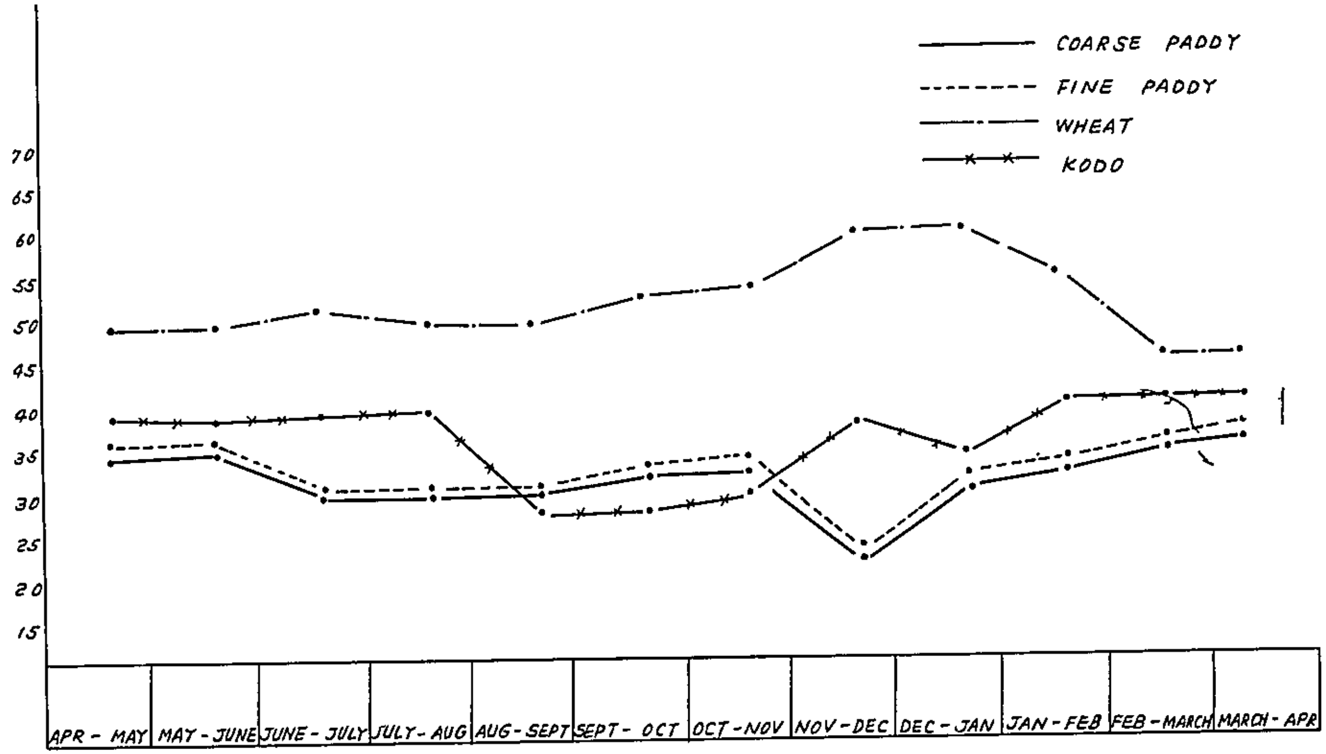


FIG. 3.1 – 12 FARM PRICES IN RAMDAIYA VILLAGE
(RS PER MD.)



3.1.2-6 Living Standard of Farm Household

Table 3.1-13 shows the durable goods possessed by the farm households covered by the survey. The farmer's living standard, as judged from this table, shows a descending order from owner to tenant farmers and then to farm labourers.

The living cost survey conducted on 47 farm households produced the following average values which cover one year period from January to December 1970 for about six family members.

(1)	Cost for food	Rs 1,848.31
(2)	" clothes	Rs 228.20
(3)	" residence	Rs 37.47
(4)	" education	Rs 59.16
(5)	" marriage, funeral & other ceremonies	Rs 139.73
(6)	Miscellaneous expenses	Rs 247.05
	Total	Rs 2,559.92

Cost for cereals and vegetables which accounts for about 80% of the food cost need not be paid in cash, but can be covered by the farmer's own products or their wages in kind. The above conversion of the food cost into monetary value clearly shows that Engel's coefficient is very high in the survey area (72.2%).

Cost for clothes goes mostly to saree and dhoti, and partly to towels, underwears and other articles. Footwear is practically not in use. Cost for residence is required mostly for reparing roofs.

Education cost is higher in upper class farm households and varies largely by the living standard. Cost of marriage, funeral and other ceremonies shows a large fluctuation by year and is the main cause for debt.

Table 3.1-13 Durable Goods in Ramdaiya

Land Tenure	Household	Bicycle	Radio	Lamp	Wall Clock	Wrist Watch	Umbrella	Torch	Bed	Chair	Cart
1. Owner cultivators	23	1	0	19	0	1	23	7	6	4	7
2. Partly owner culti-vators	12	1	1	7	0	0	18	6	4	1	6
3. Partly tenant culti-vators	10	1	0	6	0	1	16	3	3	0	7
4. Tenant cultivators	4	0	0	4	0	0	4	0	0	0	0
5. Landless labourers	11	0	0	5	0	0	4	2	0	0	0
Total:	60	3	1	41	0	3	65	18	13	5	20

In the miscellaneous cost, expenses for daily need such as fuel, transportation, jars and pots are more or less stable, but the medical fee shows a large dispersion by family and also incurs debt.

3.1.2-7 Production Cost of Paddy

It generally entails difficulties to calculate the agricultural production cost if the size of holding is small. This is particularly so in Nepalese rural communities where the money economy is not yet well developed and farmers have no habit of keeping an account-book. Mere summing up of average costs of various factors clarified by the sample survey does not therefore promise any meaningful results. Accordingly, the production cost of paddy is calculated on the basis of survey results and the mission's observation, with the farm management of an owner-tenant operating on 2 bigha of lowland paddy field taken as the model. 1 bigha of this 2 bigha paddy field is owned by the said owner-tenant and the remaining 1 bigha is the tenant land.

For the sake of calculation, a family composed of three adults engaged in paddy cultivation and three children is assumed. Further, since the crop rotation of paddy field in the survey area consists of the three cropping (paddy -> paddy -> wheat, millet and pulses) conducted by 19 out of a total of 40 farm households and double cropping (paddy --> wheat, millet and pulses) carried out by 21 farm households, calculation is made with double cropping assumed for the owned land and single cropping for the tenant land.

(1) Employed labour force 114 labourers 456 ser

Employed labour force is concentrated in fallowing, transplanting, weeding and reaping work. Two buffaloes for fallowing and threshing are assumed to be owned.

(2) Seed Rs 60

Value of homemade seeds, assumed to be 30 ser, is not included in the above cost.

(3) Fertilizer 20 kg of ammonium sulphate Rs14.6

Chemical fertilizers are used only by one-sixth of the surveyed farm households.

(4) Procurement and repair of farm equipment 20 ser

Repair is effected by carpenters to whom payment is made on a yearly basis in a fixed amount of paddy under Jajimani System which is still in existence.

(5) Livestock rearing Rs 10

Cost for bullocks cannot be estimated separately from that for dairy cattle and goats. The above cost includes the payment to the veterinary surgeon.

(6) Rice bags (to be newly procured)	Rs 6
(7) Rent (in paddy)	20 maunds
(8) Land tax (for 1 bigha only)	Rs 51
(9) Miscellaneous disbursements (e. g., interest on loans, transport cost, etc.)	Rs 40

Above are the cost of production which the farm household pays either in cash or kind. The total cost calculated at a conversion rate of 1 maund of paddy to Rs 30 amounts to Rs 1,180.6. This cost does not include the depreciation cost of farm equipment and bullocks and the value of self-supplied seeds and fertilizers. With this excluded cost estimated at about Rs 220, the total production cost which makes reproduction feasible amounts to Rs 1,400.

Assuming that the yield of the first paddy per bigha (owned land) is 30 maunds and that of the second paddy (owned land and tenant land) is 40 maunds, the gross income including the income from straw is Rs 3,400 as calculated below.

Rs 30 x 110 maunds + Rs 100 (straw) = Rs 3,400

Since the living cost of a six-member family given is Section 3.1.2-6 is Rs 2,559.92, a deficit of about Rs 560 is incurred as calculated below.

Production Cost + Living Cost	Rs 3,959.92
Gross Income	Rs 3,400.00
	- Rs 559.92

This deficit should be covered by the income from other crops, proceeds from stock farming, and wages. Failure to fill this deficit results in the accumulated increase of farmer's debt.

If a farm household is to be regarded as an industrial enterprise for calculation of its comprehensive operational cost, it is necessary to add to the above production cost such other cost as rental value of owned land, interest on fixed capital and estimated cost of armily labour and mutual exchange of labour. However, the calculation made in this section is limited to that of cost in cash and kind actually incurred for production because the inclusion of the above additional costs does not suit the actual situation in Janakpur Zone.

Notes:

1) Socio-economic survey was carried out with the interviewing service offered by Mr. J.P. Chaurasia and Mr. G.P. Sharma who are respectively JT and JTA of Dhanukha District and by Mr. A.N.L. Kavma.

2) Pradhan Panch living in Bhabari owns 125 bigha of cultivated area. In Ramdaiya, the largest landowner has 12 bigha of land only, and a mere 6 bigha is owned by the second largest.

3.1.3 Regime and Institution

This section does not give a general description of the regime and institution in Janakpur Zone, but deals with various systems and organizations functioning in rural communities to point out their outstanding problems.

3.1.3-1 Panchayat

Panchayat of rural communities constitutes the political and administrative foundation of Nepal, and enhancement of its activities is the common goal of the Nepalese people. In actuality, however, its activities vary largely by villages. In some villages, it is functioning merely as a terminal administrative organ controlled by a few men of influence, while in some other, it is actively carrying on agricultural development plans. The class organizations which are supposed to back up the activities of Panchayat is in virtual torpidity except in few specific villages.

The mission is of the opinion that efforts should be directed rather to the improved communication and coordination between organizations now functioning within respective villages as well as between such organizations and District-level organs than to the reconstruction of the dormant class organizations like Yuwak Sangathan, Mahila Samiti, Kisan Samiti and so on.

The mission also considers it necessary that Panchayat play the role of an efficient intermediary organ through which farmers can always and readily come in touch with such organizations as the District Agricultural Development Office, Agricultural Development Bank, Agricultural Supply Corporation, Land Administration Office, Guthi Corporation, Land Reform Saving Corporation and Co-operative Department.

3.1.3-2 Land Reform Saving Corporation

Land Reform Saving Corporation is the most important of all Government organs functioning on the village level. Since last year, the corporation has narrowed the scope of activities of its Ward Committee and limited its function to the collection of compulsory saving, and established a new financing system under which loans for farmers are to be provided through Gram Samiti which has been organized under each Panchayat. In addition to the existing Gram Samiti, the corporation is planning to establish, in

Table 3.1-14 Grain Account

Fiscal year 2022/23 – 2025/26 Land Reform Saving Corporation

Saphie

Income					Expenditure				
Description	022/23	23/24	24/25	25/26	Description	022/23	23/24	24/25	25/26
From the last account		1427-32-2	867-28-5	539-5-11					
From saving	1917-8-2	78-24-12	2-36-0	85-24-4	Loan distribution	531-25-0	1880-35-8	875-36-13	563-15-13
Agr. loan collected	40-15-0	2-12-0	0	0	Grain sold	0	0	0-30-0	0-20-5
Its interest	1-34-0	1-8-6	0	0	Other sources	13-24-0	59-16-0	32-34-3	28-26-0
Distributed loan collected	0	1132-39-14	483-23-0	1327-38-10					
Its interest	0	111-2-11	38-9-6	168-30-15					
Drying	0	0	0	0					
Other sources	13-24-0	54-0-0	56-10-0	0					
					Balance	1427-32-2	867-28-5	539-5-11	1528-37-6
Total	1973-1-2	2807-39-13	1448-26-11	2121-19-8	Total	545-9-0	1940-11-8	909-21-0	592-22-2

five villages of Dhanukh District, a new and larger scale Gram Samiti which will cover not only the financing cultivation but also sales and procurement activities as an multi-purpose agricultural co-operative society.

One of the merits of this corporation is that it has two terminal organs, Ward Committee and Gram Samite, which are established in each village and serving as the basis for the mutual cooperation of villagers. As things stand now, however, the corporation is liable to compete with Agricultural Development Bank in its financing activities and with Co-operative Department in the organization and activities of multi-purpose Gram Samiti (Bahumukhi Gram Samiti). It is therefore necessary to coordinate the scope of activities of these three organs.

Tables 3.1-14 and 3.1-15 show the scale of the corporation's activities on the level of Ward Committee in Saphie. These tables indicate that the cash account is not fully utilized as in other villages. Loan distribution in Saphie does not differ much from that in other villages.

Table 3.1-15 Cash Account

Fiscal year 2022/23 – 25/26 Land Reform Saving Corporation

Saphie

Income					Expenditure				
Description	2022/23	23/24	24/25	25/26	Description	2022/23	23/24	24/25	25/26
From last account		259.80	322.80	547.80					
From saving	150	0	225	0	Loan distribution	150	0	0	0
Agr. loan collected	322.80	0	0	0	Interest distribution	0	0	0	0
Its interest	0	0	0	0	Remuneration	0	0	0	0
Distributed loan collected	0	0	0	0	Deposited inland reform office	0	0	0	0
Its interest	0	0	0	14.25	Miscellenious	23	37	22.50	14.25
Proceeds from the sale	60	0	22.50	0					
Other sources	0	0	0	0					
					Balance	359.80	322.80	547.80	547.80
Total	532.80	359.80	570.30	562.05	Total	173	37	22.50	14.25

3.1.3-3 Agricultural Co-operative Society

Agricultural Co-operative Society is functioning on the village level together with Land Reform Saving Corporation, but the farmer's voluntary participation in this organ is not active. With the exception of a few model societies to which the sub-inspectors of Co-operative Department are dispatched as manager, its activities are suspended at present. In Dhanukha District, model societies are found in Gorgas and Ramdaiya, but they both have only one staff and are unable to fully meet the requirements of member farmers. Participation of member farmers in their management is therefore called for.

Considering the area and scope of activities they cover, much cannot be expected of a single staff from outside who works only three to four days a week. Development of Agricultural Co-operative Society cannot be expected so far as the member farmers regard it as a distributing agent of fertilizers and seed. Crganizational improvement should be effected to the society so that the farmer's endeavours for farm economy improvement will directly lead to the development of its activities.

Table 3.1-16 shows the activities over the past one year of Shree Bagarang Adarsh Bahumukh Sahakari Sanstha in Ramdaiya.

Table 3.1-16. Activities of Co-operative Society, Ramdaiya

I. Agricultural Goods Sold in 2027

	Goods	Amount	Price
1.	Corn Rampur yellow	4md 34 seers 15 kanwa	214.46
2.	Paddy B. R. 34	2 " 39 "	141.30
3.	Paddy I. R. 8	5 " 28 " 12 "	367.57
4.	Wheat S. 227	22 " 19 " 11 "	1515.99
5.	Wheat Sonara 64	36 " 31 "	2536.39

Fertilizer

	Goods	Amount	Price
1.	Complesal	46 Qui 82 kg	4,056.34
	"	80 " 46 "	8,146.06
2.	Anmonium Sulphote	40 Qui 34 kg	2,494.60
	"	61 " 60 "	4,784.88
3.	Potash	4 Qui 82 kg	349.90
4.	Complete	2 Quintal	225.50

Agro - Chemicals

			Rs
1.	Pholidol	200 cc ----------	9.00
2.	Metasystacs	200 cc ----------	7.20

II. Co-Operative Loan Management

(a) Society has recieved loan from ADB as following.

1) For paddy crop (2026-2027) ---------- 10,000. -

2) For wheat crop (2027-2028) ---------- 10,500. -

Total 20,500. -

(b) 1. In paddy crop the loan distributed to the members (from A D B 10,000. - Rs and from its own Capital ------448.22) 10,448.22

2. For wheat crop loan distributed to the members ---------------7312.55

III. Agricultural goods purchased in 2027

	In paddy season	Amaunt	Price
1.	Corn (Rampur yellow)	5 md.	200. 00
2.	Paddy J. R. 8	8 "	368. 00
3.	Paddy B. R. 34	3 "	138. 00
	Fertilizers		
1.	Complesal - up to 2027-3-3 ----------	50 Qui 25 kg	4, 950. 75
	from 2027-4-4- to 2027-8-3 ---	10 Qui	985. 20
2.	Anmonium Suphate up to 2027-3-3 -----------	67 Qui 50 kg	5, 136. 75
	from 2027-4-1 to 2027-6-30----	10 Qui	761. 00
3.	Complete Mal -----------	4 Qui 41 kg	486. 20
4.	Muriate of potash -------------	50 kg	27. 85
	Agro-Chemicals		
1.	Pholidol	600 cc	26. 91
2.	Meta Systacs	600 cc	21. 54
		Total	13, 102. 20

3.1.3-4 Agricultural Development Bank and Agricultural Supply Corporation

Both Agricultural Development Bank and Agricultural Supply Corporation were established by the Government for accelerating agricultural development, but their activities have so far been limited to those of branch offices in cities and therefore have not contributed much to the farm management improvement of individual farmers. Since farmers are given very few chances to transact directly with these organs, closer ralations should be established between these organs and their agents, Gram Samiti and Agricultural Societies, so that funds and agricultural equipment and materials may be supplied to respective villages whenever required.

Table 3.1-17 showing the loan distribution in the two districts of Dhanukh and Mahottari gives an idea about the role played by Agricultural Development Bank in the development of rural communities.

To purchase agricultural equipment and materials from Agricultural Supply Corporation, farmers are obliged to go all the way to town on bullock carts. Many of farmers complain that this entails much difficulty under the existing poor traffic condition. Increase of warehouses and sales offices is therefore a matter of pressing need at present, and for its effective materialization, it is considered most desirable that Gram Samiti in each village intensify its activities and act as the agent of the corporation.

Table 3.1-17. Agricultural Development Bank Branch Office (Janakpur Project Discription)

District Lorn	Tractor	Pump set	Tube-well Boring	Artission Boring	Fishery	Piggry	Mills	Production (fertilizer, seeds, in-secticide)
A. Dhanukha 1) house hold	6	53	15	38	2	1	2	34
2) total	Rs 210, 274. -	265, 696. 08	110, 762. -	75, 202. 67	35, 000. -	25, 000. -	45, 000. -	34, 550. 64
3) average	Rs 35, 045. 67	5, 013, 13	7, 384. 13	1, 979. 02	17, 500. -	25, 000. -	22, 500. -	1, 016. 20
B. Mahottari 1) house hold	9	21		6				7
2) total	Rs 317, 417. -	114, 550. 36		17, 411. -				15, 136. -
3) average	Rs 35, 268. 56	5, 454. 78		2, 901. 83				2, 162. 29

3.1.3-5 Land Reform and Land Administration

With the overall organizational improvement effected last year, Land Reform Office was reorganized into Land Administration Office which is to carry out all the work relating to land administration. It is hoped that this new organization will serve for the agricultural development in Janakpur Zone.

At present, all cultivated area in rural communities is treated as lowland and land tax is collected at a flat rate of Rs 51 per bigha. Land classification should be made as early as possible so that land tax may be levied according to the land productivity. Further, it is desirable that tenant farmers, now given to temporary tenancy right, be granted the permanent tenancy right based on the results of cadastral survey so that their position will be made stable. It is to be added that the tenancy right of the land owned by Guthi Corporation should be protected in much the same way as the ordinary tenancy right.

Immediately before the mission's visit to Janakpur, a survey mission comprising Rashtra Panchayat members interviewed the farmers' representatives to hear their opinions for the purpose of giving recommendations on the ceiling of rent. It is hoped that the determination of the ceiling will be accompanied by the abolition of the conventional sharge system and adoption of a fixed rent system so that the farmer's volition for development will be encouraged.

It is considered that a considerable period will be required before such land policy is materialized. To foster the farmer's voluntary development efforts, therefore, measures should be taken for efficient implementation of practicable land policies. For the land expropriated by the Government 10 years ago without compensation for the construction of Mahendra Nagar Highway, the Government is still collecting land tax from the old owners. Problems like this should be brought to solution as soon as possible since they only have the effect of deterring the farmer's cooperation with the Government development project.

3.1.3-6 Taditional Practices and Organizations

In the rural communities of Janakpur Zone, villagers cooperate and assist each other in various forms through the traditional practices and organizations. Such mutual cooperation and assistance among villagers differs by villages and assumes such varying forms as Bhaijaita under which villagers offer their labour service mutually during the farming season, Sajha Society which is the group of villagers who dam up the water of small streams by a small reservoir before tilling paddy fields to supply water to respective fields, and Dharma Bhakari which is intended for storing provisions in precaution against disasters.

Of these traditional organizations, Sajha Society in Kathmandu Valley is the only one which has been legally institutionalized for agricultural development. If agricultural development is planned on the basis of the spirit of such mutual aid which has a long historical background and full use is made of traditional organizations, it will lead to the farmer's voluntary participation which is hard to attain in the modern organizations established by the Government.

3.1.4 Agricultural Status

3.1.4-1 General Description

Agricultural population in Janakpur Zone accounts for about 90% or 1 million in the zone's total population of about 1.1 million. Output from this zone amounts to about Rs 18 million in value. Since virtually all of this value is covered by agricultural products, the zone may truly be considered an agricultural area.

Cultivated area is distributed throughout the zone as already stated, but more than half of it is found in Tarai Plain. Crops cultivated in Janakpur Zone vary by the natural conditions such as climate, topography and soil as well as by social conditions. Hence, farmers in the zone cultivate those crops which are compatible with the inherent natural and socio-economic characteristics of the area in which they live.

Major crops in Tarai Plain are paddy, wheat and mustard. Besides these, such cash crops as sugarcane, tobacco and jute are also cultivated.

In Inner Tarai, on the other hand, millets, maize and potato are the major crops. In the hilly area which is subjected to severe natural conditions, major crops are millets and other miscellaneous cereals, though crops found in Inner Tarai are also cultivated.

Tarai Plain in Janakpur Zone has long been known as one of the granaries of Nepal. Table 3.1-18 shows the cultivated area and production in Janakpur Zone by district and crop during the 1969-1970

Table 3.1-18-(1) Cropped Ared by Crop and District

Zone and District	Paddy	Wheat	Maize	Barley	Millets	Potato	Oilseed	Sugarcaul	Tobacco
Whole Nepal (A)	1,138,790	172,935	449,575	26,295	94,200	42,875	97,000	11,670	8,245
Janakpur Zone (B)	175,700	9,310	39,400	1,060	7,775	3,000	10,975	270	4,834
Dolakha	1,700	375	3,900	135	850	850	200	5	7
Ramechhap	3,000	650	8,200	75	1,950	750	225	10	7
Sindhuli	11,000	100	7,300	50	1,625	550	4,000	80	50
Sarlali	50,000	2,415	8,200	250	1,050	275	2,700	75	270
Mahotari	45,000	2,120	5,000	225	1,000	275	1,400	60	2,350
Danukha	65,000	3,650	6,800	325	1,300	300	2,400	40	2,150
B/A x 100	15.4	5.4	8.7	4.0	8.3	7.0	11.3	2.3	58.64

Table 3.1-18-(2) Production by Crop and District.

Zone and District	Paddy	Wheet	Maize	Barley	Millets	Potato	Oilseed	Sugarcaul	Tobacco
Whole Nepal (A)	2,321.611	226,998	899,564	28,726	110,689	289,857	56,800	187,725	6,296
Janakpur Zone (B)	378,210	10,123	72,617	965	8,208	20,870	5,921	4,050	3,859
Dolakha	4,335	506	8,073	152	1,020	4,994	90	75	4
Ramechhap	7,700	877	16,974	84	2,340	4,406	113	150	4
Sindhuli	26,675	110	14,600	50	1,788	3,300	2,400	1,200	35
Sarlali	97,500	2,535	13,530	212	945	2,585	1,418	1,125	216
Mahotar	99,000	2,120	8,250	191	945	2,585	700	900	1,880
Danukha	143,000	3,975	11,220	276	1,170	3,000	1,200	600	1,720
B/A x 100	16.3	4.5	8.1	3.4	7.4	7.2	10.4	2.2	61.3

period. As will be clear from the comparison with the whole Nepal shown in this table, agricultural production in Janakpur Zone is considerably large despite the fact that the zone covers only about 7% of the country's total area.

Production of paddy and oil seed, for instance, occupies 16.3% and 10.4% respectively of the nation's total, while that of tobacco accounts for as much as 61.3%. Therefore, it can be safely said that the zone is largely contributing to the country's economy.

3.1.4-2 Distribution of Crops

Crops in Tarai Plain differ to some degree from those cultivated in the hilly area or Inner Tarai due to the difference in natural conditions, particularly that in climatic conditions. Table 3.1-19, prepared pred from the results of statistical survey conducted in 1968/69 by the Ministry of Land Reform, Food and Agriculture, H.M.G., shows the major crops and cropped area in Tarai Plain of Janakpur Zone.

As is clear in this table, the major crop in Tarai Plain is paddy, which is followed by maize, wheat and oil seeds.

Table 3.1-20 shows the crop distribution prepared on the basis of the World Census in 1961.

A comparative study of Tables 3.1-18(1) & (2) and 3.1-19 discloses that the cultivated area of paddy has obviously expanded during the past 10 years and that of wheat and barley also increased. Expansion of cultivated area of cash crops is conspicuous with tobacco, and this is attributable to the fact that Janakpur Zone is suited for the growth of tobacco and that one of the largest cigarette factories

Table 3.1-19 Cropped Area in Both Whole Nepal and Tarai Plain Concerned with Project Area

	Paddy (ha)	Maize (ha)	Wheat (ha)	Barley (ha)	Millet (ha)	Potato (ha)
Whole Nepal (A)	1,129,815	434,150	150,045	24,835	92,600	42,500

(Cont'd)	Paddy (ha)	Maize (ha)	Wheat (ha)	Barley (ha)	Millet (ha)	Potato (ha)
Tarai Plain Concerned with Project Area (B)	149,000	11,000	8,500	800	3,675	800
B/A x 100	13.2	25.3	5.7	3.2	4.0	1.9

	Jute (ha)	Sugar cane (ha)	Tobacco (ha)	Oil seeds (ha)	Total (ha)
Whole Nepal (A)	37,000	10,900	7,850	93,700	2,023,395
Tarai Plain Concerned with Project Area (B)	65	145	2,670	6,300	180,950
B/A x 100	0.1	1.3	34.0	6.7	8.9

in Nepal was constructed in Janakpur City. From the same comparative study, it is clear that the cultivated area of maize and millets has markedly decreased in Janakpur Zone. It is considered that the decrease was invited as these two crops gave place to tobacco because of their low profitability.

Table-3.1-20 Crop Distribution (1961 Census)

Crop	Total Area under Crop (ha)	Mahotari Area (ha)	%	Sarlahi Area (ha)	%
1. Cereals	185,243	130,411	70.4	54,832	29.6
Paddy	137,217	101,207	73.8	36,010	26.2
Maize	24,761	11,478	46.4	13,283	53.6
Wheat	8,350	5,930	71.0	2,420	29.0
Barley	756	389	51.5	367	48.5
Millets	12,455	8,252	66.3	2,203	17.7
Others	3,704	3,155	85.2	549	14.8

2.	Vegetables	66,749	50,344	75.4	16,405	24.6
	Pulses	45,621	34,102	74.7	11,519	25.3
	Other legumes	17,734	13,746	77.5	3,988	22.5
	Potato	845	602	71.2	243	28.8
	Other vegetables	1,639	1,120	68.3	519	31.7
	Green vegetables	514	484	94.2	30	5.8
	Spices	396	290	73.2	106	26.8
3.	Cash crops	14,004	6,526	46.6	7,478	53.4
	Oil seeds	12,255	5,062	41.3	7,193	58.7
	Sugar cane	554	384	69.3	170	30.7
	Jute	297	296	99.7	1	0.3
	Tobacco	834	726	87.1	108	12.9
	Others	64	58	90.6	6	9.4
	Total (A)	265,996	187,281	70.4	78,715	29.6
	Net Area (B)	170,711	118,339	69.3	52,372	30.7
	Double cropping rate (A/B)	1.56	1.58		1.50	

3.1.4-3 Cropping Pattern

In all areas of Janakpur Zone, a diversity of crops are cultivated during the wet season.

Crops cultivated in the wet season are called Kharif crops and those cultivated in the dry season are called Rabi crops in Nepal.

Major Kharif crops are paddy, maize, jute and tobacco, and Rabi crops include wheat, barley, mustard and buckwheat. The present survey revealed that the cultivation in the zone is carried out by proper combination of these crops according to the soil, climate, elevation and quantity of water available in respective areas. Table 3.1-21 shows the cropping pattern in Tarai Plain.

Table 3.1-21 Existing Crop Rotations in Project Area

Location	No.	Crop sequence	Duration (year)	Intenuity of cropping (%)
Lowland	1	Paddy-Fallow	1	100
do.	2	Paddy-Wheat	1	200
do.	3	Early paddy-Khesari(Pulse)	1	200
do.	4	Early paddy-(Mustard+wheat)	1	200
do.	5	Sesbania(Green manure)-Paddy-Wheat	1	300
Special area in lowland	6	Sugar cane-Sugar cane ratoon	2	100
do.	7	Sugar cane-Ratoon-Paddy-Wheat	3	100
do.	8	Sesbania-Paddy-Sugar cane Sugar cane ratoon	3	170
Upland	9	Cowpea-Wheat	1	200
do.	10	Maize-Wheat	1	200
do.	11	Maize-Potato	1	200
do.	12	Maize-Tobacco	1	200
do.	13	Maize-(Wheat+Mustard)-Paddy-Berseem(Podder)	2	250
do.	14	Maize-Potato-Paddy-(Gram+Linseed)	2	250
do.	15	Cowpea or Hung (Pulse)-Sugarcane-Spring Maine	2	150
do.	16	Paddy-Potato-Paddy-Wheat-Paddy-(Gram+Mustard)	3	230

3.1.5 Farming Techniques

3.1.5-1 Production Techniques

The farming pattern in the hilly area and Inner Tarai as well as in Tarai Plain is originally based on the shifting cultivation. In Tarai Plain, however, the conventional farming pattern is in the course of gradual transformation with the recent increase of population, and the intensive farming pattern is spreading over a substantially wide area, showing the sign for further spread, though it has not covered the entire plain.

The spread of intensive farming pattern is well manifested by the change in the fallow period. It used to be the common practice in Nepal, as in India, to leave land fallow for quite a lengthy period of 10 to 15 years, which was intended, needless to say, for raising soil fertility. While the agricultural population was comparatively small and the pressure of population on land was consequently light, there was sufficient room to allow for such extensive cultivation pattern. With the sharp increase in population as witnessed in Tarai Plain particularly in the area near the Indian territory, however, no such extensive farming was allowed and people inevitably took to the intensive farming. To increase the soil fertility under such intensive farming pattern, a new farming pattern involving rotation came to be introduced to take the place of the conventional fallowing. This was accompanied by the introduction of chemical fertilizers, agricultural chemicals and improved varieties with the view to further raising the soil productivity.

This new farming pattern is gradually spreading in Tarai Plain, but it is not practised in a highly intensifed form except in very few areas. It cannot be denied that fallowing is still in wide existence in many areas though its once prevalent pattern is no longer followed. Since these areas are situated in the hot and dry tropical zone and devoid of improved irrigation facilities, it cannot be expected that fallowing will completely disappear. It is doubtless, however, that rotation will be introduced in these areas with the development of irrigation facilities.

As described in 3.3 "Farming Plan," the problem entailed in the agriculture of Janakpur Zone including its hilly area and Inner Tarai is that the farming technique is generally very low. This, however, is quite unavoidable because Nepalese farmers have a very limited capital accumulation and are not therefore able to purchase modern farming implements, chemical fertilizers and agricultural chemicals which are needed for elevating their farming techniques. Further, as often repeated in the foregoing pages, it can be said that the progress of farming techniques is suppressed by the deficient irrigation facilities.

It is to be noted, however, that the farming techniques are not intended for application to irrigation farming alone. Farmers in the rain-fed area with no irrigation facilities can increase their production to a substantial extent if they positively introduce the crop rotation by making full use of rainwater. Crop rotation in such rain-fed farming naturally differs to an extent from that in irrigation farming and calls for the application of green manure to increase the soil fertility and for the cultivation of many forage crops. It is considered that such farming techniques deserve extension efforts for the immediate future in many parts of Tarai Plain where no satisfactory irrigation facilities are available and yet the pressure of population growth is becoming heavier.

Application of chemical fertilizers and agricultural chemicals and introduction of improved varieties will certainly be necessary for such rain-fed farming, though not to the same extent as required for irrigation farming. Acquisition of improved farming techniques through the use of chemical fertilizers and others will provide the farmers in the rain-fed area with the basic knowledges and capability to readily digest the irrigation farming to be introduced in future.

3.1.5-2 Unit Yield of Crops

Unit yield of crops can be tabulated as shown in Table 3.1-22 by integrating the results of the present survey and FAO's survey.

Unit yield varies largely by district as well as by soil, climate, availability of irrigation water and other conditions.

In those year-round irrigation areas where improved varieties are cultivated with smooth fertilizer application and disease and pest control, the unit yield by far surpasses the nation's average.

On the other hand, in the rain-fed areas where local varieties are cultivated with no satisfactory fertilization and disease and pest control, the yield is extremely low. Paddy taken for instance, the per bigha yield reaches only 7 maunds or 0.39 tons per ha in some parts of rain-fed areas.

Table 3.1-22 Expected Unit Yields of Crops in 1990

Crop	Present (ton/ha)	In rain-fed areas in 1990 (ton/ha)	In irrigated areas in 1990 (ton/ha)
Paddy (Local)	2.0	2.0	-
1st Paddy (Improved)	-	-	3.5
2nd Paddy (Improved)	-	-	3.2
Late matured paddy	-	-	3.7
Wheat (Improved)	-	-	2.5
Wheat (Local)	1.2	1.5	-
Pulses	0.6	0.8	1.0
Mustard	0.5	0.7	1.0
Maize	1.7	1.7	-
Millet	0.9	1.0	-
Barley	1.1	1.3	-
Potato	10 (Hills)	4.5 (Tarai)	-
Sugarcane	18	24	45 (Ratoon 35)
Tobacco	0.7	0.9	-
Fruits (Mango)	-	-	10
Pasture	-	-	20

3.1.6 Irrigation and Road

3.1.6-1 Irrigation

As in other zones of the country, percentage of irrigated area in the total cultivated area of Jankpur Zone is extremely small and is far less than 10%. The percentage in Tarai Plain is substantially higher than in the hilly area and Inner Tarai but is no higher than about 13%.

Irrigation is this zone can be divided into canal irrigation, well irrigation, tank irrigation and others in accordance with the kind of water source. Lack of data prevented the mission to make a detailed study on the hilly area and Inner Tarai. Existing data indicate that the irrigation referred to in this section is inexistent in these areas. The following descripton deals specifically with the irrigation in Tarai Plain which was covered by the data obtained by the mission.

As is clear in Table 3.1-23 showing the areas covered by different irrigation facilities, land area covered by canal irrigation is dominantly large, occupying about 60% of the total irrigatged area in the zone.

Area covered by well irrigation, which constitutes about 20% of the total irrigated area, resorts to shallow wells for the greater part. Area covered by deep well irrigation is rather small.

Many tanks are found in Tarai Plain. However, since each tank covers a small area of less than 0.5 ha, percentage of tank irrigated area in the total irrigated area is not so large.

Table 3.1-23 Gross Land Area Covered by Different Irrigation Facilities

District	Canals (ha)	Tanks (ha)	Wells (ha)	Others (ha)	Total (ha)
Saptari	13,200	2,600	3,000	2,500	21,300
Mahotari	3,600	1,400	3,000	2,000	10,000
Sarlahi	0	800	1,500	500	2,800
Rautahat	8,800	400	1,500	500	11,200
Bara	2,400	300	2,000	1,000	5,700
Parsa	8,000	200	1,000	500	9,700
Total	36,000	5,700	12,000	7,000	60,700

In the following pages, a brief description of the aforementioned four kinds of irrigation will be given.

Canal Irrigation:

In canal irrigation, water drawn from a river or a lake is supplied through a canal for irrigation. In Nepal, practically all the irrigation projects implemented by the Government resort to this type of irrigation. Canal irrigation is employed in Hardinath Irrigation Project Area and Manusmara Irrigation Project Area in Janakpur Zone, and these two areas are specifically called minor irrigation project areas.

Besides the above-mentioned Government implemented canal irrigation, canal irrigation is also conducted by means of publicly constructed facilities on the village level. Irrigation of this type lacks modern facilities and is far smaller in scale than the Government implemented canal irrigation. This type of irrigation is not included in the canal irrigation referred to here.

Areas covered by Manusmura Irrigation Project and Hardinath Irrigation Project are as given below.

	(Irrigated Area)
Manusumura Irrigation Project	1,200 ha
Hardinath Irrigation Project	3,000 ha

Well Irrigation:

Shallow wells having a depth of 10 m and a diameter of 2 to 3 m are widely employed for domestic use in Tarai Plain. These shallow wells are also dug at many places to obtain irrigation water, but the area covered by such wells is rather small because of the limited availability of water quantity per well. Groundwater is drawn up by ordinary means or pumped up by means of a forced pump. To supply the groundwater to respective fields, simple ditches are cut and in certain localities, roads are used as irrigation canals in both dry and wet seasons. Such ditches and roads are also used for tank irrigation.

Deep Well Irrigation:

Deep well irrigation is fairly active recently in the southern part of Tarai Plain near the Indian territory. As already stated, the southern part of the plain abounds in the occurrence of groundwater and embraces a flowing well area. In such flowing well area, advanced farmers dig deep wells having a diameter of about 2" to use the artesian soring for irrigation and domestic purpose. In some communities in the said area, deep wells are dug publicly to provide water for all villagers. At present, however, number of deep wells in the zone is rather small.

During the 1969-1970 period. FAO conducted a test digging of seven artesian deep wells in Tarai Plain of the zone for pumping test as part of Sunkosi Tarai Irrigation Development Project. As a result of the test, it was confirmed that an average yield of 2, 000 tons can be obtained per day. At Hardinath Pilot Farm which is under FAO's control and management, artesian soring is actually used for irrigation and experiments on crop cultivation. This type of water utilization has induced the farmers in this part of the zone to pay increased attention to irrigation, whereby the demand is strongly voiced for the implementation of an irrigation project resorting to deep wells.

Tank Irrigation:

Many tanks are found in the south of Tarai Plain. Though these tanks do not always have a large capacity, stored water is uded for a wide range of purposes such as bathing, washing, cleaning of livestock and irrigation. However, since most of them have a depth of 2 to 3 m and an area of only about 0. 5 ha, irrigated area covered by them is extremely small. Therefore, the total area covered by them is not very wide for the large number of tanks. Tank irrigation area is shown in Fig. 3. 1-9 "Present Land Use Map" attached to the end of Section 3. 1. 1.

Other Irrigation

By other irrigation is meant the publicly constructed and implemented irrigation not included in the aforementioned canal irrigation. It also includes such irrigation which resorts to other water sources than wells and tanks.

Irrigation projects implemented by the Government in the past years were all intended primarily for the supplementary irrigation during the wet season, and no particular consideration was given to the dry season irrigation. Further, it often occurred that no sufficient water was supplied to the proposed irrigation area due to the deficient study on the water requirement.

On the right side of the Kamla in the east of Tarai Plain, there lies the Kamla River Irrigation Project Area in which the Nepalese Government intiated the construction work under the Indian aid several years ago and suspended it later. Irrigation has not been commenced in this area because the intake structure is not constructed yet though the greater part of main canal is already completed. Under the Fourth Five Year Plan announced in 1970, however, the Government plans to resume the construction work in this area on the basis of a revised plan which envisages the materialization of year-round irrigation. Since the estimate of water requirement was made on the basis of the actual results of experiments conducted at Hardinath Pilot Farm, completion of the revised plan will give birth to the first improved irrigation farming in this country only if the irrigation facilities are assured of smooth management, maintenance and operation.

3.1.6-2 Road

Roads in Janakpur Zone, especially those in the hilly area and Inner Tarai, are in an extremely poor condition as in other parts of Nepal. Though the roads in Tarai Plain are comparatively well developed when compared with those in the hilly area, they are hardly comparable to those in India and Pakistan.

During the wet season, the road condition becomes so bad that many villages are isolated even in Tarai Plain, allowing no passage of jeeps or even bullock carts, and people are forced carry goods on their back. The situation is no better in the dry season when the passage of buses and motorcars is virtually prohibitive except for arteiral roads. Hence, goods are transported by means of bullock carts.

This poor road condition impedes the shipment of agricultural products to the market even if satisfactory crop growing is assured by favourable climate, soil condition and topography and sufficient availability of irrigation water, and also hampers the smooth supply of fertilizers, agricultural chemicals and farming implements to the producing area. In areas subjected to such poor road condition, sound farm management cannot usually be attained. Hence, it is said that the key to the agricultural development in Nepal lies in the improvement of road condition.

Construction of the highway which runs east to west in the south of Tarai Plain has been in progress since several years ago under the Indian and Russian aid. According to its construction plan, the highway will be completed in 1972. Completion of this highway will make it possible to cover the distance between Kathmandu and Janakpur by less than a day's trip by motorcar.

Though the East-West Highway is about to be completed as mentioned above, there exist no roads that connect it with the Indian border in the south with a single exception of the so-called Mahendra Nagan Highway (Jaleswar-Dhalkewar) which links the Indian territory and East-West Highway by way of Janakpur.

The Tube Well Scheme Area planned by the Japanese Government under the existing cooperation programme is also devoid of roads which allow for free passage of trucks or even jeeps. For this reason, it is planned that the implementation of the scheme will be initiated in the area with better road condition.

3.2 . Infrastructural Improvement Scheme

3. 2. 1 Fundamental Approach

In working out the infrastructural improvement scheme for Tarai Plain in Janakpur Zone, due consideration should be given to the existing conditions given below to assure that the agricultural development in the plain will follow a gradual but steady course of progress.

1) It is naturally desirable that the infrastuctural improvement be planned for the wholesale introduction of irrigation farming throughout the plain by the construction of large scale irrigation facilities. However, since such an approach is not realistic in view of the present finacial capability of farmers and their aptitude to follow and digest the rapid technical development, the infrastructural improvement should be so planned that it will provide the basis for the future transfer from the existing farming pattern to irrigation farming.

2) From the said viewpoint, it is desirable to maintain the existing block-to-block continuous irrigation system rather than to hastily install tertiary facilities for water distribution to marginal fields far from the main canal and complicate the water management.

3) With respect to the water source, existence of a flowing well area is confirmed by the deep wells dug by farmers and by the test boring and pumping test conducted by FAO. Use of groundwater available in the said flowing well area will therefore be effective.

4) For the improvement of drainage facilities, it is to be noted that the drainage improvement in a single small area is liable to give a direct and adverse effect on the drainage condition in the neighbouring areas unless a drastic and all-out river training is effected.

5) Practically all fields are favourably conditioned for mechanized farming. However, an attempt to create highly efficient and mechanized farming conditions must be based on the drainage and road construction plans of the entire Tarai Plain, and this will incur a huge capital investment and at the same time is not economically justifiable.

6) There hardly exist roads capable of heavy traffic load.

In view of the above conditions, the following should constitute the basis of the infrastructural improvement plan for which capital investment is to be made in the immediate future.

1) Water source is to be secured by means of tube wells each planned to cover about 40 ha from the experience gained at Nardinath Pilot Form.

2) In the first phase of development, 20 tube wells are to be dug.

3) Since the delivery of the tube well drilling machinery to the scheme area is one of the important factors for materializing the tube well irrigation, the scheme area should be the area extending along Mahendra-Nagar Highway and East-West Highway where the sufficient availability of groundwater is expected and water demand is large.

3.2.2 Paddy Field Irrigation Scheme

3.2.2-1 Irrigation Area and Location

As a result of the present survey, the acreage and location of the irrigation area covered by Table 3.2-1 below have been determined.

Table 3.2-1 Tube Well Irrigation Area

Tract No.	Irrigation Area (ha)	Location	Remarks
No. 1	75.5	Kumraul	
No. 2	94.3	Ramdaiya	
No. 3	72.2	Saphi	
No. 4	60.8	"	

Remaining irrigation areas will be selected in consideration of the convenience of overland transportation of Tube well drilling machinery and water demand within the area where the availability of groundwater can be expected from the future survey.

3.2.2-2 Water Requirement

3.2.2-2.1 Effective Rainfall

The data recorded over the past two years at Hardinath Pilot Farm are the only rainfall data available in Janakpur Zone. Analysis of rainfall was therefore made using the rainfall data recorded at Sirha in the adjoining Sagarmatha Zone which is similar to Janakpur Zone in topography and elevation.

The rainfall data at Sirha cover a 19 year period from 1948 to 1966, but provide only monthly rainfall records.

Effective rainfall was determined in accordance with the method adopted in Japan for agricultural development. Since the levee height in Nepal is much larger than that in Japan, effective water consumption is considered to become likewise larger. The effective rainfall obtained by the said method may not therefore coincide with the actual effective value, but it is on the safe side as a design value. Further study is required in this respect.

Effective rainfall was determined as follows.

1) 80% of 5 to 80 mm of daily rainfall was taken as effective.

2) Daily effective rainfalls were summed up every five days and the rainfall not consumed was regarded ineffective. Since the rainfall data at Sirha do not include monthly rainfall records, the monthly ratio of gross rainfall to effective rainfall was calculated on the basis of the daily rainfall records in 1970 at Hardinath Pilot Farm. (See Table 3. 2. -2)

In determining the standard annual rainfall required for the calculation of the duty of water, the monthly rainfall ratio was calculated from the rainfall data for 19 years, and a recurrenc interval of five years was assumed for droughty year as a safety factor on the basis of the probability calculation of annual rainfall. The standard annual rainfall thus determined is 1, 150 mm which is approximately equivalent to the rainfall recorded during 1963. (See Table 3. 2-3)

3. 2. 2-2. 2 Unit Duty of Water

Unit duty of water at Hardinath Pilot Farm will be adopted. (See Fig. 3. 2-1 (A), (B) and Table 3. 2-4, 3. 2-5, 3.2-6)

Canal loss is assumed to be 20%.

3. 2. 2-2. 3 Canal Section

1) Q = 0. 0579 m^3/s in case of daily flow rate of 5, 000 m^3, and

2) Q = 0. 0289 m^3/s in case of daily flow rate of 2, 500 m^3, provided, however, that the canal gradient is 1/300.

Table 3. 2-2 Effective Rainfall Ratio

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Rainfall	11. 6	19. 0	20. 0	38. 5	65. 8	295. 5	607. 4	329. 8	202. 7	46. 2	0	0	
Effective Rainfall	0	0	0	27. 5 70. 6%	48. 4 73. 5	130. 0 43. 9	169. 0 27. 8	88. 5 26. 8	131. 3 64. 7	33. 1 71. 5	0	0	
Modified				70	70	40	25	25	65	70			

Table 3. 2-3 Standard Montly Rainfall

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1948 - 1966	436. 9	181. 6	275. 8	421. 5	1, 814. 0	3,834.3	6,605.5	6,615.9	3,394.3	1,365.1	281. 0	28. 9	25, 340.5
Ratio	1. 7	0. 7	1. 1	1. 7	6. 9	15.8	26.0	26. 1	13. 4	5. 4	1. 1	0. 1	100. 0
Standard Rainfall	1. 9	9	1. 3	20	78	182	299	300	154	62	13	1	1,150.0
Effective Rainfall	0	0	0	14	55	73	78	75	100	43	0	0	

Note: Calculation based on the rainfall data at sirko

Table 3. 2-4 Monthly Net Duty of Water for Local Variety

	Jan.	Jul.	Aug.	Sep.	Oct.
Evapo-transpiration	5. 6	5. 8	5. 8	6. 4	4. 9
Percolation	4. 7	2. 7	2. 0	3. 3	4. 1
Et + P	10. 3	8. 5	7. 8	9. 7	9. 0
Monthly total	309	264	242	291	279
Rainfall	182	299	300	154	62
Effective Rainfall	73	78	75	100	43
Net Duty of Water	236	186	167	191	236

Table 3. 2-5 Monthly Net Duty of Water for Improved Variety

	Apr.	May	Jun.	Jul.
Evapo-transpiration	8. 0	9. 7	7. 3	7. 0
Percolation	5. 3	4. 7	4. 7	2. 7
Et + P	13. 3	14. 4	12. 0	9. 7
Monthly Total	399	446	360	146
Rainfall	20	78	182	299
Effective Rainfall	14	55	73	78
Net Duty of Water	385	391	287	68

Table 3. 2-6 Duty of Water for Four Irrigation Areas

	Area	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
				189	149	134	153	189
		77	78	57	14			
		77	78	246	163	134	153	189
		92	94	295	196	161	184	227
Gross Duty of Water	1 ha	0. 000355	0. 000337	0. 00114	0. 00073	0. 00060	0. 00071	0. 00088
No. 1	75. 5			0. 086 (7. 430m³/d)				
2	94. 3			0. 108 (9. 330)				
3	72. 2			0. 082 (7. 085)				
4	60. 8			0. 069 (5. 962)				

Canal Section 5, 000 m^3/day ÷ 86, 400 sec = 0. 058 m^3/sec

FIG. 3. 2 - 1 (A) Duty of Water For Local Variety

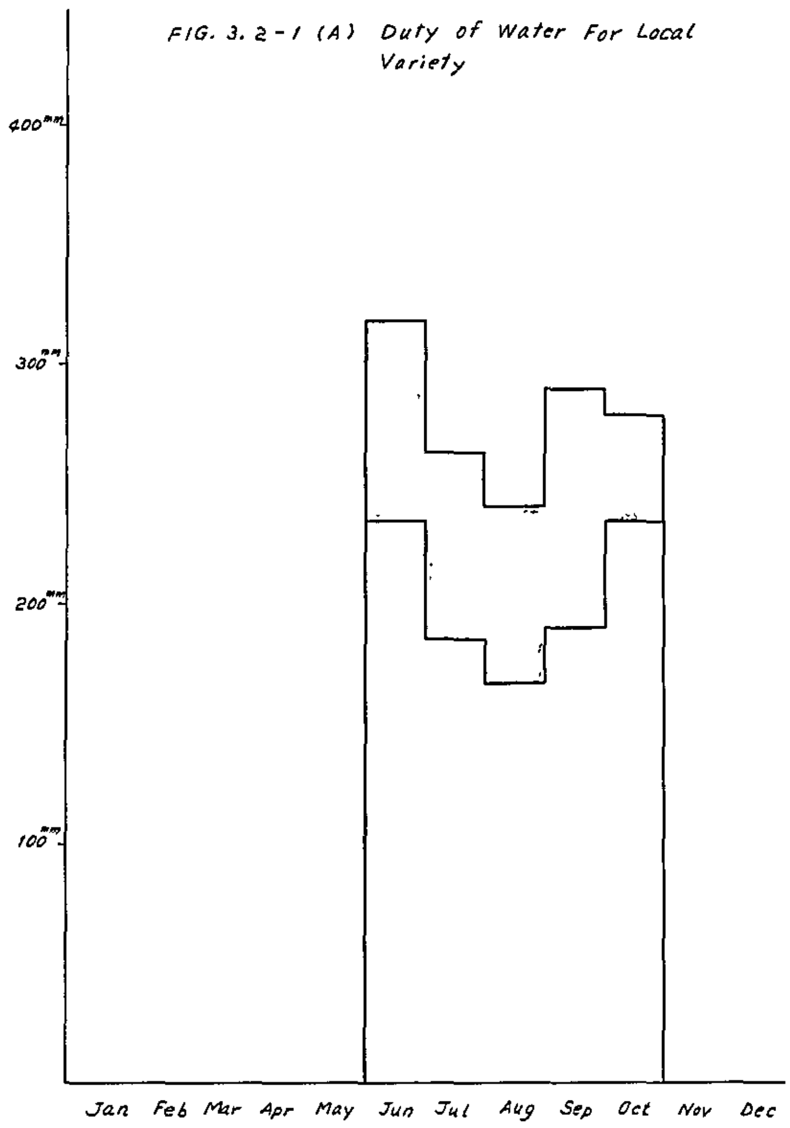
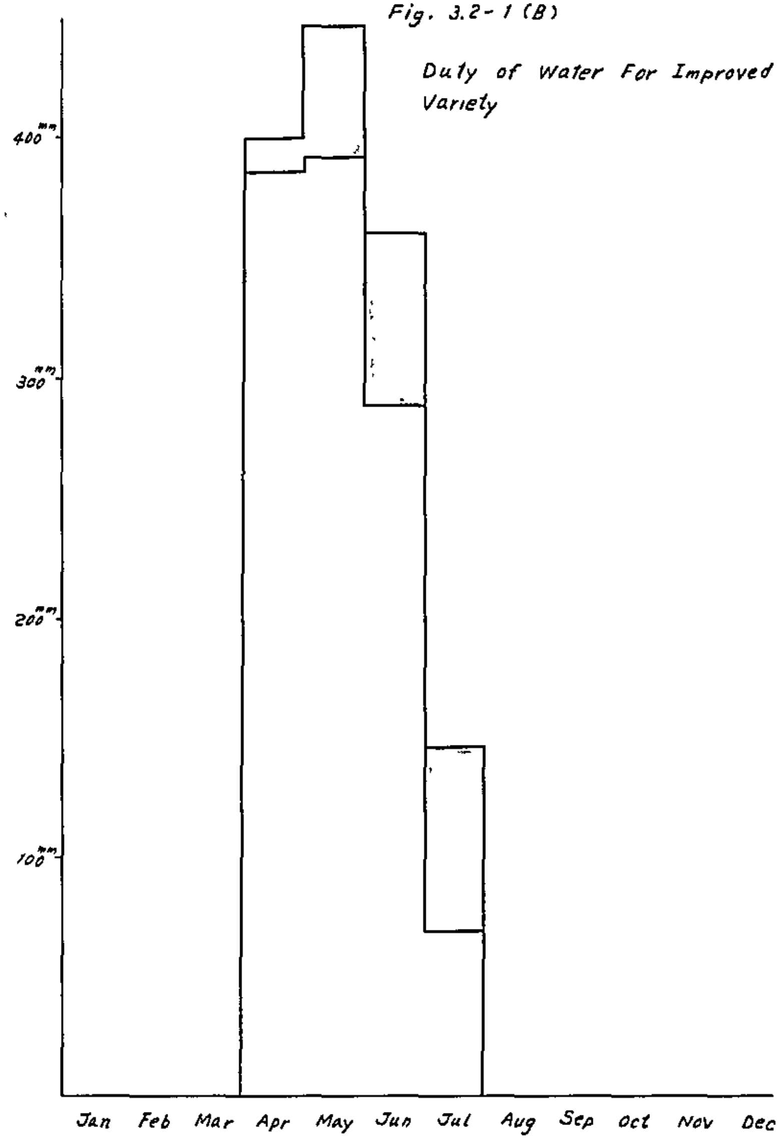


Fig. 3.2- 1 (B)

Duty of Water For Improved Variety



3.2.3 Water Source Plan

It has already been described that it is effective to seek the water source of the zone in the flowing well area. This conclusion was reached as a result of the test boring conducted under Sun Kosi Tarai Irrigation Development Project of FAO. The groundwater condition in the zone as obtained from the data of the said test boring and from hydrogeologists is briefed below.

1) The groundwater in Jankpur Zone derives mostly from the underground flow south of Churia Hill. Its volume is therefore subject to seasonal functuation, and increases in the rainy season and decreases in the dry season.

2) The flowing well area where groundwater can be obtained by digging wells to a depth of 120 to 150 m beneath the ground surface is shown in Fig. 3.1-6. A tube well with a diameter of 8" promises a daily yield of about 2,500 m^3 in this area. At Hardinath Pilot Farm, a lot of sand is included in the flowing water and its removal will be the problem to be solved in future.

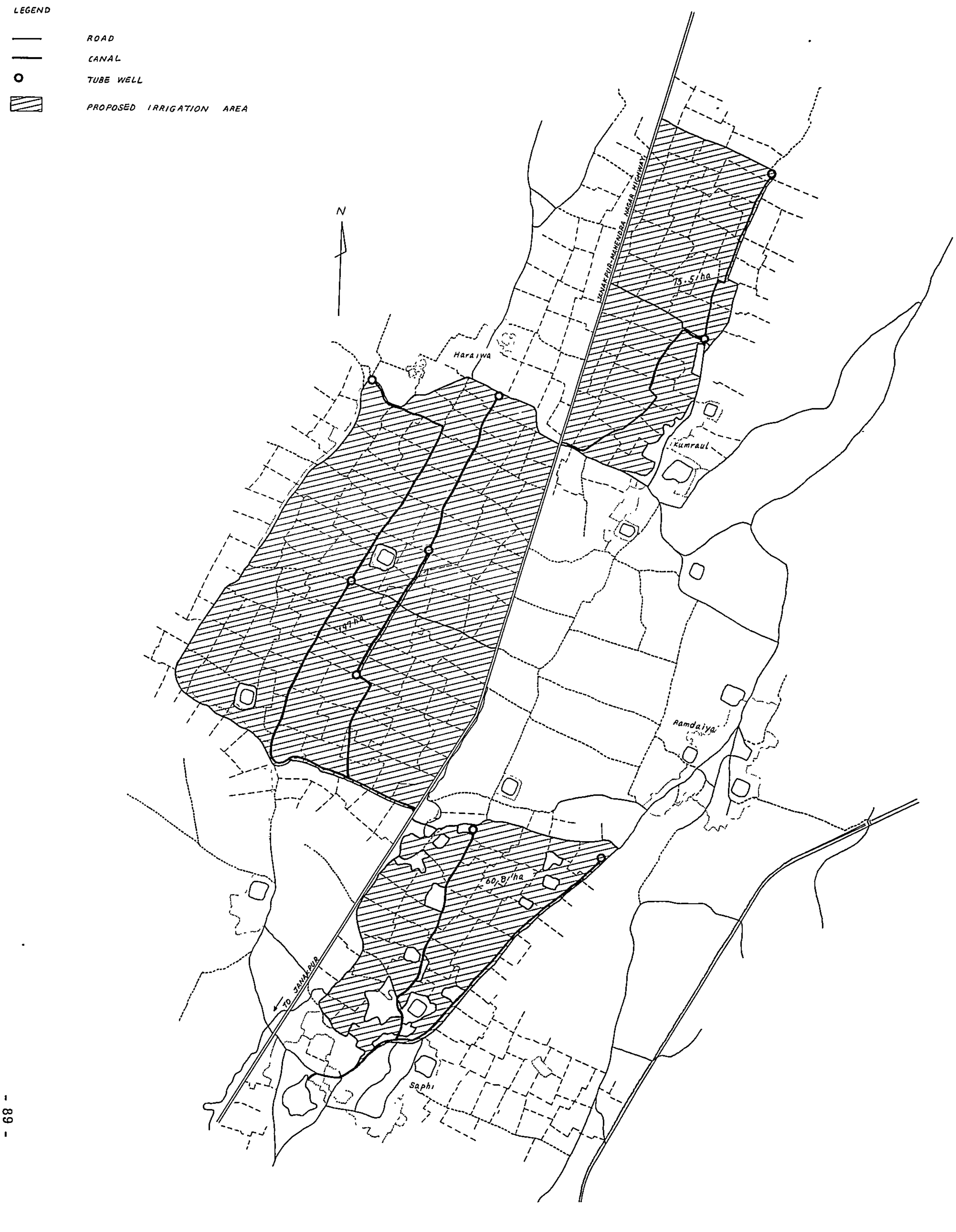
3) Availability of flowing water cannot be expected in the hill side area because of the expected prevalence of terrace.

4) Test boring conducted in Jaleswar near the Indian territory did not indicate the existence of flowing well area. It is expected, however, that the area near Jaleswar will provide a great deal of flowing water if wells are dug to a larger depth. Boring survey should therefore be continued in this area. If the well depth must exceed 200 m to obtain sufficient flowing water, however, studies should be made on the economic justifiability.

5) Availability of flowing water is not promising in the area extending eastwards from Mahendra Nagar Highway to the Kamla, though the area is geologically composed of the shallow alluvial fan of the Kamla that overlies the older alluvium.

6) Not much flowing water can be expected in the Bagmati basin either because of the coagulation of the sandy gravel layer which would otherwise be aquiferous. In this area, it will be more advantageous to resort

FIG. 3.2-2 LOCATION MAP OF TUBE WELL SCHEME AREA (FIRST STAGE)



to the abundant surface water source of the Bagmati which maintains a large run-off thrpughout the year.

In view of the above conditions, the water source plan resorting to the flowing groundwater will have to be as follows.

1) Groundwater source is to be sought in the area delineated in Fig. 3. 2-2

2) The per day yield of groundwater is to be assumed at 2, 500 m^3.

3) A pump is to be installed at one of each two tube wells to provide sufficient water required for the Farming Plan. The yield of pumped groundwater will be 5, 000 m^3/day.

3. 2. 4 Outline of Construction Plan

3. 2. 4-1 Tube Wells and Appurtenant Facilities

1) Tube Well

Tube wells having a diameter of 40 cm on top and 25 cm on bottom and a depth ranging from 120 to 150 cm will be provided to secure the water source. It is planned that the wells, each of which is to cover an area of about 40 ha, will be linked with each other by means of canals to be arranged in accordance with the topography of the irrigation area. Therefore, a belted turbine pump will be installed on the tube well to be dug at the upstream end of the canal route.

2) Canal

Canals will have two sections, i. e., 58 l/s and 29 l/s. There will be provided one canal flowing through the higher part of the irrigation area, and a notched outfall will be furnished for each field.

3. 2. 4 Outline of Drilling Work

The tube well drilling work will be carried out as briefed below.

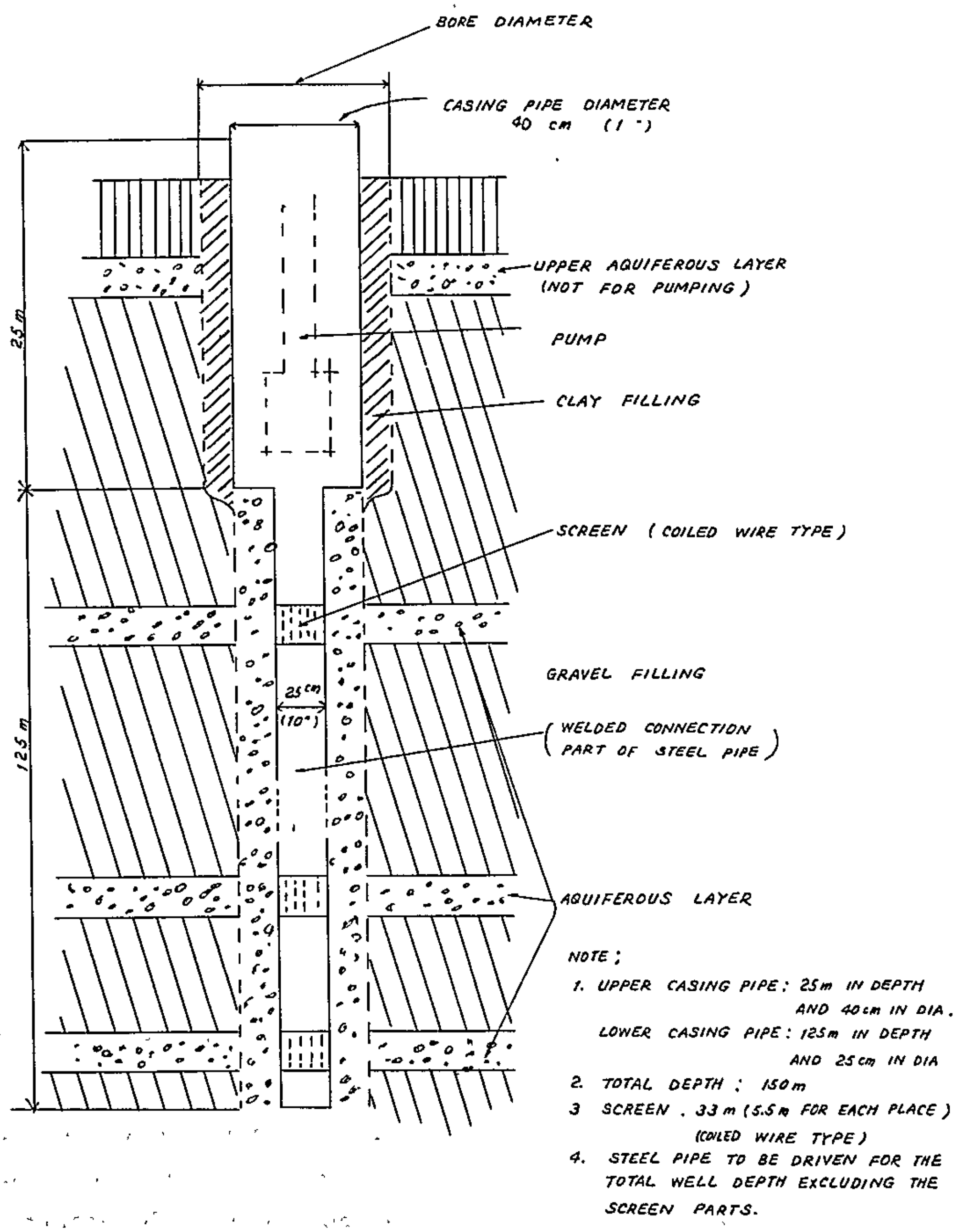
(1) 20 tube wells having a depth of 150 m will be dug with a casing pipe of 25" diameter installed to a depth of 25 m from the ground surface, which is to be connected to another pipe of 10" diameter extending further downwards, with a screen provided at a suitable position. The position of the screen will be determined by means of electrical logging.

(2) Installation of the casing pipe and screen will be immediately followed by the gravel filling work. A pumping test will be carried out when mud has been excavated and a series of finish work completed. The pumping

test involving the continuous as well as intermittent pumping operation will be followed by the observation and recording of the static water level, drawdown, water temperature and water quality.

Tube wells will be dug as illustrated in Fig. 3. 2-2.

FIG. 3. 2-3 PROFILE OF TUBE WELL



3.2.5 Volume of Work

Tube well	20 points
Pump	10 points
Canal	8,000 m

Fig. 3.2-1 shows the layout of the tube wells, canals and irrigation area proposed under the original tibe well irrigation scheme.

3.2.6 Benefits

The Tube Well Irrigation Scheme Area is a strip of land extending east to west about 20 km to the north of Janakpur City. Since the area has a relatively favourable topography and land fertility, substantial production increase can be expected if the irrigation is carried out and advanced farming techniques are introduced.

As stated in Section 3.3, "Farming Plan," double cropping of paddy will be conducted in part of the area, with succeeding crops planned to include wheat, puleses and mustard. Also, stock farming centering on smaller cattle will be concurrently carried out.

The annual gross income of farm households in the Tubs Well Scheme Area, as calculated on the basis of the cropping pattern described in Section 3.3, will be as tabulated below. In this trial calculation, the operational holding was assumed to be the current average holding of 1.7 ha.

Table 3.2-7 Annual Gross Income of Farm Household (with 1.7 ha of operational holding)

Crop	Planted Area (ha)	Unit Yield (ton/ha)	Gross Yield (ton)	Unit Selling Price (Rs/ton)	Gross Income (Rs)
1st Paddy (in unhulled rice)	0.3	4.0	1.2	920	1,104
2nd Paddy (in unhulled rice)	1.4	3.5	4.9	870	4,263
Wheat	0.6	3.0	1.8	1,000	1,800
Pulses	0.5	1.1	0.55	1,100	605
Mustard	0.2	0.5	0.3	1,600	480
Subtotal					8,252

Livestock	Q'ty	Unit Price (Rs)	Gross Income (Re)
Poultry	35	16	560
Eggs	1,600	0.75	1,200
Goat	4	50	200
Subtotal			1,960
GRAND TOTAL			10,212

3.3 Farming Plan

3. 3. 1 Zonal Development and Farming Plan

The topographical features of the six districts into which Janakpur Zone is administratively divided are as given in the following table.

District	Topographical Features	Topographical Division
Dhanukha Mahothari Sarlahi	Flat land extension of the Indian Plain having an elevation of 70 to 200 m.	Tarai Plain
Sindhuli	Central basin with an elevation of 1, 000 to 2, 000 m	Inner Tarai
Ramechhap Dolakha	Mountainous district with an elevation exceeding 2, 000 m.	Hilly Area

Planted area and production of major crops in the six districts are, as is clear from Table 3. 3-1, obviously subjected to the effects of climatic and topographical conditions.

The present survey covered mostly Tarai Plain which produces paddy as its major crop and is regarded as the granary of Nepal. The plain is the extension of Ganges Plain and can be divided into two areas,

Table 3. 3-1 Area and Production of Different Crops in Janakpur Zone (1968 - 1969)

Main	Dolakha		Ramechhap		Sendhuligadh		Sarlahi		Mahotari		Danusha	
Crops	Area	Pro.	Area	Pro.	Area	Pro.	Area	Pro.	Area	Brea.	Area	Pro.
Paddy	1700	4335	3000	7700	11000	26675	50000	97500	45000	99000	65000	143000
Maize	3900	8073	8200	16974	7300	14600	8200	13500	5000	8250	6800	11220
Wheat	375	506	650	877	100	110	2415	2535	2120	2120	3610	3975
Barley	135	152	75	84	50	50	250	212	235	191	325	276
Millets	850	1020	1950	2340	1625	1788	1050	945	1000	945	1300	1170
Potato	850	4994	750	4406	550	3300	275	2585	275	2585	300	3000
Oilseed	200	90	225	113	4000	2400	2700	1418	400	700	2400	1200
Sugarcane	5	75	10	150	80	1200	75	1125	60	900	40	600
Tobacco	7	4	7	4	50	55	270	216	2350	1880	2150	1720

Note: Area in hectar, production in M. T.

the one closer to the Indian territory which was developed by migrants from India and is similar to India in both racial composition and customs, and the other where the inhabitants of mountainous district settled and developed the jungle area. The former is a paddy field area while the latter forms an upland field area.

Since Janakpur Zone is thus divided into the paddy field area and the upland field area (for production of cash crops and vegetables), exchange of agricultural products between the two areas should be realized. In other words, agricultural development in the zone should be based on the principle of "right crops for right land."

In promoting the farm management improvement in the zone, however, hasty measures disregarding the exiting natural and socio-economic conditions should not be taken. Physical infrastructure, cultural practices, yield level and labour-saving means in the zone are the outcome of many years of efforts to attain harmony with and adapt to nature. In Chapter II. a fundamental approach is given for finding a break through in the existing harmony and charting a course of agricultural modernization in future. In this section, therefore, an attempt will be made to clarify problems entailed in the extension of improved farming techniqiues among farmers with consideration given to the current state of farm management, and to propose measures to be taken for farm management improvement.

3.3.2 Problems Involved in the Existing Farm Management

The condition of farm management is manifested in the cropping pattern, and its outline can be obtained from the cropping sequence and cultivation practices.

The survey on farm management in Janakpur Zone covered only a limited part of Tarai Plain. Area covered by the survey, however, can be topographically divided into the following three areas.

1) Paddy field area with irrigation water.
2) Paddy field area without sufficient irrigation water.
3) Upland field area where the availability of irrigation water cannot be expected at present.

Since area 2) above can be converted to area 1) through installation of tube wells and other promotive measures, it is assumed that the farm management in the survey area can be divided into two types, one centering on paddy cultivation and the other depending mostly on upland field cultivation.

3. 3. 2-1 Cropping Pattern

Fig. 3. 3-1 shows the cropping periods of major crops from seeding to reaping.

The first cropping includes a range of crops from the early planting paddy (Aus) to red pepper. The first three crops shown in the column of first cropping in the figure are all paddies and the other four are upland crops. The second cropping includes many crops such as wheat, mustard, pulses, potato, sweet potate, tobacco and vegetables.

From Fig. 3. 3-1 the general cropping pattern in these area may be imagined, but the survey revealed that the following pattern generally prevails in the surveyed area.

(1) Paddy field area

Paddy (Aus) → wheat (or mustard).

Paddy (Dhan) → wheat (or khesary).

Paddy (Dhan) → none.

The following pattern was also observed in the inner fields.

Paddy (Aus) → vegetables (potato, onion, rocamblole, radish and rape) → nursery bed for paddy.

(2) Upland field area

Maize → mustard (or wheat, pulses).

Upland paddy (Aus) → mustard (or pulses).

Upland paddy (Aus) → tobacco.

Maize → tobacco.

Sugarcane

In addition to above, patterns including vegetables were noted in the inner fields.

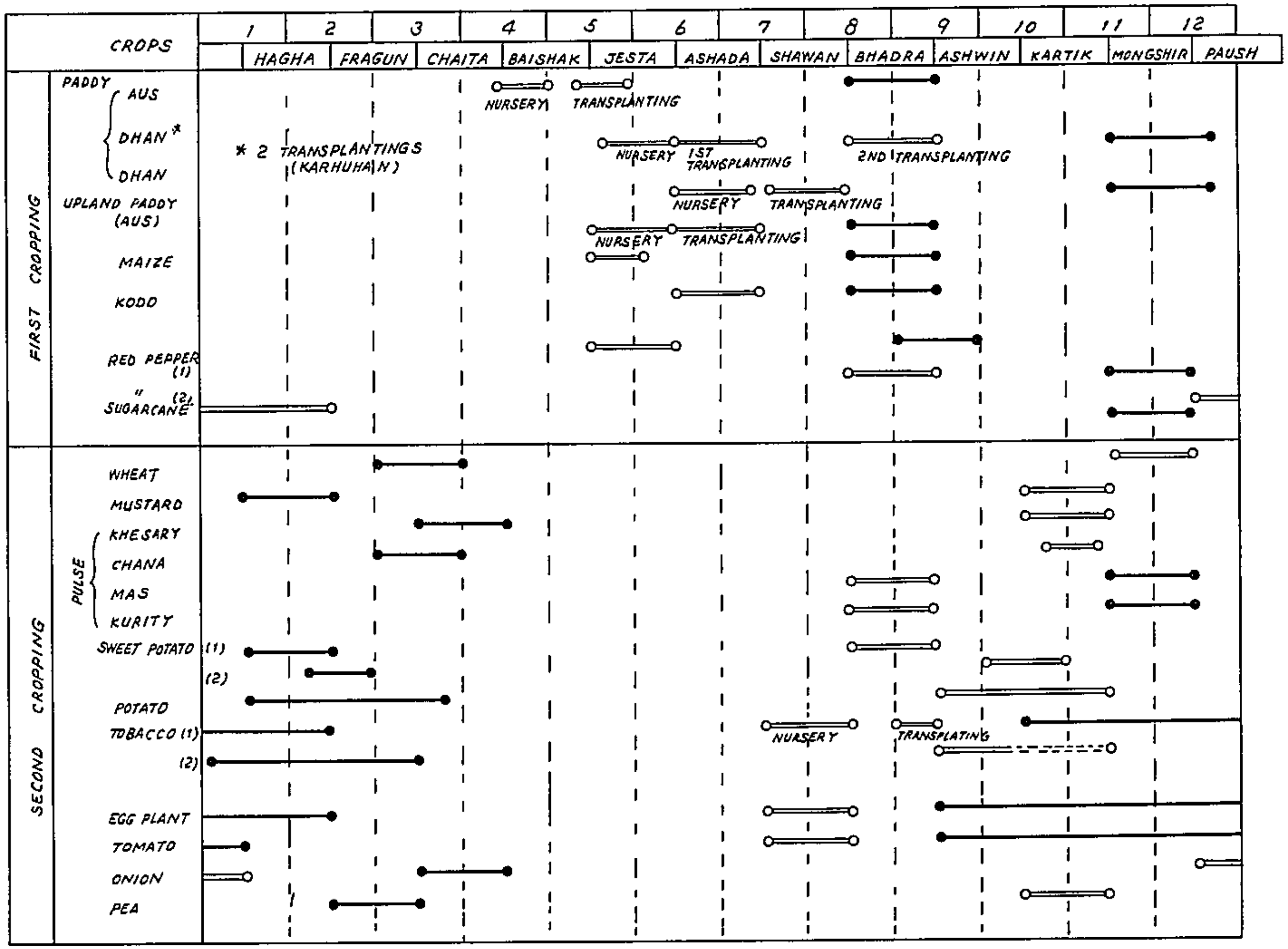


FIG 33-1 CROPPING (GROWTH) PERIOD OF MAJOR CROPS (PREPARED BY HEARING)

The cropping patterns given above are invariably subjected to the constraints of climatic and soil conditions and are most heavily affected by the availability of water.

The survey area is favoured with an annual average temperature of as high as 24°C. In April when rainfall is small, however, cultivation of crops is impossible despite the high air temperature.

All crops require a seeding period of more than one month. This indicates that the advent of the wet season and the moisture content of soil vary by year. It may also be said that the high air temperature allows the seeding to be conducted over a long period.

Wheat is grown in more or less sandy fields with a relatively large soil moisture, and pulses in fields with a larger soil moisture than is required for wheat. Mustard is cultivated in dry fields.

It can be said in conclusion that (1) the cultivation of the main crop, paddy (or maize in upland area), is controlled by when the wet season begins and how much rainfall it brings about, (2) winter crops are restricted by the soil moisture and water-holding capacity of land and can be cultivated only in limited areas, and (3) measures for increasing the soil productivity through optimum cropping pattern is not taken, and supply of nutrients depends mostly on irrigation water.

3.3.2-2 Yield Level

Yield of major crops obtained through interviewing is shown in Table 3.3-2.

Table 3.3-2 Yield Level of Major Crops
(obtained through interviewing)

Crop	Conditions for Cultivation	Yield (kg/10 a)	Remarks (Figures in this column indicate average yield kg per 10 a in Japan)
Paddy:			
Aus	Rain-fed farming	66	
	Irrigation farming	160	
	Irrigation farming coupled by fertilization	210	

	Irrigation farming + fertilizer application + improved variety	550	Improved variety: IR-8
Dhan	Rain-fed farming in sandy soil with little rainfall	0	Paddy 435
	Rain-fed farming in lowland fields with little rainfall	60	
	Rain-fed farming with suitable rainfall	160	
	Irrigation farming	160	
	Irrigation farming + fertilizer application	210	
Upland paddy	Rain-fed farming	0 - 100	Upland paddy 203
Maize		110	285
Red pepper		54	
Sugarcane		3,000	8,700
Wheat	Conventional farming (local variety and no fertilizer application)	27 - 55	265
	Fertilizer application	55 - 60	
	Fertilizer application + improved variety	210	
	Fertilizer application + improved variety + irrigation	300 - 400	Variety: Mexican variety
Mustard		70	Rape 180
Khesary		60	Soybean 130
Mas		80	
Kurity		55	
Sweet potato		1,100	1,860
Potato		900	4,013
Tobacco		1,400 (raw)	193 (dried)

Egg plant	400	715
Tomato	500	850
Onion	100	193

From the above table, it cannot be denied that the yield of most crops is rather low, but it is also clear that the irrigation farming of improved varieties aided by the application of chemical fertilizers produces a yield higher than the average value recorded in Japan.

The generally low yield level noted in the above table is ascribable to the undeveloped cultural practice and the virtual negligence of selection of proper varieties, fertilization, spraying of agricultural chemicals and control of diseases and pests.

3. 3. 2-3 Labour-saving Means

Labour-saving means are poor for the size of operational holding, and carts and plows are the only animal driven farm equipment.

Table 3. 3-3 Farming Equipment and Implements Owned by Farmers

Pump set	Cart	Plow	Harrow	Kodal	Sickle	Khurpee	Spryver	Well	Operational Holding
1	2	5	1	2	2	2	1	3	22 ha
-	1	1	1	1	3	3	-	-	4.7 ha

Bullocks are generally used for labour-saving purpose on the field, and an even number of them are kept by farmers depending on the number of plows they posses. Farmers do not always possess cows and loan them out on certain occasions, whereas buffaloes are kept by practically all farmers to obtain milk, and goats are kept by some farmers to substitute for buffaloes. Stock breeding is conducted in an extremely rough way with no stock hourse provided, and the grass of the common pasture land is not satisfactory either.

Table 3. 3-4 below shows the working hours obtained through interviewing for paddy, wheat and khesary.

Table 3. 3-4 Working Hours for Major Crops
(Obtained through interviewing)

Crop	Kind of Work	Working Hours (man/h/bigha)	(man/h/ha)	Remarks
Paddy	Plowing, harrowing and soil preparation	212	311	3 - 4 times from late December to transplanting, 2 times immediately before transplanting, once after submerging, and once for puddling, totalling 8 times.
	Levee building	32	47	
	Pulling of rice seedlings and transplanting	320	472	
	Weeding	160	236	
	Reaping and transportation	120	177	
	Threshing	48	71	A set of 8 bullocks and 2 farmhands is usually required.
	Total	892	1, 314	Working hours needed in the nursery and water management should be added to the total working hours given on the left.

Wheat	Plowing, harrowing and soil preparation	110	162	
	Seeding	20	29	
	Reaping and transportation	46	68	
	Threshing	96	141	A set of 8 bullocks and 2 farmhands is generally required.
	Total	272	400	
Khesary	Seeding	8	12	
	Reaping and transportation	64	94	
	Threshing	20	29	A set of 8 bullocks and 2 farmhands is generally required.
	Total	92	135	

Note: Working hours in the nursery bed of paddy was not obtained through interviewing

The Mission noted with interest that the plowing, harrowing and soil preparation are repeated six to eight times during the five to six months period from late December to the transplanting in the following year. This repeated field work is needed becuase of the nature of soil in the survey area which is loamy, silty loamy or silty clay loamy and demands plowing work before it becomes dry and coagulated. The plowing work, however, is very inefficient and can cover only 10 acres by four hour work with two bullocks (8:00 to 12:00 a. m.), which may perhaps be attributed to the poor physique of bullocks and the small width of plows. Since the plowing depth is shallow and the harrowing efficiency is poor, farmers are obliged to repeat the field work many times.

Though the pulling of rice seedlings from the nursery bed and transplanting them in the fields constitute the major protion of the farming work load, transportation also demands a considerably heavy labour due to the poor condition of farm roads. Wheat cultivation also requires many working hours for plowing and soil preparation, but khesary dispenses with such farming labour since it is sown during the standing paddy.

The Mission learned that substantial labour is given for paddy cultivation with occasional weeding and control of stem boreres, but no such labour is spent for second cropping in which the sowing work is the only appreciable labour and no further care is provided.

3.3.2-4 Farming Techniques

1) Paddy

Early Planting Paddy (Aus):

Farmers are well aware that they ought to sow rice-seeds before the advent of the rainy season, but they often wait until rain starts falling. Water control of nursery beds is also affected by rainfall against the will of farmers who know that water should be drained gradually after germination and filled just before transplanting. Farmers are eager to introduce improved varieties that can reaped from mid-August to mid-September after about three months of growing period in the field.

It appears that the increased planting of Aus cannot be expected, even if irrigation water becomes sufficiently available. This is because the rainfall during the harvesting season impedes reaping, transporting, drying and winnowing work, and also because such work load cannot be fully satisfied due to the farm labour required for the late planting paddy (Dhan Karhuhan). The hot wind blowing in the ripening period (mid-July to mid-August) accelerates the occurrence of bacterial leaf blight and white head to hamper the ripening and make the crop condition unstable.

Late Planting Paddy (Dhan):

Sowing time and nursery period are influsenced by climate just as in Aus cultivation. Second transplanting (Karhuhan) is conducted if the poor growth in the nursery bed invites a deficiency of seedlings to be transplanted or if the transplanting labour is desired to be saved to cover the work load needed for the harvesting of Aus. However, since transplanting is the heaviest of all farm labours, there is a limit to the area that can be covered by the second transplanting. It is believed that as the availability of water increases with the progress of irrigation plan, the second transplanting (Karhuhan) will be practised on a gradually decreasing scale.

A characteristic of the late planting paddy with respect to its growth is that its ripening after heading proceeds with the shifting of the rainy season to the dry season. Hence, its ripening process matches approximately with the decline of soil moisture, producing completely dry grains in the harvesting season. For this advantageous characteristic, it is considered that Dhan will hold the place over other paddy in future.

Advanced farmers know that additional application of nitrogen fertilizer at booting stage is effective for local variety and have proved its effect by the actual practice of such after-manuring.

It appears that too many local varieties are cultivated for both Aus and Dhan. The practice of zigzag planting is noted to be retarding the care of fields, and practically no measures are taken for fertilization, weeding and control of diseases and pests. Fertilizer input is far smaller than in Japan, and irrigation water is resorted to for the supply of necessary soil nutrients.

2) Wheat

Wheat cultivation is limited to those areas where the soil maintains sufficient moisture even in the dry season. Farmers know by experience that they should select sandy soils with good water permeability rather than clayey soils with poor drainage capacity even if such soils are provided with ample irrigation water.

Selection of wheat varieties is carried out systematically under the American aid by introducing Mexican varieties. Sonora 64 and S-227 (Kalyan Sona) introduced by such selection are producing a large yield by the proper choice of sowing time and rational fertillizer application. (See Fig. 3.3-2)

3) Khesary

Pulses including khesary are the important source of protein and oil

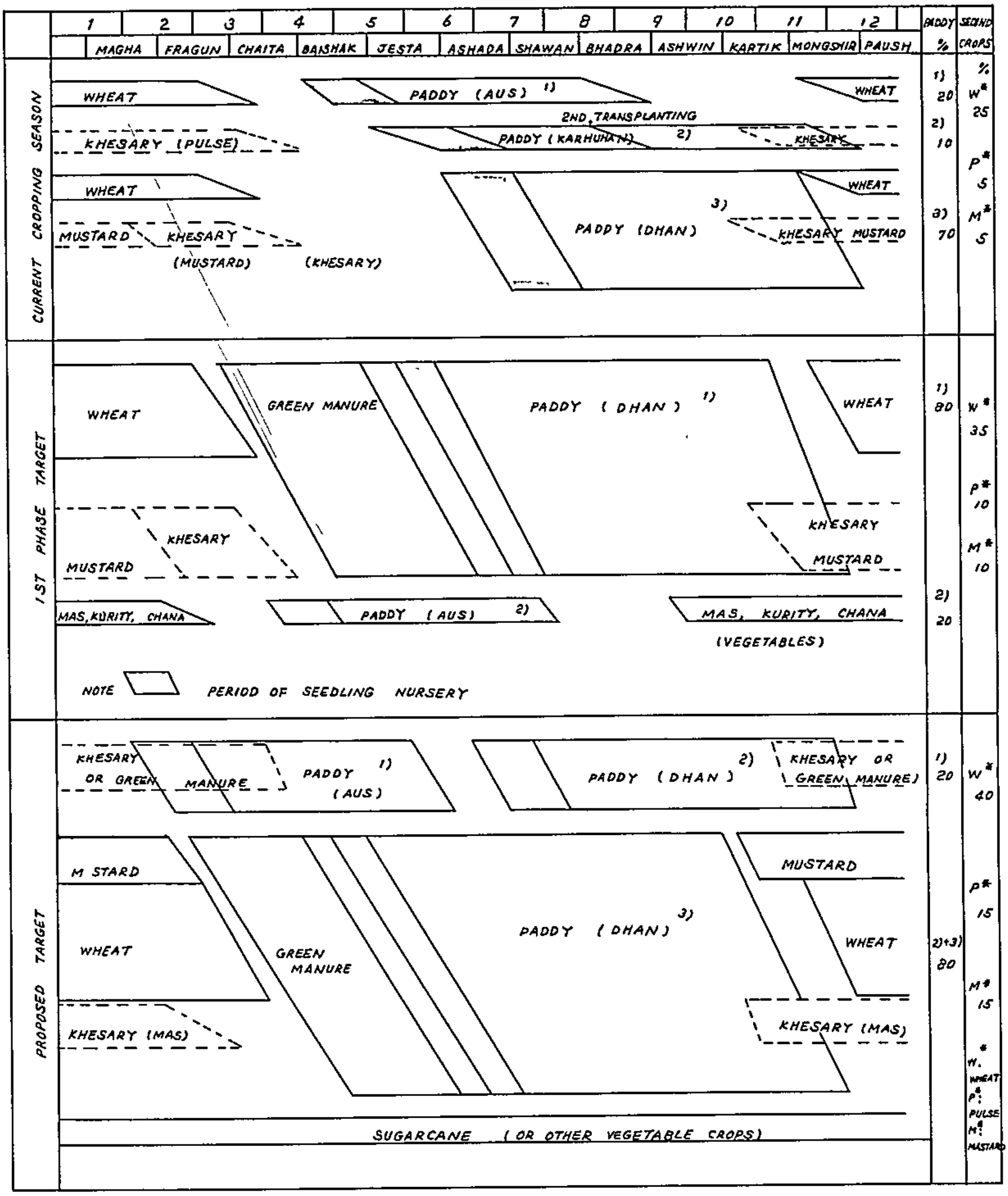


FIG 3.3-2 GRADUAL IMPROVEMENT OF CROPPING PATTERN IN AREAS CENTERING ON IRRIGATION FARMING

in Nepal and also serve for the maintenance of soil productivity. Diversity of their varieties, however, should be brought to a solution.

4) Other Crops

Uniformity of variety should be materialized for maize, upland paddy, mustard, sweet potato and potato.

3.3.2-5 Physical Infrastructure

Though agriculture is essentially supported by the supply of water, current techniques of controlling water is rather poor in Nepal. The Mission noted that water channels are often indistinguishable from roads, and the utilization of reservoir water is not satisfactory. The high levee height of 50 to 60 cm, which the Mission learned was inevitable for storing rain water, is impeding various works.

Farm roads and public ways are both reduced to a poor condition by the passage of bullock carts.

A problem which deserves attention for the maintenance of soil productivity is that the animal manure is mostly used as fuel and not supplied to soil. No attention is given to wind and water erosion, resulting in the aggravated decline of soil productivity in the upland field area.

3.3.2-6 Summary

In the foregoing pages, problems relating to the current cropping pattern, yield level, labour-saving means, farming techniques and infrastructure have been pointed out on the basis of the survey conducted in a number of villages situated along Mahendra Nagar Highway in Danukha District of Janakpur Zone. To summarize these problems, agriculture in the surveyed area is forced to adapt itself to natural conditions including the constraint in water utilization invited by the uneven distribution of rainfall and seasonal change in soil moisture. Poor level of labour-saving means and farming techniques can be also cited as one of the constraints. However, these problems indicate that efforts for technical improvement will augment the yield and eventually make it possible to control and utilize the natural environments.

3.3.3 Farm Management Improvement Plan

Solution of the problems presented in Section 3.3.2 are the object of farm management improvement. As already stated, farm management shows itself in the cropping pattern. In this section, therefore, cropping pattern will be described for the two types of farm management in the survey area, i.e., paddy field cultivation and upland field cultivation, and further, techniques for improving the yield level, improvement and introduction of farming implements and equipment, and rational utilization of domestic animals will be discussed with account taken of the gradual improvement of the existing cropping pattern.

3.3.3-1 Cropping Pattern

1) Paddy Field Cultivation

The average daily temparature exceeds 10°C throughout the year in Tarai Plain of Janakpur Zone, and its accumulated temperature is about 8,600°C for a year. But at Kōnosu, Saitama Prefecture where a Japanese agricultural experiment station is located, the average daily temperature over 10°C is observed only for seven months and the total accumulated temperature for this duration is about 4,500°C.

Therefore, rice seedlings can be raised from as early as January so long as the nursery bed is kept warm enough, and double cropping of rice is also feasible. In other words, it must be possible to cultivate some crops throughout the year only if the impediments caused by the deficient control of water are removed. Hence, it is imperative to establish irrigation farming by tube wells in the flowing well area.

Fig. 3.3-2 shows the first phase target and desired target proposed to to attained in the improvement of corpping pattern. Though clear in this figure, the Mission wishes to point out that the problems entailed in the current cropping pattern are that 1) there are three cropping seasons (Aus, Dhan (Karhuhan) and Dhan), 2) cropping period is generally long and cannot be commenced before the advent of the rainy season, and 3)both seeding time and transplanting time are affected by the availability of irrigation water in all cropping seasons. Conversely speaking, however, these problems can be construed as an outcome of farmer's wisdom to cope with the irregular rainfall, unstable availability of water and low level of labour-saving means. They may also be taken as means to escape from the concentration of damages due to hot wind, rain and diseases and pests.

When the restriction on the availability of irrigation water is lifted by tube wells, the seeding can be carried out earlier than at present as proposed in the first phase target in Fig. 3.3-2. However, considering the fact that the rainfall during the four month period from June to September occupies 80% of the total annual rainfall, tube wells must be considered to play a supplementary role in irrigation. Construction of tube wells will make it possible to plant the seeds of both Aus and Dhan about one month earlier than at present, discontinue Karhuhan, and increase the planting area of second crops to some extent. In this stage of improvement, the primary objective is to stabilize the seeding time and increase the yield of individual crops such as Aus, Dhan, wheat, mustard, and khesary. Detailed description will be given later for such seeding time stabilization and production increase.

The desired target shown in Fig. 3.3-2 is the level of improvement hoped to be attained in the near future, and aims at partial materialization of double cropping (a year) of paddy (20% of paddy field area), extension of the seeding period of Dhan (including the advancing of its seeding time), and expansion of Dhan cropping area (about 70% of paddy field area).

To sum up, construction of tube wells will assure supplementary supply of water needed for irrigation farming and make it possible to plan (and advance) the seeding time and improve the yield level.

(2) Upland Field Cultiuation

Improvement target of cropping pattern cannot be given for upland fields because of the diversity of upland crops and deficient surveys made in the past. Since no irrigation improvement can be expected for upland fields, efforts should be made primarily for augmented cultivation of cash crops with consideration given to the maintenance and improvement of soil productivity.

The dominant cropping pattern in the outer field will be maize ⟶

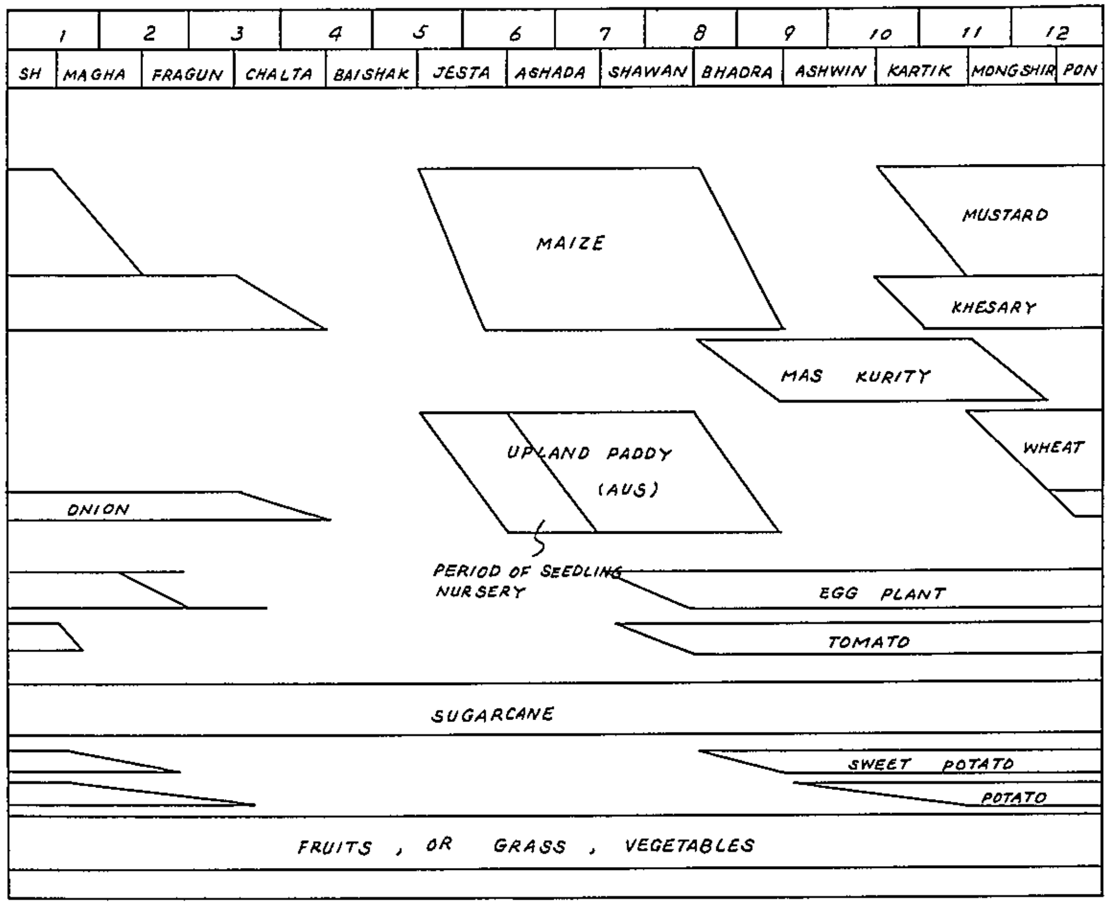


FIG. 3.3 - 3 CROPPING PATTERN IN UPLAND FIELD REA.

mustard, and upland paddy (Aus) $\longrightarrow$ mustard (or pulses and buckwheat). For the maintenance of soil productivity of outer field, introduction of legumes will be required. Also, since the input of staple manure is important for prevention of fertilizer leaching, cultivation of its materials such as paddy, wheat and millet should not be negected.

In the inner field, cash crops such as egg plant, tomato, onion, potato, pea, tobacco will be cultivated with increased input of fertilizers. Order of cultivation of these cash crops should be so planned that crops of the same family are cultivated at as long intervals as possible with attention directed to the soil acidity (p^H value), deficiency of soil minor elements, and occurrence of diseases and pests so as to prevent the injury of continuous cropping.

Since water cannot be controlled for upland field cultivation, the cropping pattern should be planned with due regard to the principal need for increasing the water-holding capacity of soil, minimizing the surface water loss and preventing the wind erosion. The cropping pattern shown in Fig. 3. 3-3 is simply a proposal and should be modified in the actual planning according to the need to fufill the above three requirements.

It is to be added that application of green manure should be enhanced to maintain the soil productivity for both paddy and upland field cultivation.

3. 3. 3-2 Improvement of Cultural Practice and Yield Level

Table 3. 3-5 shows the cultural techniques which can be introduced by farmers for improvement of their present farm management as well as the possible increase in unit yield that may be brought about by such improved techniques. If progressive extension is to be attained at all, techniques included in this table should be digested in three years.

Table 3. 3-6 shows the yield level of major crops in the paddy field area where irrigation farming prevails as well as the cultural techniques to be practised to attain such yield level. Techniques included in this table need to be introduced and digested to achieve the first phase target shown in Fig. 3. 3-2.

Since upland field cultivation must resort to rain water for some time to come, screening of varieties with drought resistivity is the first step to be taken for improving the yield level of upland crops. For maize, kodo, mustard and pulses, five to six suitable varieties discriminated from each other in ripening period and quality should be selected so that the output of these crops will be characterized by the uniform quality peculiar to respective varieties and will also have a higher market value. It will also be necessary to make endeavours for extending the cropping period and improving the quality of vegetables and fruit trees through introduction of advanced raising techniques of seedlings and selection of suitable varieties.

It is believed that if these improvement measures are implemented, the present yield level in both paddy and upland field can be increased by 50 to 100% without much difficulty.

If a higher yield level than mentioned above (e. g. , the target level shown in Table 3. 3-5) is desired to be achieved, it will become inevitable, due partly to the limitation to irrigation water supply, to plan a joint control of water within respective villages including the rational distribution of irrigation water and drainage or storing of water at time of heavy rainfall. In addition, increased fertilizer application will necessitate deep plowing and improvement will have to be made in such works as plant protection, weeding, reaping and threshing.

Table 3. 3-5 Yield Increase through Improvement of Cultural Techniques (With Mechanization Plan)

Yield in kg/ha

Crop	Yield (kg)	Main Techniques
Paddy (Aus):		
Present level	1,500 - 2,000	Local variety, no fertilization, rain-fed farming.
3 years hence	4,000	Introduced variety, fertilzer application, irrigation farming, disease and pest control.
Target	5,000	Introduced or improved variety, fertilizer application, irrigation farming, disease and pest control, and soil improvement.

Paddy (Dhan):		
Present level	1,500 - 2,000	Local variety, no fertilization, rain-fed farming.
3 years hence	3,000	Introduced or selected variety, fertilizer application, irrigation farming, and diesease and pest control.
Target	4,000	Introduced or improved variety, fertilizer application, disease and pest control, and soil improvement.
Wheat:		
Present level	1,000	Introduced variety, and limited fertilizer application.
3 years hence	3,000	Introduced variety, irrigation farming, fertilizer application, and disease and pest control.
Khesary:		
Present level	550	Local variety (additional sowing), no fertilization, and no irrigation.
3 years hence	650	Selected variety (early sowing), irrigation farming, and fertilizer application.
Target	800	Introduced or improved variety, irrigation farming, fertilizer application, and disease and pest control.
Mustard*		
Present level	700	Local variety, no fertilization.
3 years hence	1,500	Selected variety, fertilizer application, and soil improvement.
Target	1,800	Introduced or improved variety, fertilizer application , irrigation farming, and disease and pest control.

Maize*		
Present level	1,100	Local variety, no fertilization.
3 years hence	3,000	Selected variety, fertilizer application, and soil improvement.
Target	4,500	Introduced or improved variety, fertilizer application, irrigation farming, and disease and pest control.
Sugarcane*		
Present level	30,000	Local veriety, no fertilization.
3 years hence	50,000	Selected variety, fertilizer application, and soil improvement.
Target	55,000	Introduced or improved variety, fertilizer application, Irrigation farming), disease and pest control, and soil improvement.

* Main crops in upland field area.

Mechanization Plan:

Year	Plowing & Soil Preparation	Sowing	Inter-tillage	Weeding, Disease & Pest Control	Reaping	Threshing
Present level	Bullock power	Manpower	Manpower	Manpower	Manpower	Bullock power
3 years hence	Improvement of plow (bullock power)	Manpower	Manpower	Herbicide sprayer	Manpower	Pedal rotary thresher
Target	Powered plow	Manpower	Powered tiller	Powered sprayer	Manpower	Powered thresher

Table 3.3-6 3 Year Improvement Plan of Cultural Techniques for Irrigation Farming

Crop & Yield	Level of Cultural Techniques
Paddy (Aus) 4 tons/ha	Variety: Early or medium maturing variety resistant against bacterial leaf blight (IR-8 or IR-5

	should be cultivated for some time to come). Sowing time: 2 weeks earlier than at present (from early April to late April). Fertilizer:

		N	P	K	
Nursery bed		10	10	5	g/m^2
Paddy field	Local variety	60	60	20	kg/ha
	Introduced variety	100 - 120	60	20	kg/ha

Weeding: Granulated PCP for initial period, to be substituted by MO if it proves harmful for fishes.
Granulated PCP for the intermediate period, to be substituted by Saturs S if it proves harmful for fishes.

Diseases: 1/700 - 1/1,000 solution of Sankel wettable powder (dilution of 600 times) for bacterial leaf blight to be applied at a rate of 1,000 - 1,500 1/ha.

Insects: For stem borer and stink bug, 2% granulated Sumithion is to be applied at a rate of 10 bags/ha (each bag containing 3 kg), or 50% Sumithion emulsion is to be applied at a rate of 10 bottles/ha (each bottle containing 100 g)

Paddy (Dhan) 3 tons/ha	Variety: A number of suitable local varieties with photoperiodic response should be selected depending on the purpose of cultivation with consideration given to ripening period and quality (e.g., fine grain, coarse grain and scented rice). Sowing time: 1 - 1.5 months earlier than at present.

Crop & Yield	Level of Cultural Techniques
	Fertilizer:

	N	P	K	
Nursery bed	10	10	5	g/m^2
Paddy field — Local variety	60*	60	20	kg/ha
Paddy field — Introduced variety	(100)	(60)	(20)	kg/ha (Not recommended at present)

* Base fertilizer - 20, Top dressing for heading time - 40.

Weeding:
Diseases: Same as for Aus.
Insects:

Wheat
3 tons/ha

Variety: S-227, C-306, Sonora, Lerna Raho, etc.

Sowing time: mid-November to around December 5.

Fertilizer:

N	P	K	Note
100	60	40	kg/ha 100 kg/ha of N should comprise 50 basic and 50 top dressing.

Weeding: Granulated CAT to be applied at a rate of 1 bag/10 a.

Plant protection: Daisen (dilution of 400 - 650 times) for leaf rust

Khesary (Pulse)
0. 8 tons/ha

Variety: Screening of local varieties to select a number of suitable varieties.

Sowing time: mid-October to mid-November

Fertilizer: N = 20, P = 60 and K = 30 in kg/ha, provided that P is fused phosphatic fertilizer to be supplemented by the application of Ca and Mg.

Mustard	Variety:	Screening of local varieties to select a number of suitable varieties.
	Sowing: time	mid-October to mid-November
	Ferti-: lizer	N = 80, P = 60 and K = 30 in kg/ha, provided that P is fused phosphatic fertilizer. B (Boron) should be applied immediately if its deficiency is detected.

Note: Planting pattern - Square planting is advisable, but not recommended as absolutely necessary. Irrigation should be compatible with the crop growing and should also assure a stable yield level through advancing the nursery period and stabilizing the cropping period.

3.3.3-3 Irrigation Techniques for Irrigation Farming

Irrigation by means of tube wells makes the dry season cropping feasible, but the cropping pattern for such farming should be carefully planned because there is a limit to the water quantity obtainable from tube wells. Assuming, for instance, that tube wells are capable of supplying 2,500 m^3/day of water and that the benefited area is 40 ha, no more than 25 ha can be covered daily if 10 mm of water is to be supplied. At Hardinath Pilot Farm, a daily duty of water of 12 to 15 mm is assumed for evapotranspiration from paddy and soil percolation. If this duty is to be satisfied, the daily coverage will be reduced to 21 to 17 ha only. If, again, the said amount of water from tube wells is to be used for wheat in the heading period, it can cover no more than about 28 ha/day because the duty of water in the heading period is estimated to reach 9 mm/day.

Since the irrigation water from tube wells is not sufficient as mentioned above, it is desirable that the sowing time of the early planting paddy (Aus) be advanced by about 20 to 25 days (duration of nursery period) so that healthy seedlings will be raised by proper water control during this period and transplanting carried out when rain water becomes available.

As for Dhan, rice seeds should be planted in the nursery bed and water from tube wells' should be supplied primarily for supplementary irrigation during the growing period and ripening period.

Feasbility of partial double cropping of paddy should be determined after a year or two of the trial irrigation described above. Wheat, khesary and mustard which are the succeeding crops of paddy will not present any serious problems at their sowing time, but they are subjected to a heavy evapotranspiration in their ripening period (March to April) which coincides with the dry season. In the initial stage, therefore, efforts should be made to achieve satisfactory irrigation with as little water as possible so that the second cropping area may be expanded.

3.3.3-4 Improvement and Introduction of Farming Implements and Equipment

Hasty introduction of large farm machinery and equipment is not necessarily justifiable because of the existing availability of surplus labour force.

If the extension of improved farming techniques is to be promoted, improvement of existing farming implements and introduction of equipment which will alleviate or save the work load of respective operation of farm labour should be given priority over the introduction of large machines used in advanced countries.

For this reason, the following improvements and introduction should be effected.

1) Improvement of plow: Use of improved plows encouraged by Rapti Experiment and Model Farm of Tokyo University of Agriculture is reported to be contributing to improving the efficiency of plowing and tilling work.

2) Improvement of bullock cart: Improvement should be made to increase the tractive efficiency of bullock, and the wooden wheels should give place to rubber tyres. This is needed to improve the transport capacity and prevent the deterioration of road condition.

3) Introduction of the weeding wheel in paddy field and shoulder type duster: These equipment are needed for weeding and control of diseases and pests which are indispensable for production increase. Use of these equipment will awaken the farmers to the necessity of regular row planting.

4) Introduction of pedal rotary or powered thresher: This will raise the efficiency of threshing and winnowing work, and will prove particularly instrumental in completing the harvesting work of the early planting paddy (Aus) within a time short enough to allow the transplanting of late planting paddy (Dhan) to be undertaken without overlapping of workload.

5) Introduction of straw cutter: Use of straw cutters for littering of straw, handling of compost material, and prepering of feed will contribute to productivity increase.

Powered equipment such as tiller, tractor and combine, whose introduction should be planned for the future, are quite expensive and their high depreciation cost demands that a collective utilization programme be established in advance. Further, there are many problems to be solved prior to their introduction such as the training of farmers on the construction of the equipment, assurance of availability of spare parts for repair, and establishment of repair shops.

3.3.5-5 Rational Utilization of Livestock

Bullocks in Nepal should have a larger tractice force, higher efficiency in plowing and soil preparation, and larger transport capacity. For this purpose, introduction and rearing of improve Indian species should be promoted. It is also important to increase the milking capacity of buffaloes and goats.

Since livestock rearing is conducted in an extremely rough way with no planned production of feedstuff, efforts should be made to improve the common pasture land with account also taken of the need for cultivating for cultivating forage crops on farm land.

It is desirable that the in intake of feedstuff is returned as manure to the farm land. This is particularly important for upland fields. Hence, it is hoped that the prevailing habit of using the bullock manure as fuel will be discontinued in the near future.

Improvement of livestock rearing should be promoted to the extent that the livestock plays its role reasonably in the cycle of soil ⟶ livestock ⟶ crops.

3.3.3-6 Infrastructural Improvement

Since this subject has already dealt with in items falling under Section 3.3.2, the Mission wishes only to point out the need for establishing wind-break forests in upland field area and facilities for breeding livestock.

3.3.3-7 Summary

Tarai Plain in Janakpur Zone is Nepal's granary area and has the development potential of advanced agricultural enterprises.

Development of such agricultural enterprises can be expected either in the irrigation farming centering on paddy or in the upland farming intended primarily for production of cash crops such as vegetables and industrial crops.

In the foregoing pages, the Mission emphasized the need of planned farming based on rational utilization of water for the former and the maintenance and increase of soil productivity for the latter, and explained how the yield level in both types of farming should be elevated according to the respective land conditions and through the improvement of individual cultural techniques covering varieties and fertilization, improvement and introduction of farming implements and equipment, and rational utilization of livestock. The Mission also stated that the proposed development should be achieved basically by gradual improvements in various aspects of agriculture.

It is believed that the current yield level can be increased by 50 to 200% without much difficulty through the selection of suitable varieties, improvement of fertilization and control of diseases and pests, and that the existing peak labour load can be mitigated through improvement of farming implements and equipment. These promotional measures are considered to contribute to the gradual improvement of farm management and also serve for the maintenance of soil productivity and improvement of stock rearing techniques.

The Mission is convinced that the favourable air temperature and the diligence of farmers will certainly lead to the development of advanced agriculture in Nepal.

3.4 Hardinath Extension Centre Scheme

The Hardinath Extension Centre Scheme will be continuously implemented at the existing Hardinath Pilot Demonstration Farm.

3.4.1 Existing Condition of Hardinath Pilot Demonstration Farm.

See Note 1.

3.4.1-1 Location

Hardinath Pilot Demonstration Farm (hereafter called Hardinath Pilot Farm) is located at a point about 15 km to the north of Janakpur City in lat. 26°45' N. and long. 85°58' E. and has an elevation of 323.3'. Mahendra Nagar Highway (Jaleswar - Dhalkewar) runs north to south approximately 1.5 km to the north of the farm, but the farm is connected with this highway with an unpaved farm road which allows no traffic in the wet season.

3.4.1-2 Objective

Hardinath Pilot Farm, inaugurated in April 1969 as part of FAO's Irrigation Development Study in Tarai Plain (Sun Kosi Tarai Irrigation Development Project), is being operated for the following purposes.

(1) Collection of basic data for the development of irrigation farming in Tarai Plain from the results of surveys on agro-economy, soil, land utilization and other aspects to be undertaken for Sun Koshi Tarai Irrigation Development Project.

(2) Trial cultivation based on the above data to study the feasibility of agricultural extension.

(3) Extension of improved irrigation farming techniques among farmers.

(4) Provision of technical guidance to agricultural technicians and farmers to improve the technical level of irrigation farming.

3.4.1-3 Organization

Hardinath Pilot Farm is operated under the agreement between FAO and the HMG of Nepal (Department of Irrigation, the Ministry of Power and Irrigation). Actual operation of the farm is undertaken by Nippon Koei Co. Ltd. under the contract concluded with FAO, with the counterpart service offered by the HMG of Nepal (Department of Irrigation).

Japanese Staff of the Farm (Staff of Nippon Koei):

Chief agronomist (overall control and experiments)	1
Irrigation engineer (agricultural engineering)	1
Extension engineer (cultivation)	1
Mechanical engineer (control of farming equipment & cars)	1

Nepalese Staff of the Farm (Staff of the HMG of Nepal):

Assistant irrigation engineer (general affairs & construction)	1
Assistant agronomist (management of farm)	1
Junior technician (management of farm)	2
Cashier (accounting)	1
Radio operator	1
Store keeper	1
Assistant store keeper	1
Tractor driver	3
Jeep and truck driver	3
Field man	2
Assistant mechanic	1

For the satisfactory operation of the farm, additional services of Nepalese staff including office workers, assistant engineers in various specialized fields and agro-mechanists are required.

3.4.1-4 Facilities

(1) Land Area:[2] (See Fig. 3.4-1)

Land area of the farm is as given below.

Total land area	42.59 ha
Farm land area	38.38 ha
Residential area	1.20 ha
Airport, pond, road and canal	3.06 ha

About 8% of the farm land is not complete yet, but is expected to be completed before the coming wet season.

(2) Field:

Each plot of the field measures 10 m x 40 m covering an area of 40 a in principle, excepting those plots on the periphery of the farm which have an irregular configuration. Besides ordinary fields, the farm is provided with five plots of concrete-bound paddy field intended for fertilization test by soil type.

(3) Roads:

Two kinds of roads, one having a width of 12' and the other 8', are provided. The total extension of the 12' wide road is 735', and that of 8' road is 5,655'. All plots of fields are interconnected by these two types of roads having a total extension of about 12,70'.

(4) Irrigation Water:

Irrigation water is obtained from a tube well dug in the farm which has a diameter of 12" and a depth of 40'. The maximum yield of flowing water from this well is 30 ℓ/sec (or 2,600 tons/day) which suffices for the irrigation of the farm. Irrigation water can also be obtained from Hardinarth Irrigation Canal adjoining the farm on the northeast, but a pump will be required for this purpose.

(5) Irrigation and Drainage Canal:

Canals having a total extension of 16,800' are provided along the roads for irrigation of the entire farm. Part of canal construction work still under way is expected to be completed before the advent of the next wet season.

The brick-made supply canal has an extension of 1,642', the lateral earth canal 5,938' and the side ditches 9,200'. The irrigation canals intersect the roads and drainage canals by means of siphon and culvert.

A total of 7,535' of drainage canal is provided on the opposite side of irrigation canal with each plot of field in between. Part of drain water is collected in the drain pond (32,000 sq. ft.) and pumped out into the canal outside the farm. Remainder of drain water is left to flow into the fields outside the farm.

No complaint has so far been raised by farmers in the area surrounding the farm about the outflow of drain water from the farm but this is liable to cause the inundation of their fields. The drain pond in Plot 66 is not deep enough so that draining of Plot Nos. 37 to 41 becomes impossible in the wet season. The southern lowland section of the farm is submerged during the wet season when the fields of the neighbouring farm households are also submerged to render the draining impossible.

(6) Buildings:

Office and laboratory	77.25 m^2	1
Grain and fertilizer warehouse with adjusting, winnowing and drying space	101.73 m^2	1
Warehouse for storing seeds, equipment materials	42.73 m^2	1
Garage (used also for keeping repairing tools)	112.04 m^2	1
Guest room (2 rooms)	68.28 m^2	1
Staff dormitory	213.58 m^2	3
Guard house	40.13 m^2	1

The building constructed for Hardinath Irrigation Project is utilized as the dormitory of Japanese staff and part of Nepalese staff. Buildings including warehouse, working shed, stock house and the number of the staff are still deficient for the smooth and satisfactory operation of the farm.

(7) Airport:

UNDP owns a seven-seater Swiss made Pilatus Porter for communication between the farm and Kathmandu. An airport measuring 60' x 1,100 in space is therefore established in the farm compounds.

3.4.1-5 Mechanical Facilities

Farm Machinery and Equipment (now in use):

Wheeled tractor, 35 HP	2 units
Hand tractor, 6 HP	2 "
Automatic thresher with 3 HP engine	1 unit

Pedal rotary thresher	1 unit
Mist blower	1 "
Hand duster	1 "
Semi-automatic sparayer	1 "
Irrigation pump with 3 HP engine	1 "
Grain dryer	1 "

Experimental Equipment and Appratus (now in use):

Apparatus for soil moisture testing	1 set
Apparatus for crop testing	1 "
Instrument and apparatus for meteorological observation (owned by the Department of Hydrology, the HMG of Nepal):	1 "

Equipment Additionally Applied For:

Automatic thresher	1 unit
Mist blower	2 units
Air compressor with engine	1 unit

Of the above-listed farm equipment and machinery, the 35 HP tractor, which is an Indian make, is easy to get out of order and can therefore be hardly counted on for the extension work. Other equipment and machinery are also superannuated because of the heavy load imposed on them.

Besides the aforementioned farm equipment and machinery, the farm is provided with two jeeps, two generators with diesel engine (3 KW/h), and one radio set, but these belong to UNDP.

3.4.1-6 Activities

Activities of the farm started with the creation of fields. Crops cultivated in the farm are mostly paddy and wheat and also include maize, oilseeds, pulses, sweet potato and vegetables.

(1) Experimental and Testing Activities

Experiments on different varieties of paddy, wheat, maize and sweet potato, fertilization test, experiments and surveys of water duty, and experiments and tests for determining optimum seeding time, etc. are carried out.

(2) Trial Cultivation

Trial cultivation is carried out for improved varieties of paddy, wheat, oilseeds and pulses with respect to their rotation, fertilizer application and irrigation techniques.

(3) Extension Activities

Demonstration farms are established in the fields of ordinary farm households for extension of techniques and varieties considered to deserve extension efforts as a result of the experiments and tests conducted by the farm and other research institutes.

(4) Technical Guidance

Close cooperation is maintained with DADO to provide extension workers and ordinary farmers with the opportunity to visit and inspect the farm.

3.4.1-7 Cost of Farm Operation

Construction Cost of the Farm (share of the HMG of Nepal):

Land expropiration cost	Rs 387,000
Field creation cost	Rs 153,000
Building construction cost	Rs 375,000
Fence construction cost	Rs 62,000
Total:	Rs 968,000

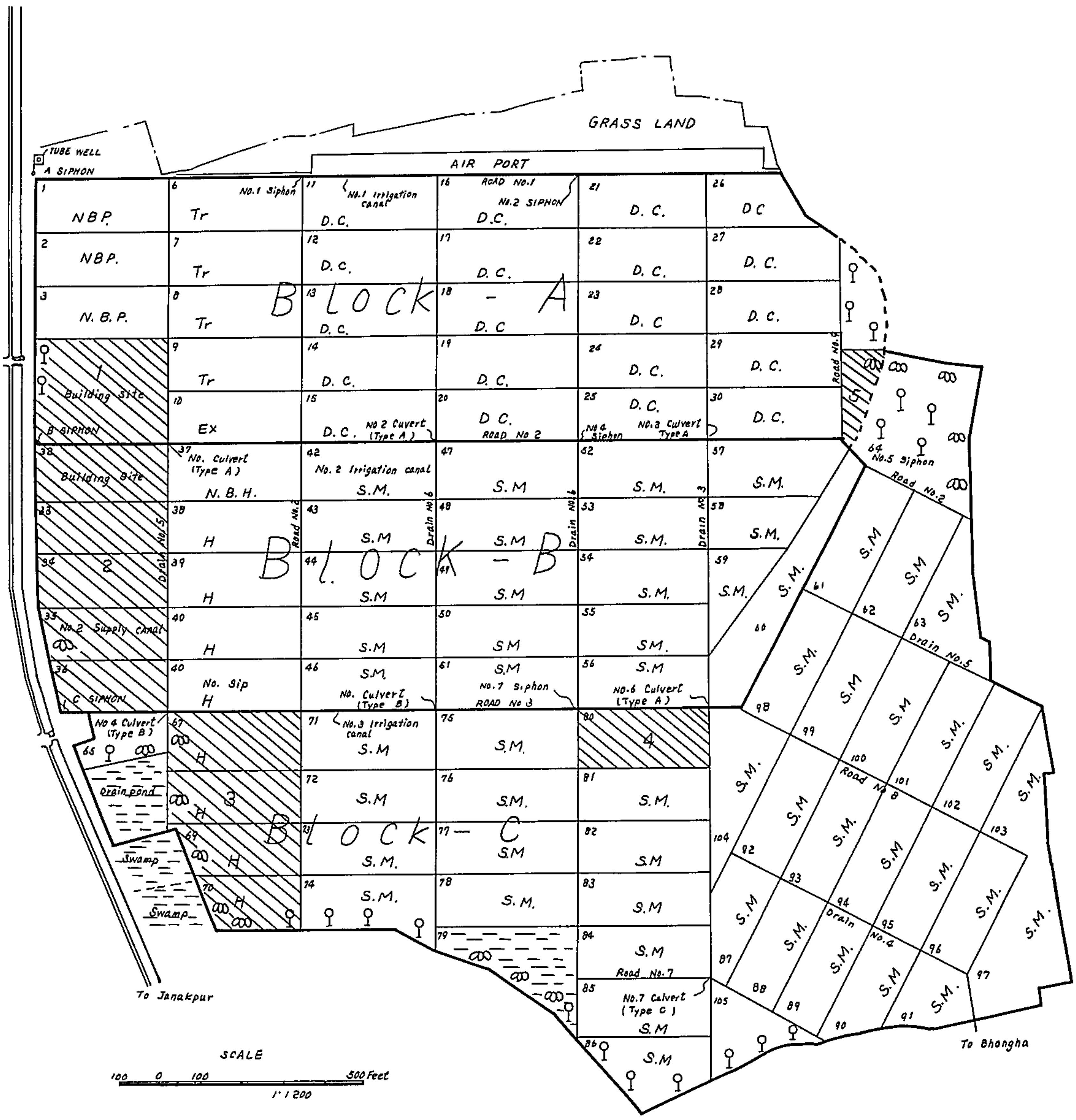
Farm Operational Cost (share of the HMG of Nepal in 1970 - 1971):

Personnel cost of Nepalese staff	Rs 73,500
Cost for daily labourers	Rs 12,000
Cost for farmers	Rs 64,000
Repairing and adjusting cost	Rs 7,800
Transportation cost	Rs 4,000

Notes: 1. UNDP Sun Kosi Tarai Irrigation Development Project - Annual Report No. 1 (1969/70) on Hardinath Pilot Demonstration Farm (June 1970) and hearing from the staff of the farm are the source of information.

2. Land area was obtained from the materials and data available at the farm at time of survey.

Fig. 3.4 - 1. Land Use Map of Hardinath Extension Farm



Legend.

▨	Building Site	ꝏ	Bamboo Bush
1.	Farm Management office	N.B.H.	Horticultural Nursery Bed
2.	Project Office	H.	Field of Banana, Pine, Apple and other Garden Crops.
3.	Dormitory	N.B.P	Nursery Bed of Paddy
4.	Stock House and Working Shed	Tr.	Trial Cultivation
5.	Compost Shed	Ex.	Experiment
▤	Drain Pond	D.C.	Demonstrational Cultivation
♀	Fruit Tree	S.M	Seed Multiplication of Paddy and Wheat, Field of Garden and Industrial Crops, or Pasture Land Area.

3.4.2 Extension Plan

3.4.2-1 Fundamental Approach

(1) Hardinath Extention Centre is expected to play an important role in the effective extension of improved farming techniques among Nepalese farmers. The primary function of the centre is to develop farming techniques suited for the project area and to train agricultural extension workers who are assigned to the task of extending such techniques among farmers. Its function also includes such other services as the multiplication of seeds and seedlings of improved varieties and adjustment and repair of farm machinery and equipment which are all indispensable for farmers who will be practising the said improved farming techniques.

(2) Techniques developed at the centre are practicable for most farmers in the project area. Under the extension plan, it is planned to provide suitable guidance and supplementary services to farmers in the project area who are expected to improve the level of their farming techniques by their voluntary efforts. It is not intended to attain the development of farming techniques simply by the input of modern equipment and materials and introduction of high-yielding varieties.

Development of farming techniques is therefore planned to be promoted with full understanding of the level of development in the project area, adopting basically the conventional farming techniques and introducing, at the same time, the merits of modern farming techniques and means.

(3) In the initial stage of development, the plan will cover Tarai Plain for increased and more efficient paddy production. Efforts for developing irrigation farming will be made at the centre because of the expected improvement in irrigation facilities. However, since nonirrigation farming still prevails in the greater part of the project area, due consideration will be given to the improvement of such farming. The plan is essentially intended to embrace farmers in an extensive area. Therefore, upland crops will be included in the plan for their improved cultivation though paddy and wheat constitute the main crops under the plan. Further, for the balanced intake of nutrients by farmers and stabilization of farm economy, consideration will be given to the increased production of cash crops such as vegetables,

fruit trees and other horticultural crops.

(4) Since the collection of various data required for the extension work is the major function of the centre, basic agricultural research work will not be conducted. Basic research work will be carried out by other research institutes of the HMG of Nepal. The centre's primary efforts will be devoted to extending the findings of such research work over a wide area it coveres. Problems arising from the extension work among farmers will be reviewed at the centre, and if basic research work is found necessary to bring them to a solution, they will be transferred to other pertinent research institutes.

(5) The centre provides both Japanese and Nepalese engineers and technicians with an arena for technical experience as well as for conducting experiments and tests for applying their knowledges and techniques to the agricultural development of the project area. The centre is also an arena for elevating the technical level of respective engineers and technicians. Since the farmer's fields are intended for production and not experiments, maximum efforts should be made to prevent the failure of new techniques applied thereto. Use of new techniques, equipment or materials in the farmer's fields will have to be withheld until its success is guaranteed. New techniques, equipment or materials will have to be studied and reviewed at the centre until their practicability is ascertained.

3.4.2-2 Plan for Activities

3.4.2-2.1 Studies and Experiments

The following studies and experiments will be carried out to obtain basic data required for implementing the extension plan as well as for extending the improved techniques among farmers.

(1) Selection of Improved Varieties

Selection of improved varieties will be carried out for crops for food, industrial crops and horticultural crops. The improved varieties referred to here indicate not merely high-yielding varieties but those with high marketability which are compatible with various farming and soil conditions and easy to cultivate. In other words, they should be such varieties that will stabilize the farmer's economy. Selection will therefore be made from among introduced as well as local varieties.

(2) Introduction of New and Improved Crops

Introduction of new and improved crops that can be cultivated in the project area will be reviewed besides studying the crops now under cultivation. In view of the expected completion in 1972 of a road which will connect the project area with Kathmandu and the desired export of agricultural products to countries other than India which is one of the problems of Nepalese agriculture, agriculture in the project area now centering on paddy and wheat production should be transformed into a more diversified one. The centre will play the role of pilot in such direction of progress.

(3) Improvement of Irrigation Techniques

To ensure rational water utilization and proper water control for fertilization, duty of water for respective crops will be measured and an optimum utilization method of irrigation water will be established. The plot-to-plot irrigation practised by the majority of farmers entails a great loss of water. With the progress of groundwater utilization by means of tube wells, studies will be made for the economic utilization of water.

(4) Improvement of Fertilization Techniques

Rational dosage, timing and method will be established for fertilizer application for respective crops. At present, farmers apply a small quantity of staple manure to the fields not far from their villages, and application of chemical fertilizers started only one to two years ago with the introduction of Mexican variety of wheat. To increase agricultural production, therefore, improvement of fertilization techniques should be accelerated. For this reason, data will be collected on the application of chemical fertilizers, cultivation of green manure crops, and production and application of compost and staple manure.

(5) Plant Protection

Countermeasures against diseases and pests, weeds, bird damage and wind damage will be studied to establish the practical plant protection techniques. Farmers are making efforts in prevention of damages due to birds and wind, but no measures are being taken against diseases and pests.

As an attempt to prevent wind damages, wind break forests are being formed. The plant protection measures, which call for the use of various equipment and materials, should be drawn up for an extensive area from a long-range viewpoint. Therefore, data required for establishment of plant protection techniques will be collected and studies will be made on the joint plant protection measures. Studies will also be made for protecting grains in the warehouse against degradation.

(6) Improvement of Cultural Practice

Introduction of new crops and varieties and improvement of irrigation and fertilization should be accompanied by the improvement of cultural practice. Data will be collected for respective crops to make a detailed study for such improvement.

(7) Maintenance of Soil Productivity

Maintenance of soil productivity is the fundamental requisite to the increased agricultural production. While farmers in the hilly area are exerting strenuous efforts to maintain soil productivity, those in Tarai Plain are not making such efforts. In some parts of Tarai Plain, cultivation of maize is made impossible due to the decline of soil productivity, and in that part of Tarai Plain extending in the east of Nepal where irrigation facilities were constructed many years ago, there are found some farm lands which have turned into desert, because of inadvertent irrigation. It cannot be said with confidence that the progress of the extension plan and the consequent development of irrigation farming will not invite the similar decline of soil productivity. For this reason, measures will be taken immediately and necessary surveys and experiments conducted to maintain and increase soil productivity through improved rotation, cultivation of green manure crops, application of calcium nitrate manure and staple manure, and proper irrigation method.

(8) Study on Farming Implements and Equipment

Introduction of improved farm equipment and improvement of conventional farming implements will be studied for the increased agricultural production. Speeding up of farm labour or its rationalization is not a major problem confronting the Nepalese agriculture. Farmers take a strong interest in the equipment that directly serve to raise the cultivation effect (such as pumps for irrigation) and in the equipment that reduce the loss of output (such as threshers and polishing machines). To cope with the future development of Nepalese agriculture, studies will be made on improved farming implements and equipment, with the collection of necessary data concurrently carried out. Improvement and development of conventional farming implements are being conducted by the Nepalese Government. Studies will therefore be made on the application of such improved farming implements in the project area. Improvement of animal driven equipment is particularly needed by the farmers in the project area.

(9) Collection of Basic Data for Development

In the course of implementing the extension plan, surveys and studies should be carried out on meteorology, soil moisture, farm economy and marketing for continuous collection of the data needed for development. With the exception of the meteorological survey initiated by FAO in 1969, virtually no basic data collection has so far been conducted in the project area. Hence, the data required for carrying out the plan must be collected and arranged in the course of its progress, making its implementation extremely difficult.

3.4.2-2.2 Demonstration

All the new crops, varieties, cultural practices, fertilization and irrigation techniques, plant protection techniques and all the new equipment and materials whose extension among farmers has been revealed practicable by the afore-mentioned surveys and experiments will be demonstrated at the centre prior to their actual extension. The demonstration is intended, on the one hand, to confirm and justify the results of surveys and experiments by the practical test in a wide area, and to provide, on the other, training and guidance materials to engineers, government officials and educational personnel who will be engaged in the actual extension work as well as to farmers. Extension items for farmers will be limited to those whose practicability has been confirmed by the demonstration. For items which are discovered not suited for actual extension, further surveys and experiments will be conducted.

Thus, the extension work can be embarked upon only after completion of the demonstration.

3.4.2-2.3 Production of Seeds and Seedlings

Seeds and seedlings of crops and varieties which have been evaluated as suitable for extension through surveys, experiments and demonstration will be produced at the centre to help farmers promote their agricultural development. Production of seeds and seedlings at the centre must be co-ordinated with that carried out at other agricultural experiment stations of the HMG of Nepal. Seeds and seedlings of superior quality need to be produced in a most economical way. Hence, the most modern facilities and means available should be employed for their production.

3.4.2-2.4 Maintenance and Repair of Farm Machinery and Equipment

Maintenance and repair of farm machinery and equipment to be used for the extension plan will be conducted at the centre because facilities for such purpose are not available in the project area. Maintenance and repair of various cars will also be carried out at the centre..

3.4.2-3 Staff Composition (Staff of the HMG of Nepal)

Staff composition identical or similar to the one given below will be required for the management of the centre and for experiments and tests.

1.	Agronomist	1
2.	Agro-mechanist	1
3.	Assistant agronomist	1
	Assistant horticulturist	1
	Assistant plant protection	1
4.	JT agro-botanist	1
5.	Agro-mechanic	2
6.	Typist-cum-office secretary	1
7.	Accountant	1
8.	Store keeper	1
9.	Jeep driver	1
10.	Tractor driver	3
11.	Guard	1

12. Office boy 1

13. Stock rearer 1

Total: 18 persons

3.4.2-4 Centre Facilities

The following facilities will be required for the operation of fields, tests and experiments, and maintenance and repair of farm machinery and equipment.

3.4.2-4.1 Irrigation Facilities

(1) Partial Improvement of Supply and Drainage Canals

Supply and drainage canals, which are already complete, will have to be improved partially with the installation of new facilities. About 600 m of earth canal will have to be improved to mortared brick canal and 100 of drainage canal reinforced with mortared brick on its three sides.

(2) Creation of a New Drain Pond and Partial Improvement of Existing Drain Pond

Dredging work of 3,115 m^3 will be effected to the drain pond in Plot No. 66, and a new drain pond will be created in Plot No. 79 by earth-moving work of 6,346 m^3.

3.4.2-4.2 Screened Room and Framed Paddy Field

The screened room, intended for tests and experiments on different varieties and cultivating period, will be a steel framed building covered with polyvinyl sheet and metal screen, having a height of 2.5 m and its mortared brick floor measuring 20 x 25 m. The framed paddy field will measure 1 x 2 m, and have a depth of 0.5 m and

(See Fig. 3.4-2)

3.4.2-4.3 Nursery Bed

Nursery for raising seedlings of horticultural crops for the most part. (Fig. 3.4-3)

(1) Roofed Nursery Bed 6

Intended for raising seedlings in the wet season and hot season. Steel framed and roofed with corrugated and transparent plastic sheet, each will measure 4 m in width, 10 m in length, 2.3 m in ridge height and 1.8 m in eaves height.

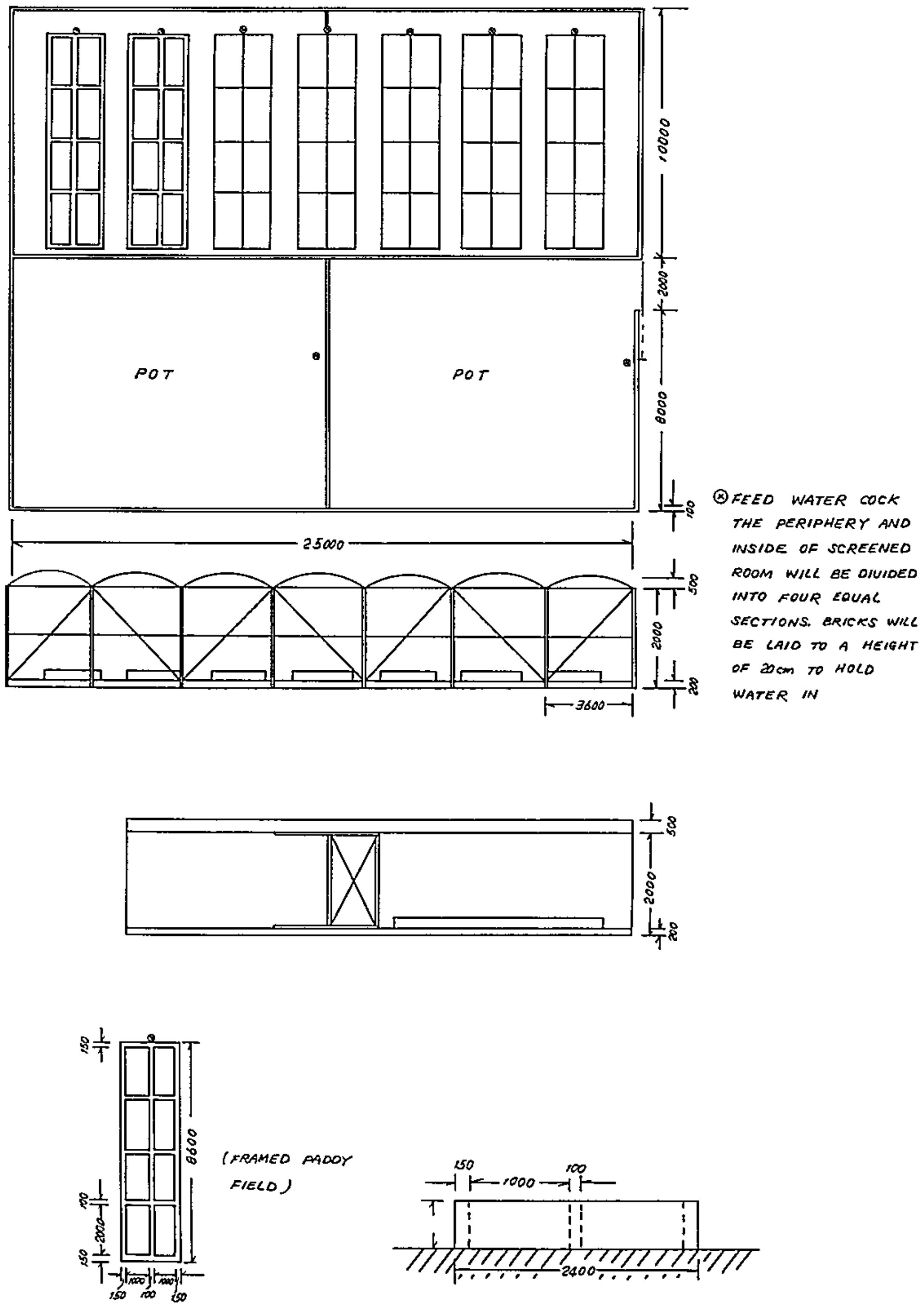
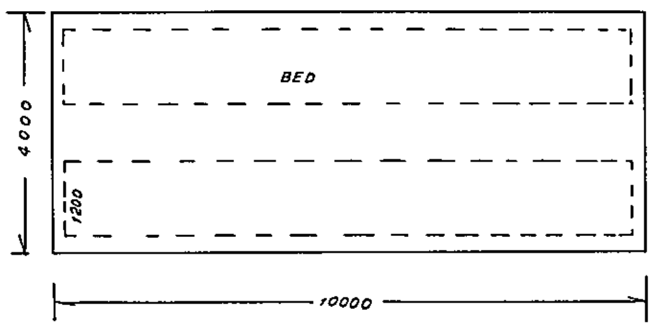
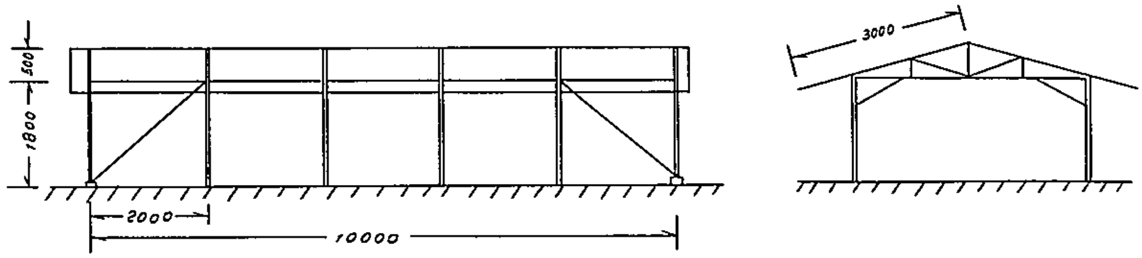


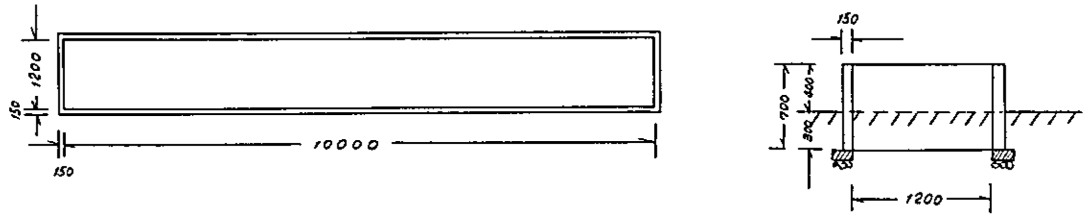
FIG 3 4-2 SCREENED ROOM AND FRAMED PADDY FIELD

FIG 3.4-3 NURSERY BED

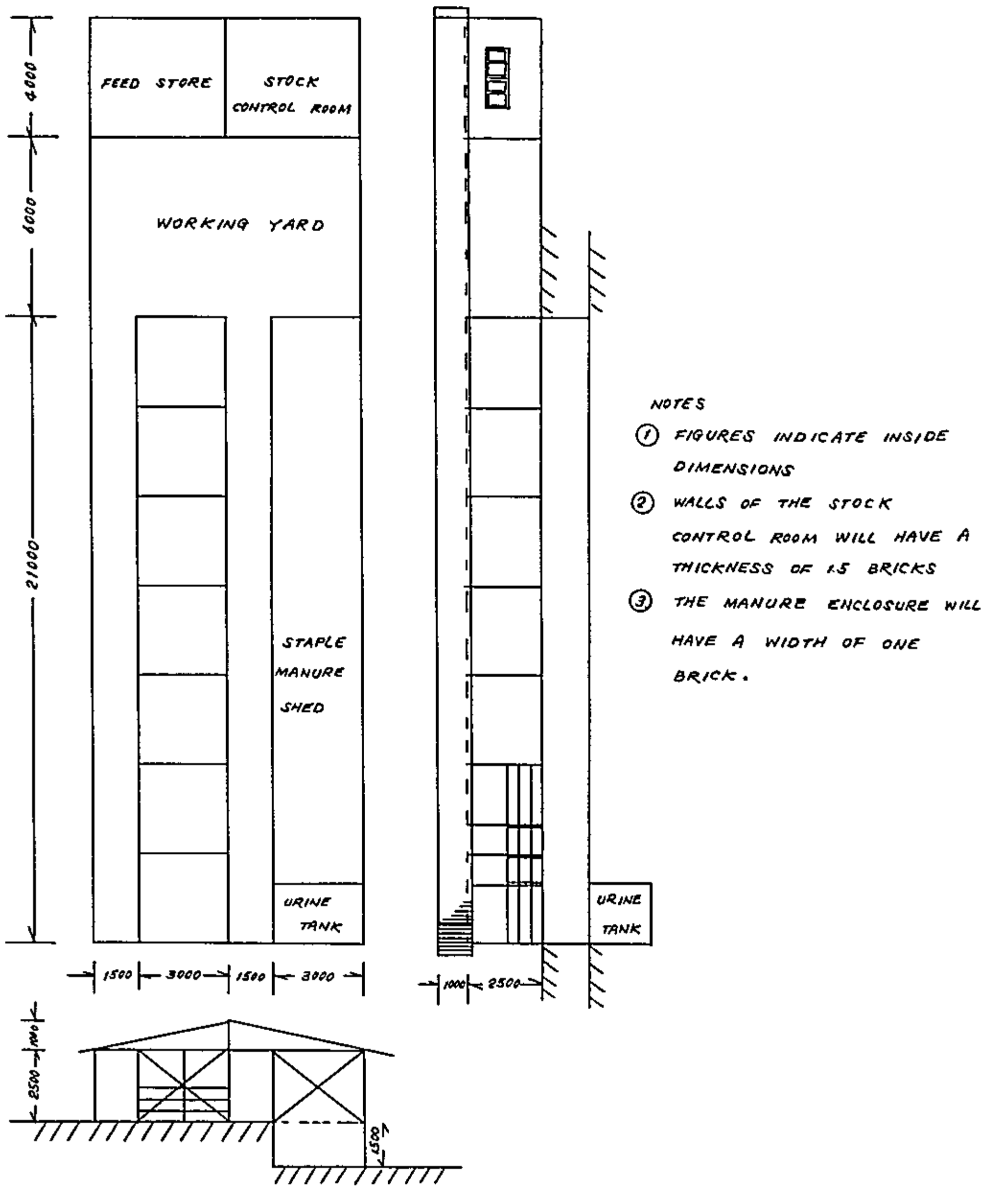




ROOFED NURSERY BED



OUTDOOR NURSERY BED



THE DIFFERENCE IN ELEVATION OF PLOT NO 80 WILL BE MADE USE OF IN CONSTRUCTING THE STAPLE MANURE SHED

FIG 3 4 - 4 STOCK HOUSE

(2) Outdoor Nursery Bed 20

Mortared brick made (or plastic framed), each will measure 1.2 m in width, 10 m in length and 0.7 m in depth.

(3) Horticultural Control Room 1

This will be used concurrently as the dormitory of the assistant horticulturist. Dormitory type "B".

3.4.2-4.4 Stock House-cum-Staple Manure Shed 1

This is intended to keep ten bullocks and two buffaloes, and has a staple manure shed, feed store, working yard, and stock control room.

It will be a steel-framed and slate-roofed building, measuring 9 m in width, 31 m in length, 3 m in ridge height and 2.5 m in eaves height, with concrete or mortared brick floor.

(1) Stock Control Room (to be used concurrently as the dormitory of stock rearer): 4 x 4.5 m. Windowlighted and electrically illuminated.

(2) Feed Store: 4 x 4.5 m

(3) Working Yard: 9 x 6 m. Not walled.

(4) Stock House: 9 x 21 m. Concrete floor with steel fence. Two bullocks and one buffalo for each compartment.

(5) Staple Manure Shed: 3 x 21 m. Manure enclosure will have a height of 1.5 m. At one end of the shed will be provided a urine tank. The floor will be 1.5 m lower than the stock house floor.

3.4.2-4.5 Compost Shed 2

Steel framed, single slate-roofed building for compost production, measuring 7 m in roof width, 2.5 m in ridge height on one side and 2.0 m on the other side. Each compartment will measure 6 x 2 x 1.5 m. Mortared brick floor and walls. One of the two sheds will have 24 compartments and the other 16. (See Fig. 3.4-5)

3.4.2-4.6 Warehouse (See Fig. 3.4-6)

(1) Seed Store: The existing two-room store will be used as the seed store. Interior illumination and boarded ceiling over which heat insulating and moisture-proof board will be planked.

(2) Fertilizer Shed: The existing T.O & driver quarters will be utilized for storing fertilizers. Interior illumination and boarded ceiling.

FIG 3 4-5 COMPOST SHED

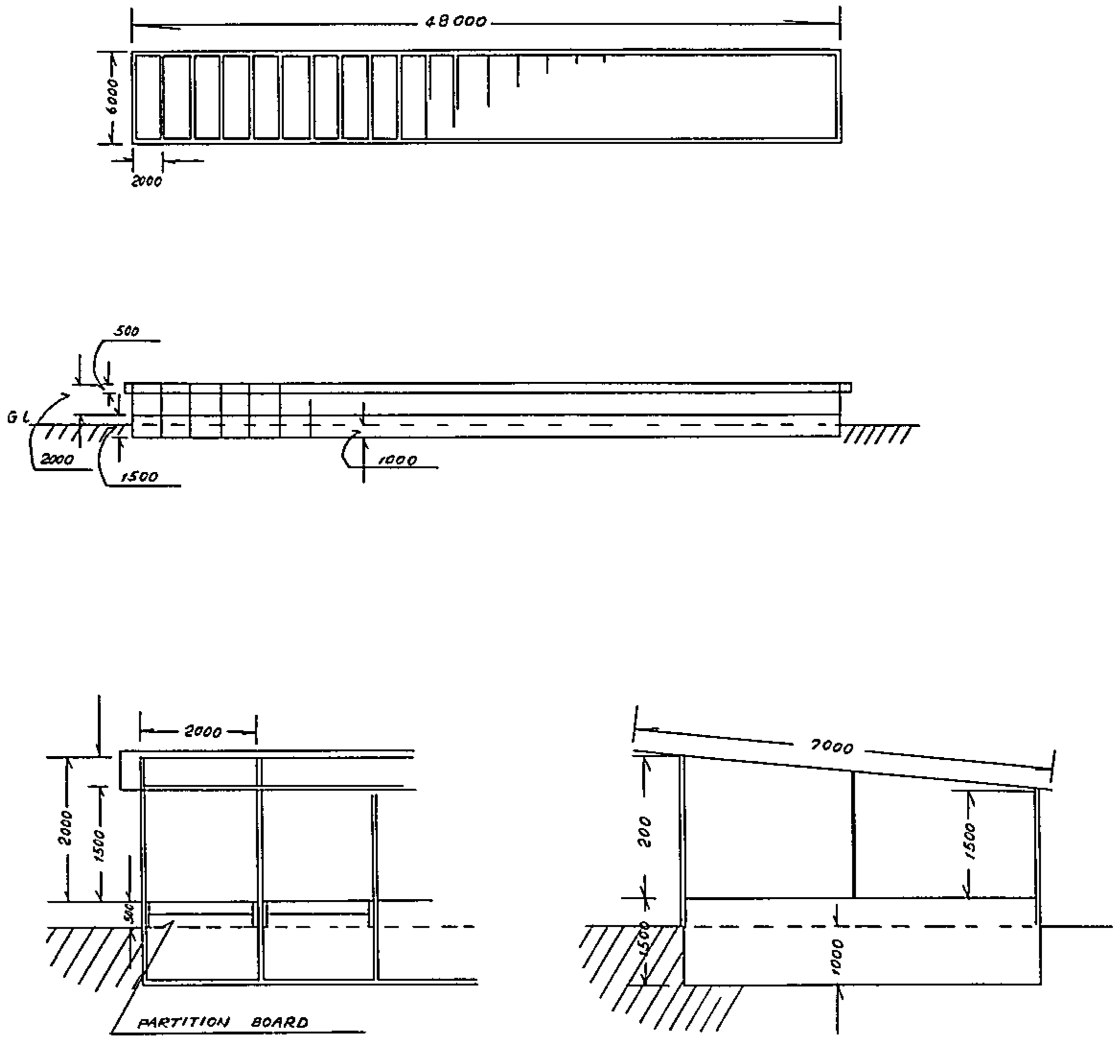
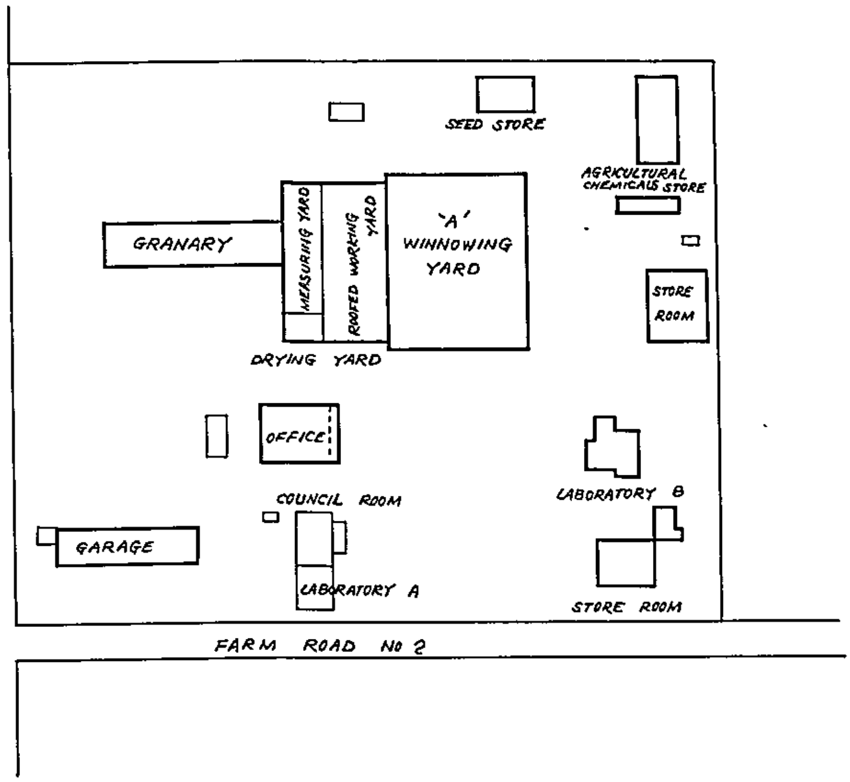


FIG 3 4-6 LAYOUT OF CENTRE STRUCTURES IN PLOT NOS 4 AND 5



(3) Agricultural Chemical Store: The existing kitchen type "B" will be used for storing agricultural chemicals. Interior illumination and boarded ceiling.

(4) Store Room: For keeping various materials and farming implements in good order. The existing guest house will be used for this purpose. Interior illumination and wooden fences for assorted storage.

(5) Granary: For storage of farm produce. Steel framed, slate-roofed building with mortared brick floor and walls. The floor will measure 6 x 25 m. Boarded ceiling with heat insulating and moisture-proof board planked over it, with three large ventilation fans. It will be divided into three rooms, each provided with interior illumination and hermetically sealable. The floor will be 1 m above the ground.

(6) Machinery and Equipment Depot: 1

9 x 30 m in size for keeping farm machinery and equipment. Steel framed, slate-roofed building with concrete floor and lightweight shutter on either side. Interior illumination. A 9 x 4 m room with steel fences and an aluminum sashed window will be provided in the building for storage of machinery and equipment.

3.4.2-4.7 Working Yard

(1) Winnowing Yard: (See Fig. 3.4-7)

For threshing and winnowing of grains.

Type A - A new winnowing yard measuring 24 x 20 m with 24 cm thick mortared brick floor above the ground will be provided on the east of the existing winnowing yard in Plot No. 4 1

Type B - 35 x 25 m in size, to be provided in Plot No. 80, with its floor thickness and height designed to be identical to those of Type A. 1

(2) Roofed Working Yard: (See Fig. 3.4-7)

For threshing and winnowing work in the wet and hot season. A steel framed, slate-roofed and mortared brick floored building with no walls.

Type A - 24 x 10 m in size, to be constructed at the existing threshing and winnowing yard. 1

Type B - 20 x 35 m in size, to be provided adjacent to the western side of Type B winnowing yard. 1

(3) Drying Yard: 1

A steel framed, slate-roofed building measuring 5 x 3.5 m in space intended to enclose the existing dryer for drying grains.

(4) Measuring, Polishing and Milling Yard: 1

For measurement of farm produce and polishing and milling work. The existing warehouse will be utilized for this purpose.

3.4.2-4.8 Centre Office (See Fig. 3.4-6)

(1) Office:

For administrative work of the centre. To be composed of the agronomist's office, general office room-cum accountant's room, and drawing room. The existing technician's quarters will be utilized for this purpose.

(2) Laboratory Type A: 1

For measurement of crop samples for plant protection and of soil specimens. The existing laboratory will be used.

(3) Laboratory Type B: 1

For measurement of crop and seedling samples. The existing agronomist quarters will be used.

(4) Meteorological Observation Yard:

The existing meteorological observation yard will be continuously used.

(5) Council-Room: 1

For conference of the centre's staffs. The existing office room will be utilized for this purpose.

3.4.2-4.9 Maintenance and Repair Yard (See Fig. 3.4-8)

For maintenance and repair of farm equipment and cars.

(1) Repair Shop:

A steel framed, slate-roofed, concrete-floored building measuring 9 x 30 m in space with an aluminum sashed too light, mortared brick walls on three sides, a lightweight shutter on one side, and interior lighting arrangement. It will be provided with an office room measuring 7 x 5 m in size with mortared brick walls on the lower part of two sides and aluminum sashed windows on the upper part, two tool parts stores with steel shelves on the ground floor (2 x 6 m) and 1st floor (6 x 9 m), and an oil and grease store (5 x 6 m) below the tool parts store.

(2) Washing Yard: 1

For washing farm equipment and cars. Concrete floored, measuring 9 x 30 m in space, and equipped with water tank, pump and drainage facilities.

(3) Fuel Tank: 2

Underground storage tank of gasoline and light oil equipped with a supply pump. (Capacity: 6 month supply of fuels)

3.4.2-4.10 Generator Room 1

A steel framed, slate-roofed, concrete floored building equipped with one unit of diesel generator.

3.4.2-4.11 Paved Road

Paved roads for communication will be constructed around and between buildings, and a course of paved road will also be constructed for driver's training. The road width will be 4 m and the total extension 600 m.

3.4.2-4.12 Dormitory (See Fig. 3.4-9)

Type A for the centre's staff: 2

Steel framed, slate-roofed buildings with mortared brick floor and walls, each measuring 150 m^2 in space and accommodating five families of tractor operators and car drivers, and equipped with screened aluminum sashed windows, interior illumination, beds, tables, chairs, and lockers.

Type B for assistant agronomists and others: 3

Steel framed, slate-roofed buildings with mortared brick floor and walls and heat insulating board planked on the ceiling, each measuring 123 m^2 and accommodating two famililies, and equipped with screened aluminum sashed windows and interior illumination. Each compartment will be composed of two furnished rooms and a kitchen.

Type C for agronomist and agro-mechanist: 2

Same in construction as Type B. Each will measure 125 m^2 to accommodate one family and will be composed of two furnished rooms and a kitchen.

3.4.2-4.13 Water Supply Facilities

For water supply to dormitories and other facilities. 20 ton sedimentation tank, 10 ton water tank and pump with 3 HP motor to be set up by 6 m steel frame for water supply through the main pipe (2-1/2" ϕ, 1,500 m) and branch pipes (1" ϕ, 2,000 m). All fittings and parts will be provided.

3.4.2-5 Machinery, Equipment and Materials

The following machinery, equipment and materials will be required for the operation of the centre and tests and experiments.

(1) Farm machinery and equipment
(2) Farming implements
(3) Fertilizers
(4) Agricultural chemicals
(5) Fuel
(6) Measuring instrument
(7) Seeds and seedlings
(8) Transport equipment
(9) Cold storage box for preservation of seeds
(10) Generator and distributing facilities
(11) Tools and machines for maintenance and repair of farm machinery and equipment
(12) Office supplies and furnitures, and equipment and materials for farm management.

FIG 3.4-7 WINNOWING YARD AND WORKING YARD

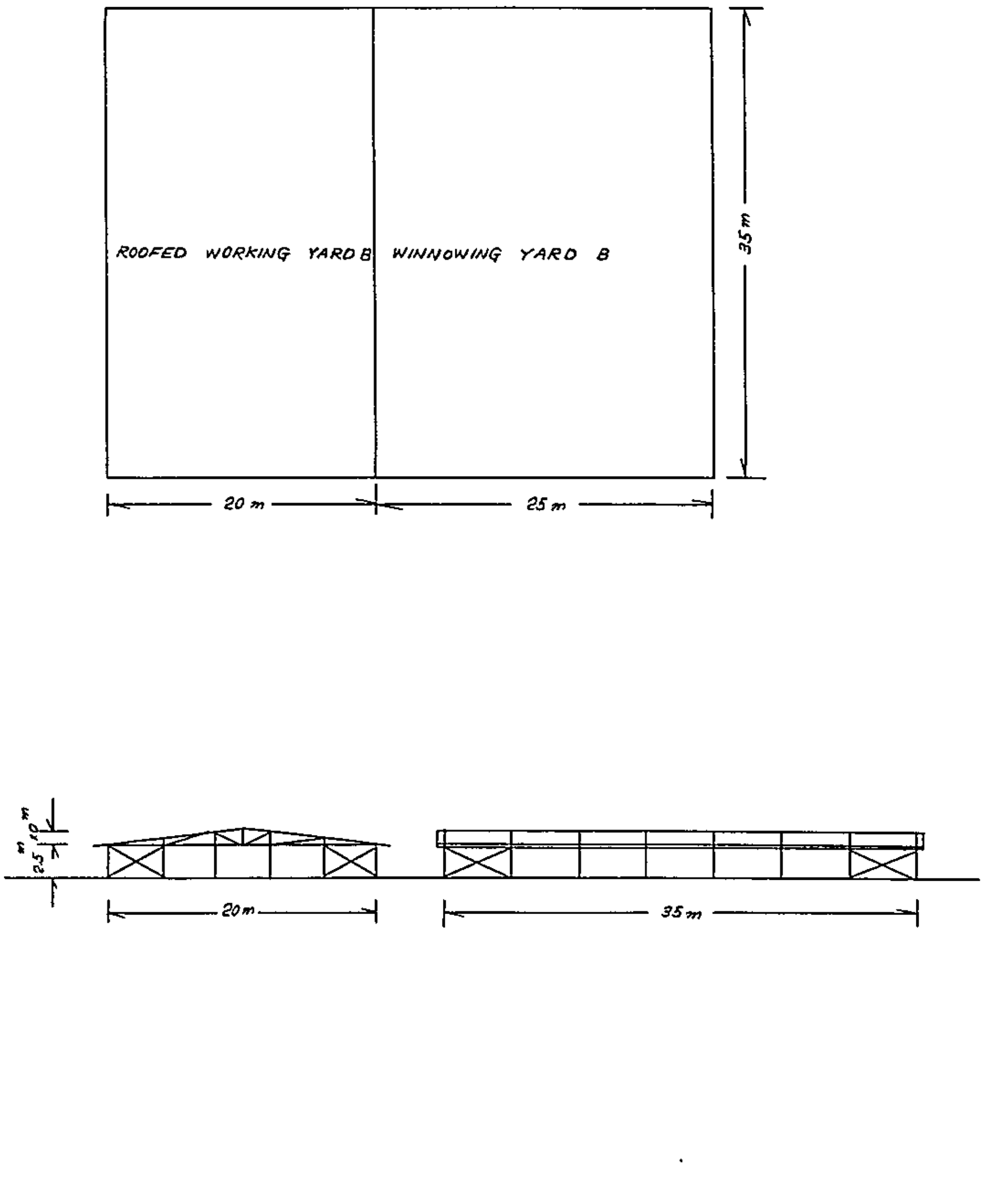
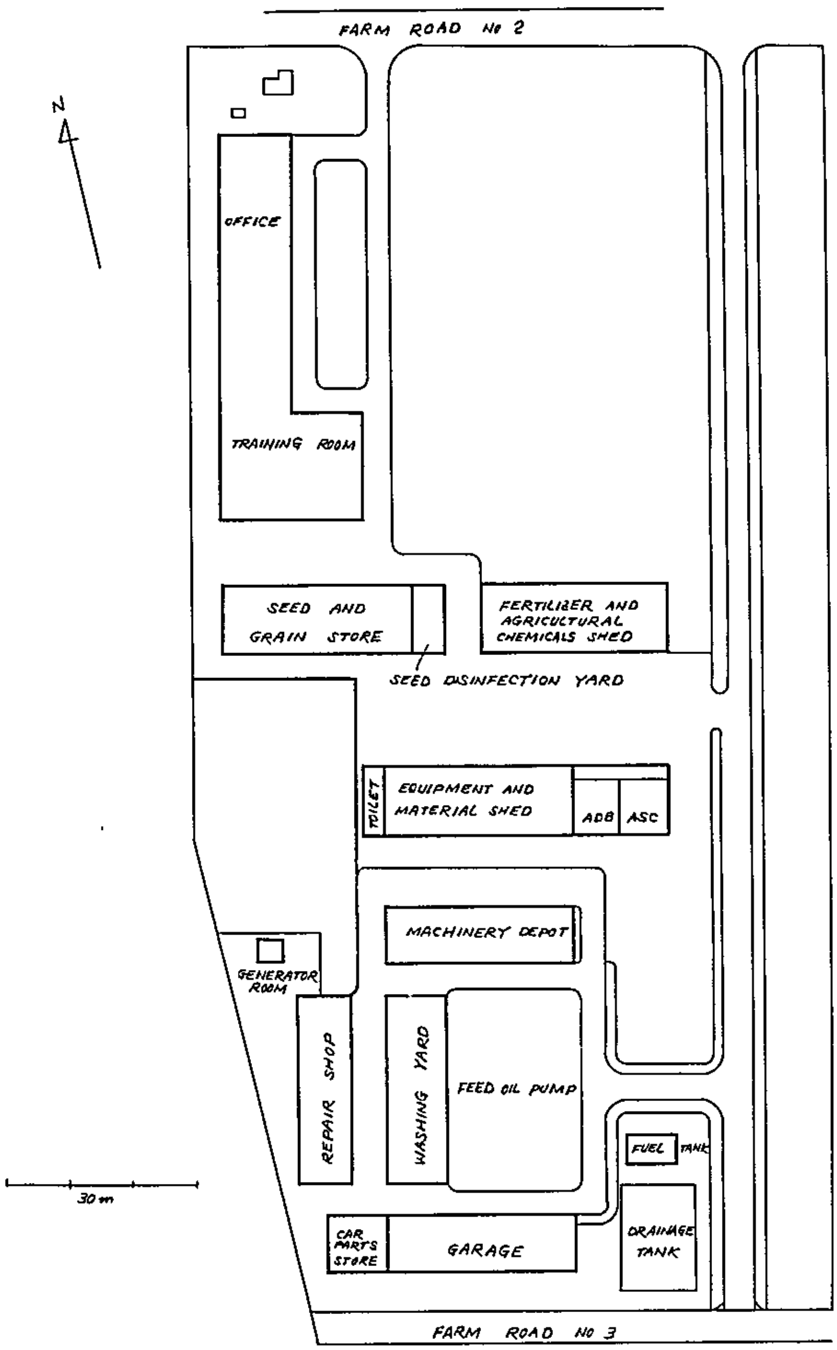
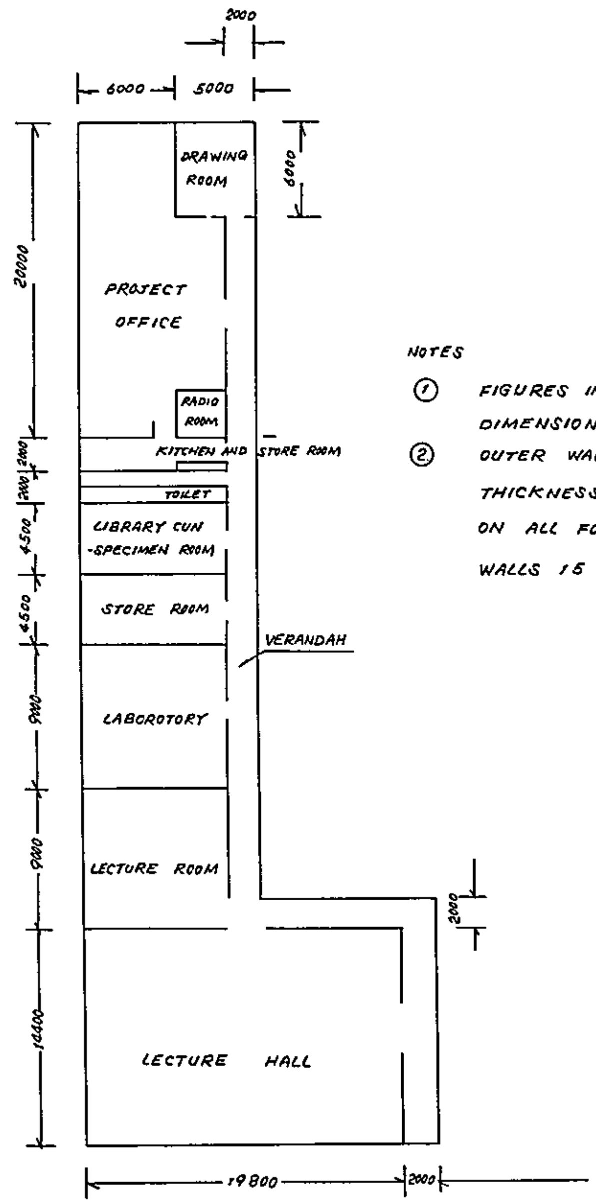


FIG 3 4-8 (1) LAYOUT OF PROJECT BUILDINGS IN PLOT NOS 32~36





NOTES

① FIGURES INDICATE INSIDE DIMENSIONS

② OUTER WALLS WILL HAVE A THICKNESS OF TWO BRICKS ON ALL FOUR SIDES, AND WALLS 1.5 BRICKS.

FIG 3.4-8 (2) OFFICE AND TRAINING FACILITIES

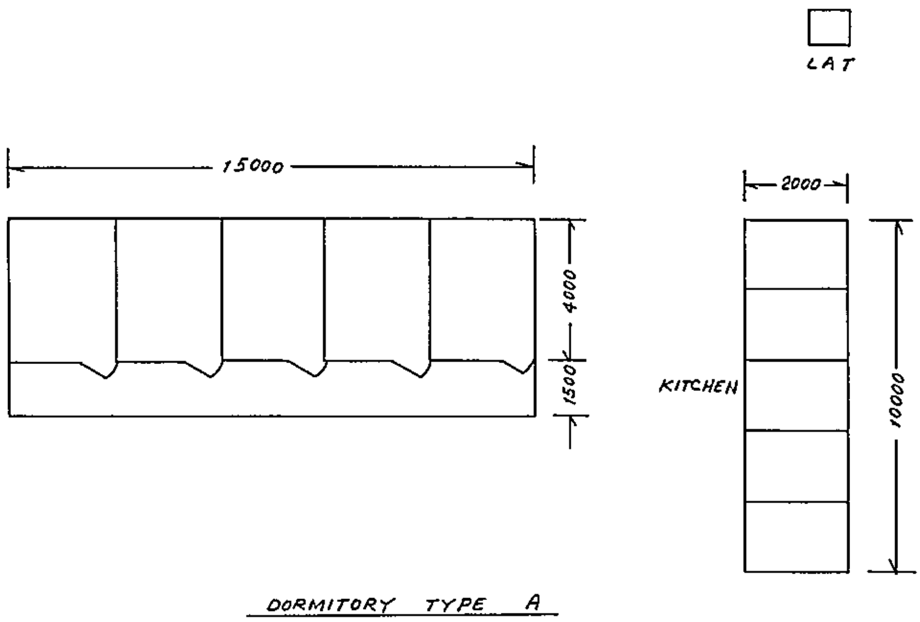
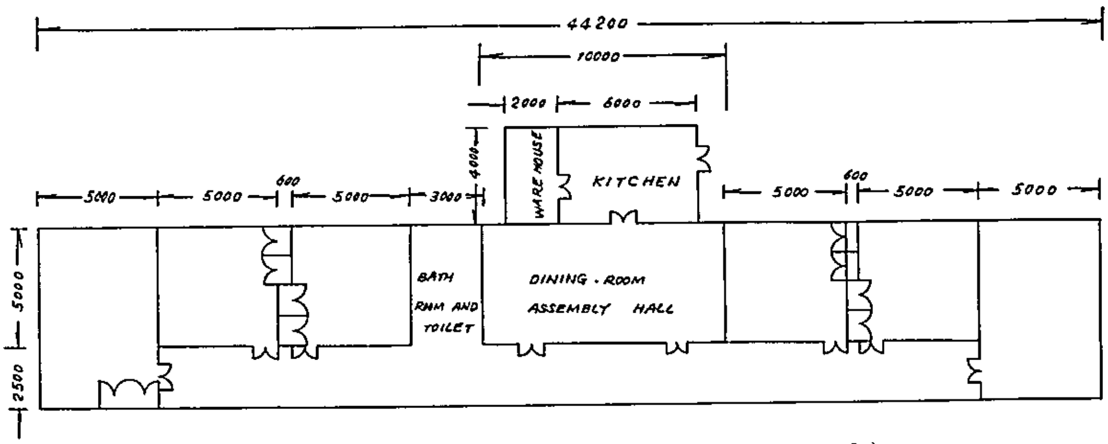
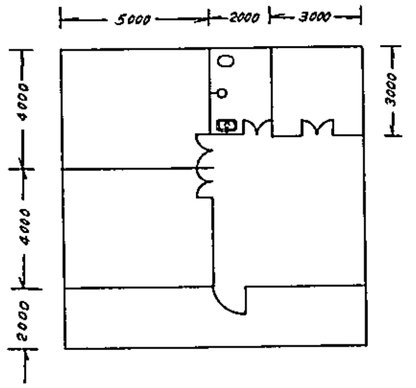


FIG 34-9 DORMITORY

FIG. 3.4 - 9 (2) DOMITORY



GUEST HOUSE (331.5 m^2 VERANDAH : 80.5 m^2)

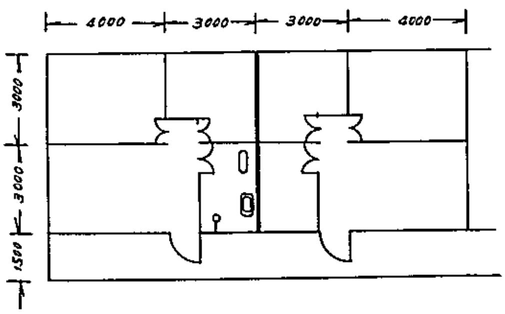


NOTES

① FIGURES INDICATE INSIDE DIMENSIONS

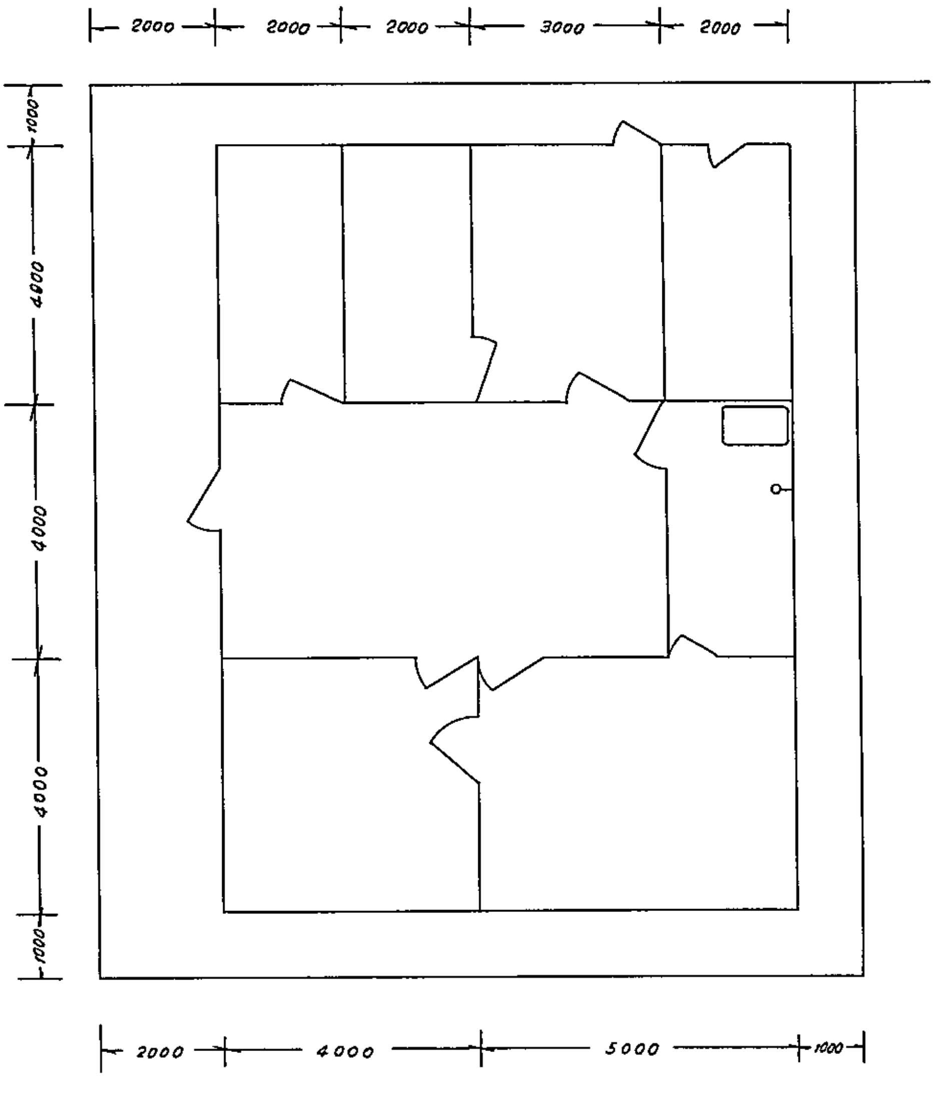
② WALLS WILL HA E A THICKNESS OF 1.5 BRICKS OUTER WALLS OF THE GUEST HOUSE WILL HAVE A THICKNESS OF 2 BRICKS .

DORMITORY TYPE C (100 m^2 VERANDA : 20 m^2)



DORMITORY TYPE B FOR TWO FAMILIES

(SPACE OF EACH COMPARTMENT : 52.5 m^2 IN WHICH VERANDA OCCUPIES 10.5 m^2)



DORMITORY TYPE D

FIGURES INDICATE INSIDE DIMENSIONS

OUTER WALLS WILL HAVE A THICKNESS OF TWO BRICKS (ABOUT 50 cm) AND INNER PARTITION WALLS 1.5 BRICKS

3.5 Training Programme

3.5.1 Fundamental Approach

Training under the present programme will be divided into two categories, i. e., the training of technicians of the HMG of Nepal who will actually engage themselves in the extension service and that of ordinary farmers. (Training of higher level officials not directly partaking in the present programme and research workers will be considered separately) Training of technicians will be conducted mainly at Hardinath Pilot Centre and that of farmers at extension plots.

3.5.1-1 Training of Technicians

(a) This is intended to improve the quality of technicians who will participate in the extension plan. In order to assure that these technicians satisfy the farmer's requirements in their extension service, arrangements should be made to provide them with a high technical level and deep and practicable knowledge so that they may discharge their duties with confidence and thereby win the confidence of farmers. For the satisfactory performance of their duties, these technicians will be so trained that their competence as leaders will be cultivated besides raising their technical level. This is particularly important in the project area where farmers are placed in undeveloped and immobile social environment, because agriculture in such fixed social environment is repellent against the introduction of new farming techniques and no remedy can be brought about unless the technicians who come in touch with farmers have a humane personality and mutual confidence of technicians and farmers is built. In the training of technicians, therefore, stress will be placed on their character building.

(b) Technicians participating in the training programme will be trained on the detailed techniques in the extension service. They will be trained into capable agricultural technicians who are able to provide, in a manner most suited to each occasion, guidance and extension services for introducing new techniques or improved farming practices which are demanded and can be digested by farmers.

(c) Training will be conducted chiefly through participation of trainees in the project activities at Hardinath Pilot Centre. Trainees will be given practical training through their performance of various activities of the farm, and lectures by instructors will be limited to the minimum possible extent. Instructors will play the role of an advisor to the discussion between trainees at seminars so that the capability of respective trainees will be increased through mutual training. It is expected that by such self-active training, trainees will acquire practical knowledge and techniques, learn to act on their own discretion and judgement, and find the way to further developing their character and technical level.

(d) Trainees who have completed the training will be given a certain qualification depending on the course they have majored in.

3.5.1-2 Training of Farmers

(a) Training of farmers, to be conducted through the extension work, is intended to encourage them to take an active part in the agricultural development for the improvement of their livelihood and to elevate their technical level. Stabilization of farm economy through introduction of new crops and production increase should be preceded by the elevation of the farmers' technical level which will enable them to improve their farming practice with confidence. Guidance and training will be given to farmers in a practical way in the extension work to allow them to absorb techniques required for improved farming.

(b) Training will be carried out to give mobility to the now fixed rural communities as well as to encourage farmers to create social environment suited for agricultural development. The under-developed social environment generally observed in rural communities in Tarai Plain is greatly impeding the agricultural development. Unless remedy is brought to the existing situation, progress of agricultural development cannot be expected. If the remedy is to be effected at all, it should preferably be initiated from the farmer's own motive rather than by external force. Extension workers are assigned to the task of encouraging and leading farmers, through their service, to make such remedy.

(c) Through such training activities, farmers will be guided to find problems lying in the way of agricultural development and exert their own efforts to bring them to a solution.

3.5.2 Training Course

3.5.2-1 Training Courses for Technicians

(a) Subject Matter Extension Worker Course

Objective: Retraining of ADO or JT stationed in project areas to provide them with higher technical knowledges in specialized fields with which to guide and lead extension workers stationed in agricultural extension areas.

Period: Approximately one year.

Trainee: JT or JTA who has the same capability as JT and more than three years of experience.

Subjects and No. of Trainees:

Agronomy	- 2	Agro-engineer	- 1
Horticulture	- 2	Soil science	- 1
Plant protection	- 2	Agro-mechanic	- 1
Agro-irrigation	- 1		

Total: 10 trainees

Lecture: Approximately 420 hours.

Practical Exercise: Approximately 1,170 hours.

Qualification Granted: Trainees who have passed the final examination will be entitled to the qualification for Subject Matter JT.

Privileges: Part of travelling expenses and food expenses during the training period will be borne by the HMG of Nepal. Also, trainees whose training record is excellent will be dispatched for further training in Japan which will be described later.

(b) Extension Worker Training Course

Objective: Retraining of technicians engaged in extension service in agricultural extension areas. To be commenced from the second year of training.

Period: Approximately one year.

Trainee: JTA with more than three years of experience in extension service.

No. of trainees: 20

Lecture: Approximately 420 hours.

Practical Exercise: Approximately 1,170 hours.

Qualification Granted: Trainees who have passed the final examination will be entitled to the qualification for JT or equivalent qualification.

Privileges: Part of travelling expenses and food expenses during the training period will be borne by the HMG of Nepal. Also, trainees whose training record is excellent will be dispatched for further training in Japan.

(c) Technical Course

Objective: Training of farm equipment operators and agro-mechanics considered necessary in the course of the extension plan.

Period: To be determined as occasion demands.

Trainee: Government technicians and non-government persons.

No. of Trainees: Several.

(d) Lecture Meeting

Lecture meetings will be held for persons in leading positions other than agricultural technicians (such as school teachers, staffs of government organs, leader farmers, etc.) to develop them knowledges on various subjects to be enlightened for the development of Nepalese agriculture.

(e) Training in Japan

Objective: Training in Japan is intended to allow Nepalese trainees to find the farming techniques and means suited to Nepal through their acquisition of practical techniques of advanced Japanese agriculture, and to encourage them to apply the knowledge and techniques they have acquired in Nepal.

Trainees who have completed the aforementioned courses and whose training record is excellent will be trained in the following courses depending on their specialized field.

Training Course, No. of Trainees and Period:

(1) Rice Cultivation and Its Extension Work - One trainee will be trained each year for 11 months from April on the practical knowledge of rice cultivation and its extension.

(2) Agricultural Machinery Utilization for Rice Cultivation - One trainee will be trained each year for 11 months from April on the agricultural machinery utilization for rice cultivation.

(3) Irrigation and Drainage for Rice Cultivation - One trainee will be trained each year for 11 month from April on the basic knowledge and application techniques of irrigation and drainage for rice cultivation.

(4) Agricultural Machinery Repair and Maintenance - One trainee will be trained each year for six month from June on the maintenance and repairing techniques of agricultural machinery.

(5) Vegetable Crop Cultivation - One trainee will be trained each year for 11 months from April on the practical techniques of vegetable cultivation and seed growing.

(6) Agricultural Extension Service - One trainee will be trained each year for three months from June on the actual state of Japanese agriculture and its extension work to enable him to reach a conclusion as to how agricultural guidance should be.

Total: Six trainees for six courses.

3.5.2-2 Training of Farmers

(a) Technical Training

In the extension plots, farmers will be guided to introduce improved farming to their own fields by applying, in the practicable order, the new techniques relating to new crops, improved varieties, fertilization, irrigation and cultural practice. In the course of such improvement, JT and JTA will make efforts to establish a close contact with farmers. Wholesale' guidance will be provided for each crop covering the entire process from the preparations prior to planting or seeding to harvesting.

(b) Agricultural Advice

JT will give advices to all farmers in the extension areas on any problems relating to farm management.

(c) Short Training Course

Short training courses covering a wide range of subjects including farming techniques, politics, economy, sociology and improvement of living standard will be given to elevate the level of farmer's knowledge. Activities for enlightening farmers will also be conducted using motion pictures and slide films.

(d) Agricultural Fair

Agricultural fair will be held once a year at the extension farm to awaken farmers to the need of improved farming techniques and to promote their volition for production increase.

3.5.3 Training Facilities

Training facilities including trainees' dormitory should be constructed in or around Hardinath Pilot Farm for the smooth implementation of the training programme for technicians. For training of farmers, however, no particular facilities will be required with the exception of extension plots.

The present training programme is planned to be implemented within the rough budgetary framework given below.

Contributions for Training Facilities:	Rs 130,000
Investment in Buildings and Others :	Rs 200,000

The above budgetary framework does not include the personnel cost of experts and instructors.

3.6 Farmer's Organizations for Agricultural Development

3.6.1 Necessity of Organized Activities of Farmers

As has been made clear in the general description of project area, there exist gaps between different classes of farmers in Janakpur Zone with respect to their soci-economic conditions. Introduction of improved farming techniques and the resultant increase in agricultural production is therefore liable to lead to wider gaps between classes rather than to bring about better livelihood of the whole inhabitants of the zone.

The plan to be introduced in this section centers on the organized activities of farmers and is intended to be carried out simultaneously with the extension of improved farming techniques so as to contribute to the welfare of the zone as a whole. In the course of its implementation, the plan will naturally have to be revised to a considerable extent since it is based on the findings of the survey conducted within a limited period and area. Emphasis is placed on farmer's organizations indispensable for the agricultural extension project, but the ultimate objective of the plan is to elevate the living standard of all inhabitants of Janakpur Zone. Success of the plan therefore depends on what type of rual communities will be created by the proposed agricultural development. In this context, the voluntary activities of the zone's inhabitants are far more important than the activities of foreign experts.

3.6.2 Registration of Inhabitants and Establishment of Krishak Samiti

With the exception of voter's lists, there exist no records of resident registration in Nepalese rural communities. Therefore, it is proposed that farmers having any right or title to the farm land to be covered by the tube well irrigation scheme and labourers earning wages by constant farm labour be registered under the following four categories.

(1) Land lord

(2) Owner cultivator

(3) Tenant cultivator

(4) Agricultural labourer

It is further proposed that for the control and management of irrigation facilities, Krishak Samiti be established with its membership comprising chiefly owner cultivators and tenant cultivators who are the backbone of farm management in the zone. Landlords cultivating even a part of their land will be entitled to the membership, but no admission will be allowed for absentee landlords and non-cultivating landlords. Farmers who make their living mostly by agricultural wage labour will be entitled to the membership if they concurrently cultivate their own land or tenant land, and farm labourers who make their living solely by wage labour will be entitled to the associate membership.

Water rate will be collected from each member depending on the acreage of their respective holdings in the tube well irrigation area. The water rate thus collected is to be saved as the funds of Krishak Samiti to be used in its activities for developing individual villages. The amount of water rate is to be determined by the consensus of opinion of members. 53 farm households were questioned as to the amount of annual water rate to be collected per bigha. Of these 53 farm households, 38 replied Rs 5 to 15 wound be the optimum charge, and 10 hoped for Rs 16 to 30, 3 for less than Rs 5, and 2 approved of an amount ranging from Rs 31 to 50.

Agricultural labourers who are the associate members will be given preferential employment opportunities over other labourers in the construction of irrigation and drainage facilities and other undertaking within each area, and will also be offered the facility to obtain the right to cultivate the farm land within the area which is disposed of or released for tenant farming by absentee or non-cultivating landlords so that their status in Krishak Samiti will be elevated to the regular membership in future.

3.6.3 Activities of Krishak Samiti

Activities of Krishak Samiti should be carried out on the initiative and by the joint efforts of its members. In implementing its activities, Krishak Samiti should maintain close contact with other organizations in individual villages (Panchayat, Gram Samiti, Class Organization, Ward Committee, Co-operative Society, etc.). In particular, it should keep constant touch with Panchayat and Gram Samiti.

If such liaison and coordination system is established, Krishak Samiti will be approved by Agricultural Supply Corporation as its dealer and direct procurement of seeds, fertilizers, agricultural chemicals and farming implements and equipment will become possible. By the establishment of the said system, Krishak Samiti will also be given the approval to act as a terminal organ of Agricultural Development Bank and Land Reform Saving Corporation and enabled to provide its members with the funds to purchase the above-mentioned materials and equipment.

Rules should be laid down for promoting the mutual exchange of labour force among the members (Aruma-Paruma) so as to minimize the dependence on the wage labour of non-members and to give priority to associate members if the need for wage labour arises. Short-term funds required to cover the cost of wage labourers, livestock and carts will be provided by Krishak Samiti. Foodstuff, kerosene and other daily necessaries will be obtained by joint procurement of Krishak Samiti and will be provided to its members on credit during the period preceding the harvesting season.

The survey revealed that the farmer's debts not intended for farm management are incurred by three major causes, i. e. , purchase of living necessaries, cost of education and medical treatment, and expenses for marriage, funeral and other ceremonies. Farmers who borrow money from near-by money lenders must pay an exorbitant interest which imposes heavy pressure on their economy. It is therefore desirable that Krishak Samiti offer living funds in addition to farm management funds in order to improve the farmer's livelihood. In offering such living funds, however, arrangement should be made to impose a lower interest rate on loans to cover the cost of living necessaries, education and medical treatment, and a higher rate on loans to be used for marriage, funeral or other ceremonies.

The Mission's survey on the farmer's intentions about farming implements and equipment disclosed that the use of a pump set and large tractor is desired by upper class farmers. Considering the existing state of farmer's economy, however, it is next to impossible for the farmers in the surveyed area to own such large type machinery. The Mission therefore considers it most expedient that Krishak Samiti purchase these machinery for the joint use of its members. In this case, it will be required to draw up a detailed joint use plan before the actual purchase, with the rent so set that the cost of each machine will amply paid off by the proceeds from the joint use.

3.6.4 Development from Krishak Samiti into Agricultural Co-operative Society

Krishak Samiti is intended to serve as an organization for utilizing irrigation water in tube well areas in the initial stage of its activities. When it grows to the extent mentioned in the preceding paragraph, it is preferable that its activities be not restricted to the tube well area but expanded to cover the whole of a spontaneous village boundary or an administrative area of Panchayat so that it may perform the function of Gram Samiti and Ward Committee which carry out agricultural development on the village level. When the said growth is attained, Krishak Samiti will be capable of playing the role of an all-round agricultural co-operative society and will therefore be able to act as a branch organ of the existing agricultural co-operative society or to absorb all its activities.

If Krishak Samiti is to act as the true backbone in the development of rural communities, its activities should not be limited to the vicarious execution of the functions of the aforementioned legally established organizations, but should be expanded to perform the undertakings of traditional co-operative organs of rural communities when it grows to embrace all villagers as its members. To be more precise, Krishak Samiti will become the promoter of rural development in name and fact when its activities cover the rationalized implementation of such common works as the improvement of canals and construction of farm roads which are currently left to the hand of Sajha Society as well as the storage of foodstuff and materials presently conducted by Dharma Bhakari to provide against disasters. It goes without saying that Krishak Samiti should assume full responsibility for the control of irrigation and drainage of water from tube wells and small streams in the entire village area it covers.

Growth of Krishak Samiti in scale will make it possible to transport major cereals and vegetables to the market in Janakpur and Sakhuwa by joint shipment which will bring about particularly large profits to the village along Mahendra Nagar Highway and the railways leading to Bijalpura. The joint shipment of farm produce naturally calls for the availability of suitable warehouses and transport means (such as trucks and bullock carts), but what is more important for its smooth implementation is to establish a system under which an exclusive staff is assigned to the task of distributing the profits impartially among the members.

If a rice mill can be managed directly by Krishak Samiti in this stage of development, further reduction of sales cost will be attained through joint shipment. In villages where private rice mills are already existent, however, arrangement should be made to adjust the competition between the existing private mills and the mills to be newly established by Krishak Samiti.

The fact that the membership of Krishak Samiti comprises two classes of farmers, i.e., owner cultivators and tenant cultivators is liable to create conditions detrimental to smooth execution of various activities, and could become a serious impediment to the future development of rural communities. It is therefore proposed to secure special long-term loans (repayable over 15 to 25 years) from Land Administration Office or other relevant financing organizations and to make arrangements to enable tenant members and associate members to purchase land from landlords at low cost. If efforts are made to increase the savings of members by setting aside the proceeds from joint shipment as reserve fund, it will serve to cut down the amount of loans to be made from the said organizations. Whether Krishak Samiti functions successfully as an agricultural co-operative society depends largely on the willingness of its members to increase their savings and the proper operation of its credit activities.

When owner cultivators come to constitute the greater part of the membership, it will become possible for Krishak Samiti to take an active part in agricultural production through establishment of joint farming groups which will work according to the farming plan for peak labour period covering ploghing, transplanting, weeding and harvesting.

3.6.5 Development of Rural Communities and Improvement of Livelihood

The present agricultural development project, which aims primarily at augmenting agricultural production, can also contribute to the development of rural communities. The first enterprise that can be undertaken within the framework of the project to improve the livelihood of inhabitants in the project area is the installation of the water supply facilities for domestic, bathing and washing purposes which is to be carried out in time with the construction of tube wells and irrigation canals. The Mission noted that some of the villages surveyed have only one well and that the well water soiled by the inflow of surface water is often used for domestic purpose to invite the spread of epidemics. In such villages, supply of clean and hygienic drinking water is a matter of pressing need to which higher priority should be given over the supply of irrigation water.

In one of the villages visited by the Mission, 20 to 30% of adult population were suffering from a disease which was suspected to be goiter. There also was an instance where many inhabitants suffer from the said disease in one village, whereas no such symptom was observed in the next village. This is attributed to the quality of well water. Test on well water quality should therefore be conducted as early as possible to take appropriate countermeasures against the disease.

The Mission considers it desirable to provide two tube wells in the residential district of Ramdaiya Village where many cases of this disease are observed in order to ascertain if the disease can be prevented by using deep-seated groundwater for drinking purpose. This may perhaps appear irrelevant to agricultural development, but it should be noted that a plan to materialize advanced agriculture without regard to the living environments of inhabitants is an attempt disconnected with reality.

In the development of rural communities, improvement of sanitary conditions should be paralleled with the promotion of education. Production increase by agricultural development should bring about better livelihood of individual farm households and should simultaneously lead to the consturction of school buildings and repletion of adult education. For this purpose, whatever practicable steps including the appropriation of part of proceeds of farm produce to the funds for school feeding should be taken so that the cultural level of the whole rural communities will be elevated in the ultimate.

3.6.6 Characteristics of Rural Communities vs. Agricultural Development

In this paragraph, existing conditions of the villages covered by the present survey will be dealt with in order to study the significance of characteristics of individual villages with respect to the agricultural development as well as to point out matters that need to be given careful consideration in carrying out the project.

3.6.6-1 Ramdaiya - Bhabari

Residential districts of these two villages adjoin each other to form a single Panchayat. Since Bhabari Village is favoured with more water supply and economically better conditioned than Ramdaiya Village, primary efforts should be directed to eliminating the gap between the two villages rather than to narrowing the gaps between classes.

3.6.6-2 Sapie

The whole village was donated as Guthi area about 150 years ago to Mathihani Temple near the Indian territory, and the land tax is still collected by Guthi Corporation. Perhaps for this reason, the class distinction has not shown much progress in this village, and owner farmers outnumber tenant farmers by an overwhelming margin. Due partly to the positive guidance activities of JTA stationed in the village, Sapie is one of the most advanced villages in Dhanukha District embracing many progressive farmers who are willing to introduce improved farming techniques. However, the tenancy right of Katendar, who are the subtenants cultivating the estate of Mathihani Temple which is operated by Thekadar on a contract basis, is very unstable because it is not protected by the Land Reform Law. Measures should be taken to give these subtenant farmers the same permanent tenancy right as granted to other tenant farmers.

3.6.6-3 Lohar Patti

Lohar Patti is an old village situated along the railway leading to Bijalpura. Prior to the enforcement of the Land Reform Law, 15 villagers belonging to Teli, the dominant caste, constituted Zamindar, and it is said that one Zamindar held a maximum of seven assessable land areas (moja). Since the village is the residential district of former Zamindars, its development is fairly in progress, but wide gaps are noted between different classes in the village. Musalman, Chamar and Mushar who account for as much as 30% of the village's total population are mostly degraded to the status of landless labourers. In this village, there is the practice that a partly cultivating landlord lends a small piece of land (about 1/4 bigha) to a particular labourer to secure the labour force he need in the busiest farming season. The mission noticed that there exists a deep-rooted antipathy between Teli, the landlords, and Muslim labourers, and that landlords have already made substantial capital input for agricultural development. When compared with other villages, therefore, it will entail more difficulties to promote the development based on the co-operative organization of villagers.

3.6.6-4 Kumharaul

Kumharaul is a small community with 45 farm households belonging to Sakhuwa Panchayat, and is situated along Mahendra Nagar Highway to the north of Ramdaiya Village. Since it is conveniently situated for transport to and from the market, development efforts will yield large benefit if stable supply of irrigation water is assured. However, for the organized activities of farmers through establishment of, for instance, Krishak Samiti, the village is too small. Farmer's organizations, if established in this village, will inevitable be merged with those in other larger villages, and when such merger becomes an actual need, choice between Sakhuwa which is far from the village but is within the same administrative area and Ramdaiya which is situated nearby will present itself as a serious problem.

3.6.6-5 Aurhi

Like Loharpatti, Aurhi Village is relatively large with about 500 farm households and constitutes a Panchayat. The mission noted that the construction of irrigation and drainage canals was in progress by the joint efforts of villagers under the guidance of an ex-Zamindar family who migrated from Pokhora 55 years ago. In this village, there is a long-established practice to pay 0.75% of proceeds of farm produce to Panchayat. Panchayat of this village therefore has a budgetary framework incomparably larger than that of other villages (about Rs 15,000 per year), and is vigorously carrying out various activities with particular stress placed on education for which half of the budget is appropriated. Development work is being pushed forward by Yuwak Sangathan, an organization of young villagers, and the headman of the village is only 23 years of age, which is very rare in Nepalese rural communities. The percentage of tenant land in the whole farm land of the village is extremely small (about 5%), and the management and control of irrigation water is undertaken by Panchayat. For the development of advanced rural communities like this one, Krishak Samiti will have to be organized by consolidating the activities of Panchayat (or Gram Samiti) from the beginning.

3.6.6-6 Kalabanja

Kalabanja is a new village situated opposite to Ramdaiya Village along Mahendar Nagar Highway and has about 18 farm households. It was created four years ago by the migrants from Manarakati Village (Mahottari District) near the Indian territory who disposed of their land at Rs 20,000 per bigha and obtained new land at the present site which was offered at a cheap price of Rs 2,700 to 8,000 per bigha due to its poor conditions. Though the village is a newly reclaimed area, the villagers seem to have inherited the old social structure. The 18 farm households of the village constitute 12 castes. The upper class four farm households own a total 40 bigha of land, and the remaining seven bigha is owned by nine farm households, and there are as many as five families of landless farm labourers. Development of this village is liable to reproduce the social structure prevalent in rural communities near the Indian border which are characterized by the extreme disintegration of peasant community unless it is planned and implemented to create an entirely new social set-up.

CHAPTER IV CHITWAN DISTRICT

4.1 Existing State of Project Area

The project area covers an area of about 32,800 ha in Chitwan District of Narayani Zone. The existing state of this area has already been described in the Report of the Japanese Preliminary Agricultural Survey Mission in Nepal (May 1970). In this section, therefore, supplementary information on the existing conditions will be provided and problems to be solved will be pointed out to facilitate the mapping out of the development plan for the project area, with description also given on Rapti Experiment and Model Farm of Tokyo University of Agriculture (hereafter called TUA Rapti Model Farm).

4.1.1 Natural Conditions

4.1.1-1 Climatic Conditions

Climatic conditions in Chitwan district as observed by Rapti Agricultural Station (hereafter called Rampur Farm) are shown in Fig. 4.1-1.

As is clear in the figure, the annual rainfall averages 2156.3 mm, and about 75% of annual rainfall is recorded during the period from Ashadha (mid-June to mid-July) to Bhadra (mid-August to mid-September). From Jaistha (mid-May to mid-June) to Ashvina (mid-September to mid-October), greater rainfall is observed than in the remaining period of the year. Rainfall in winter is extremely small. Hence, no high yield can be expected of the non-irrigation farming of wheat and other winter crops.

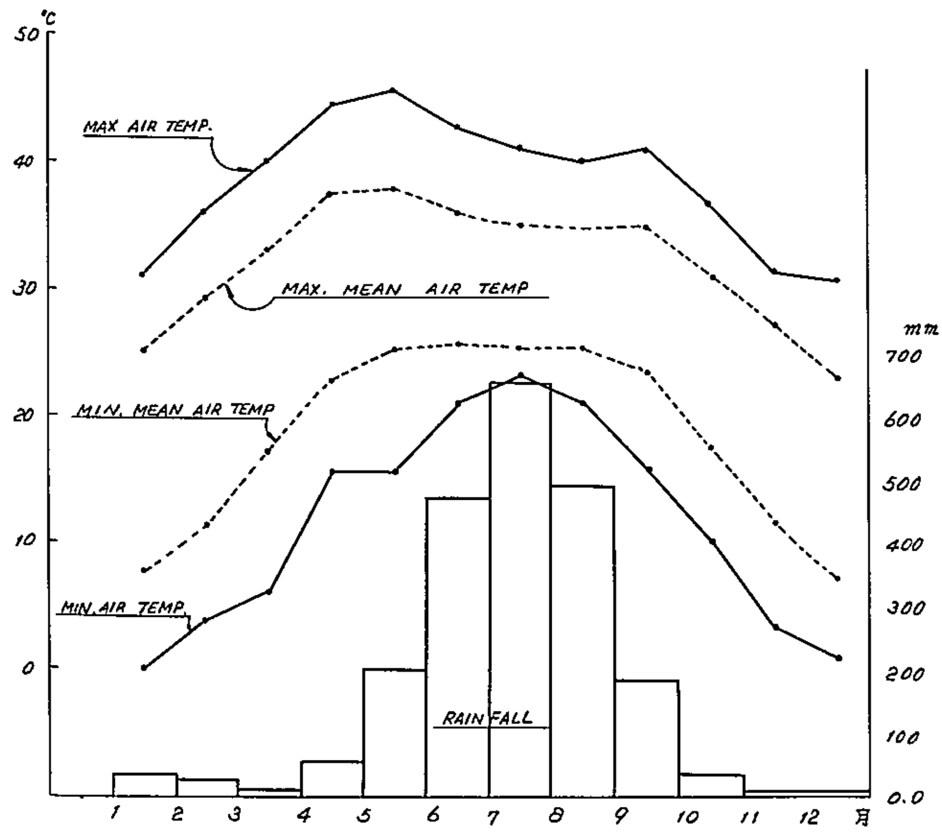
The monthly maximum mean temperature ranges from 23.1°C (December to January) to 37.9°C (May to June), while the monthly minimum mean temperature ranges from 7.2°C (December to 25.5°C (June to July). Minimum mean temperature of more than 20°C is observed over a six month period. In summer, the maximum temperature exceeds 45°C and the minimum is lower than 15°C, whereas in winter, the maximum temperature is in excess of 31°C and the minimum is lower than 0°C.

The seasonal distinction and its relationship with cultivation do not differ much from those in Janakpur Zone. The dust storm and hailstorm

FIG 4 1-1 RAPTI AGRICULTURAL STATION (PAMPUR FARM) AIR TEMPERATURE AND RAINFALL (MEAN VALUE FOR 1958 ~ 1966)

DATA . RAMPUR FARM , CHITWAN (2015 ~ 2023)

COMPILATION TUA RAPTI MODEL FARM



MONTH	1~2	2~3	3~4	4~5	5~6	6~7	7~8	8~9	9~10	10~11	11~12	12~1	TOTAL
MAX. MEAN	25.1	29 3	32.9	37.4	37 9	36 1	35.2	34 6	35.0	31 1	27 0	23 1	
MIN MEAN	7 7	11 2	17 3	22 5	25 1	25.5	25 4	25.3	23 4	17 4	11.6	7 2	
MAX.	31 2	36 1	40 0	44.5	45. 6	42.8	41. 1	40 0	41 1	36 7	31 2	30 6	
MIN.	0. 0	3 9	6 1	15.5	15.5	21 1	23 3	21 1	15 7	10 0	3 3	1. 1	
RAINFALL	34.5	27 3	11 6	56.8	201 7	468 6	651.6	490 7	182 0	39.2	4 3	7.0	2156 3

NOTES : ① AIR TEMPERATURE IN °C AND RAINFALL IN mm
② YEAR IN AD

attack the district during the April - June period to inflict serious damages upon the growth of various crops. For instance, leaves of banana trees are split into a broom-like shape, vines of the gourd family are stripped off and their fruits broken, and the early planting paddy, maize and late planting wheat are subjected to the development white head caused by their imperfect pollen germination. Provision of windbreak forests and supply of sufficient irrigation water are therefore required to prevent these damages.

4.1.1-2 Soil Conditions[1)]

(1) The surface soil is either loam or sandy loam, and the sub-surface soil, which is composed of sandy soil, is underlain by a gravel layer having a large percolation ratio, and therefore has a small water capacity.

(2) The soil in the district generally shows a high acidity (pH 4.5 - 5.5), contains little nitrogen, effective phosphoric acid and organic matters. Crops are observed to be affected by phisiological diseases caused by the deficiency of boron, magnesium and lime.

(3) Soil productivity has markdedly declined in recent years. In some farm land, the yield of maize has dropped to one-tenth of the value recorded 10 years ago or no yield at all is recorded.

(4) Increase in agricultural production cannot be attained without taking active measures for improving soil productivity such as the cultivation of green manure crops, larger dosage of compost and stable manure, application of lime and chemical fertilizers, improvement of cropping pattern, irrigation and other measures for proper soil management. If these measures are not taken, Chitwan district is liable to turn into a desert area in a matter of few years.

Note: 1) Refer to the Report of the Japanese Preliminary Agricultural Survey Mission in Nepal, p. 51.

4.1.2 Socio-economic Conditions [2) 3)]

. (1) The project area embraces new farm land created by the settlers from mountainous districts who are willing to participate in agricultural development. Inhabitants in the area are therefore freed from the conflict for religious reasons, conventional formalistic restrictions on daily life or calss discrimination due to caste system, and show strong desire to digest and adapt themselves to the improved farming in their social environment which are characterized by a considerably mobility. On the other hand, however, they tend to leave their villages when they are confronted with a certain degree of difficulties in their farm management. Particularly, when the outcome of their cultivation efforts falls short of their expectation due to the decline of soil productivity or the lack of their farming techniques, they are apt to leave their land in search of better conditioned places. This is considered attributable to the absence of their deep attachment to land as well as the lack of will to exert themselves to the last, though the severe natrual conditions, particularly soil conditions, are also responsible for such trend of farmers.

(2) Farm economy is now in the process of transition from natural economy to monetary economy. However, due to the short history of settlement, capital accumulation of individual farm households is limited. The first phase development of the whole Chitwan district under the settlement programme is already completed, [4] but the second phase development has not been yet embarked upon. Capital investment by individual farmers is limited to the initial input effected immediately after reclamation, and no successive investment for the second phase development is yet made because of the deficient recovery of initial capital input. This has resulted in the decline of soil productivity, and unless the second phase development is put into practice, Chitwan district will be reduced to its former state of herb zone.

Chitwan district used to be the area of shifting cultivation of Tharu due to its soil conditions which refuse the development of settled agriculture. Improvement of farming techniques should therefore be coupled by economic reinvestment.

Notes: 2) See Report of JASMN, p. 15
3) " " p. 25
4) " " p. 37

(3) It is impossible for farmers in Chitwan district to carry out its second phase development with their own funds. Construction of irrigation facilities, roads, warehouses and farm produce processing facilities will be undertaken by the government investment, but the investment for improving farm management should be made with the loans from Agricultural Supply Corporation and Land Reform Saving Corporation with the co-operation of Agricultural Development Bank and Co-operative Society.

Structure and existing state of the above-mentioned organizations whose assistance is indispensable for improving farm management are described in Section 3. 1. 3, "Regime and Institution," and common problems relating to these organizations are found in both Chitwan district and Janakpur Zone.

(4) Activities of agricultural co-operative societies in Nepal have originated from Chitwan district. Though famrers in the district have co-operative organizations (such as Gram Sabha, irrigation association, etc.), their activities are stalemated. Of a total of more than 40 co-operative societies, there can be found not a single society whose activities merit attention.

Since farmers in the district show a progressive attitude towards the development project, the current stagnancy of co-operative societies will be remedied if the farmers are convinced, in a practical manner, of the importance of the role which co-operative soceities will play in improving their farm management.

(5) In Chitwan district, merchandising of agricultural products is fairly developed, but their distribution is in the hand of brokers. Because of the limited sources of cash income and absence of processing and storing facilities, farmers sell most of their produce immediately after havesting. Hence, the price of agricultural products in the harvesting season differs markedly from that in the off-crop season. For the establishment of a satisfactory distribution system which will encourage the farmer's volition for production increase, agricultural co-operative societies should play the major role in providing farmers with the facilities for storage,

winnowing and processing, and should also carry out, in cooperation with Agricultural Supply Corporation and agricultural financing organizations, such activities as the storage of agricultural products, provision of loans to member farmers required for such storage as well as the distribution of profits and proceeds of joint procurement and sales among members farmers.

4.1.3 Irrigation [5)]

(1) In the total farm land area of 32,800 ha in Chitwan district, irrigation farming is conducted in the10,000 ha area covered by Upper Khageri Canal. In the remaining two-thirds of farm land, rain-fed farming prevails but its production is on the marked decline because of the shortage of water which is aggravated by the poor water retaining capacity of soils.

Geology of Chitwan district does not allow the irrigation using groundwater from tube wells as practised in Janakpur Zone, nor does it permit the minor irrigation resorting to small streams except in the limited area in the eastern and southwestern parts of the district. Many villages in the district are therefore suffering from the constant shortage of water. In view of the clear distinction between the wet and dry seasons, improvement of irrigation facilities should be given high priority in the agricultural development of the district.

(2) The Chitwan plan is composed of three stages of river-side terraces. The fluctuation of groundwater level between the wet and dry seasons is very large in the plain. According to the measurement conducted at Bharatpur and Yagyapuri by the staff of TUA Rapti Model Farm, the range of fluctuation is as large as 2 to 10 m or more. Considering the high due attention to the relationship between the irrigation

high permeability of soils in the district it will be necessary to pay due attention to the relationship between the irrigation water management

(3) The design benefited area of Upper Khageri Canal is 10,000 ha, but the acreage actually covered in 1968/1969 was no more than 3,200 ha. This is partly due to the fact that the rainfall in the said year was smaller than in normal years, but the major cause is the poor water managment.

The plot-to-plot irrigation currently adopted calls for a large duty of water, and the excessive intake of water in the upstream section of the canal results in the shortage of water in the downstream area, making it impossible to supply water to the whole design benefited area.

Note: 5) See Report of JASMN, pp. 36 - 42.

4.1.4 Agricultural Extension

Agricultural extension in Chitwan district is being carried out by District Agricultural Development Office, a subordinate organ of the Department of Agricultural Extension, Ministry of Land Reform, Food and Agriculture, HMG, in cooperation with other pertinent organizations.

Organs cooperating with the said office in the administrative aspect are District Panchayat Office and Village Panchayat, those cooperating in the supply of agricultural materials, equipment and funds are Agricultural Supply Corporation, Bharatpur Depot, Bharatpur Branch Office of Agricultural Development Bank, Narayani Ghat Branch Office of Land Reform Saving Corporation and Bharatpur Branch Office of Co-operative Society, and those cooperating in the technical aspect include Rapti Agricultural Station (Rampur Farm), Rapti Horticultural Centre (Yagyapuri Farm), TUA Rapti Model Farm, and Bharatpur Veteranary Hospital.

Assistance is offered by USAID for the overall agricultural extension work, with one agricultural engineer stationed in the district to give guidance and assistance to both DADO and Rampur Farm.

DADO in Chitwan District, now located within the compounds of Yagyapuri Farm, is expected to move to Bharatpur shortly. At present, no exclusive officer is appointed to this DADO, and Makuwaupur District Agricultural Development Officer is concurrently serving as DADO in Chitwan district.

Six JTs are assigned under the said DADO to assist him in the guidance of extension workers. 22 JTAs are stationed in different villages and engaged in the extension service for farmers together with a few members of the Peace Corps of the United States.

The number of Village Panchyat in Chitwan district is 42, of which 21 have JTAs stationed for direct extension service.

DADO is responsible for the extension administration and technical guidance of JTA, and exercises overall control over the extension work in the district. JTA performs the demonstration of improved farming techniques in the demonstration plots provided within the fields of farmers to enlighten them on the need of agricultural development. He also assists farmers in the procedures they must take in procuring agricultural materials, equipment and loans, and further offer them guidances and recommendations on farm management and farming techniques.

Spread of wheat cultivation in Chitwan district is truly remarkable in recent years. Planted area of wheat rose from virtual zero in 1965 to more than 5,000 ha in 1969. This phenomenal expansion was achieved because the existence of domestic and Indian wheat markets served as an effective incentive to increased wheat production. When considered from the technical viewpoint, the expansion is attributable to the fact that the varieties suited to Chitwan district were introduced from the outset, wheat cultivation does not demand particularly sophiscated techniques, improved varieties were introduced after the distribution system of chemical fertilizers had been established, and farmers were favourably conditioned for wheat cultivation.

However, such remarkable expansion is not yet achieved with paddy, maize, horticultural crops and industrial crops. Generally speaking, suitable varieties of these crops have not yet been obtained. For some of these crops, market exploitation is still deficient, sophiscated cultivation techniques are required, or farming environments are still ill-conditioned.

The Mission wishes to point out that solution should be brought to the following problems which relate to the existing state of extension work.

(1) The current shortage of absolute number of JTA and JT demands the increase in their number so as to provide as many villages as possible with the benefit of extension service. It is to be noted, however, that the elevation of their technical level and enriching of their knowledges are also essential for the smooth and sound progress of extension work.

(2) Extension workers stationed in villages have no necessary agricultural guide-books and they only carry publicity pamphlets for farmers.

They are not equipped with extension materials and equipment such as the pumps for controlling diseases and pests, nor do they have even bicycles for communication. There is a lot of room for improvement in both working and living environments of extension workers.

(3) Current extension service is intended for production increase of major cereals such as paddy and maize alone. In Chitwan district, however, production increase of these crops should be coupled by the efforts for increased cultivation of such other crops as leaf mustard and horticultural crops as well as dairy farming of buffaloes. Need for such efforts is voiced in respective extension plots to improve the economic footing of farmers.

(4) Exten sèrvice covers each of a few major crops such as paddy, wheat and maize, with emphasis placed on the introduction of improved varieties, application of chemical fertilizers and control of diseases and pests. In future, extension service should be developed to cover the farm management itself for its overall technical improvement. Smooth progress of agricultural development cannot be attained without the extension service intended for sound farm management and increased agricultural income. For this reason, extension efforts should be directed to rational crop rotation, cultivation of green manure crops for increasing soil productivity, and production of compost and staple manure.

4. 1. 5 Farm Management

Farm management of many farm households in the project area is extremely unstable. Most farmers have completed the first phase development after their settlement, but no preparations are as yet made for the second phase development. The first phase development, though completed already, has in effect ended in the mere deprival of the natural productivity of soil and has not been directed towards reproduction.

External causes for such unstable farm management are:

1. Unstable soil moisture due to rain-fed farming.
2. Decline of soil productivity.
3. Undeveloped distribution system of agricultural materials, equipment and products.

4. Immaturity of agricultural credit activities.

5. Immaturity of agricultural extension work.

Internal causes deriving from farmers themselves are:

1. Poor farming conditions.

2. Poor farming techniques.

4.1.5-1 Internal Factors of Farm Management

(1) Among the inhabitants settled in the project area prior to the implementation of the settlement programme, there are landowners or large scale owner farmers whose operational holding exceeds 50 ha. The percentage of tenant land in the area is as small as 20% since the majority of farmers are those settled by the settlement programme. Hence, the average operational holding per farm household is about 2. 7 ha.

(2) Farm work load is covered by family labour and employed labour. Tenant farmers and small scale owner farmers resort to their family labour and daily labourers in their farm management, wherease owner farmers with more than 3. 4 ha of operational holding depend on the permanent farmhands and daily labourers. Participation of farmily members in the farm labour decreases with the increase in the operational holding.

(3) Large type tractors are owned by large scale farmers or rice mills, and are also used for plowing at a charge. Introduction of small irrigation pumps is noted to be increasing in recent years. Ordinary farm households own Nepalese wooden plows with metal tips called Halo, Dhande (animal-driven break harrow), hoes, sickles and winnows. About half of farm households in the area possess wooden-wheeled (steel rimmed) carts driven by two bullocks as a means of transportation. It is noticed that an increasingly large number of farmers are hoping for the introduction of hand tractors to save the plowing labour and powered threshers to improve the threshing effiency of wheat.

(4) More than two bullocks are kept by every farm household. Bullocks are used for farm labour, and cows are kept only to obtain calves. No dairy cattle are kept. Farmers in the project area keep a large number

of cattle which are not fully made used of. The prevailing practice of rearing a large number of cattle, which is ascribed to a religious reason, is imposing undesirable pressure on farm economy and also incurring yield reduction because the cattle eat the growing crops. Goats are kept by almost all farm households to obtain meat. Buffaloes and poultry are reared by some farm households to obtain milk from the fomrer and eggs and meat from the latter. Rearing of buffaloes is desired by many farmers because it promises daily cash income from milk, but is difficult for most farmers because of the shortage of funds and feedstuff.

4.1.5-2 Farming Techniques*

4.1.5-2.1 Crops and Cropping Pattern

In areas where irrigation water is available during the wet season, maximum efforts are made for paddy cultivation, and in areas where no irrigation water is available, maize is cultivated. Farmers in the project area are known to often exert their utmost for paddy cultivation to avail. This is ascribable to the fact while their aspiration for paddy cultivation is extremely intense, irrigation facilities are not satisfactory at all. It deserves attention, however, that in the past, they never failed to produce some, though not a large, yield on paddy (which is close to upland paddy in terms of variety) only if water was available during the transplanting period.

* Description in this paragraph is based on the survey conducted by TUA Rapti Model Farm.

Upland paddy and ragi are cultivated in upland fields, but the acreage of their planted area is limited because of the lack of improved varieties and the heavy work load for their weeding which coincides with the transplanting of paddy. Ragi is cultivated only as the material of the local wine, and its planted area and yield are both small.

Major crops cultivated in the dry season are mustard and wheat. Mustard used to be the major dry season crop, but it gave place to wheat about three to four years ago. Both mustard and wheat are cultivated in upland fields, and mustard is hardly cultivated as the second cropping in paddy fields. In some areas, wheat gives its place back to mustard due mostly to the decline of soil productivity. The ratio of non-planted area is substantially large in the dry season because of the deficient soil moisture.

Wheat cultivation as the second cropping in paddy fields is not popularized yet because it is impracticable since most of paddy varieties cultivated in the area are late planting type. For the second cropping in paddy fields, therefore, Khesari (Lathyrus Sativus) and Chana (Cicer Ariotinum) are cultivated.

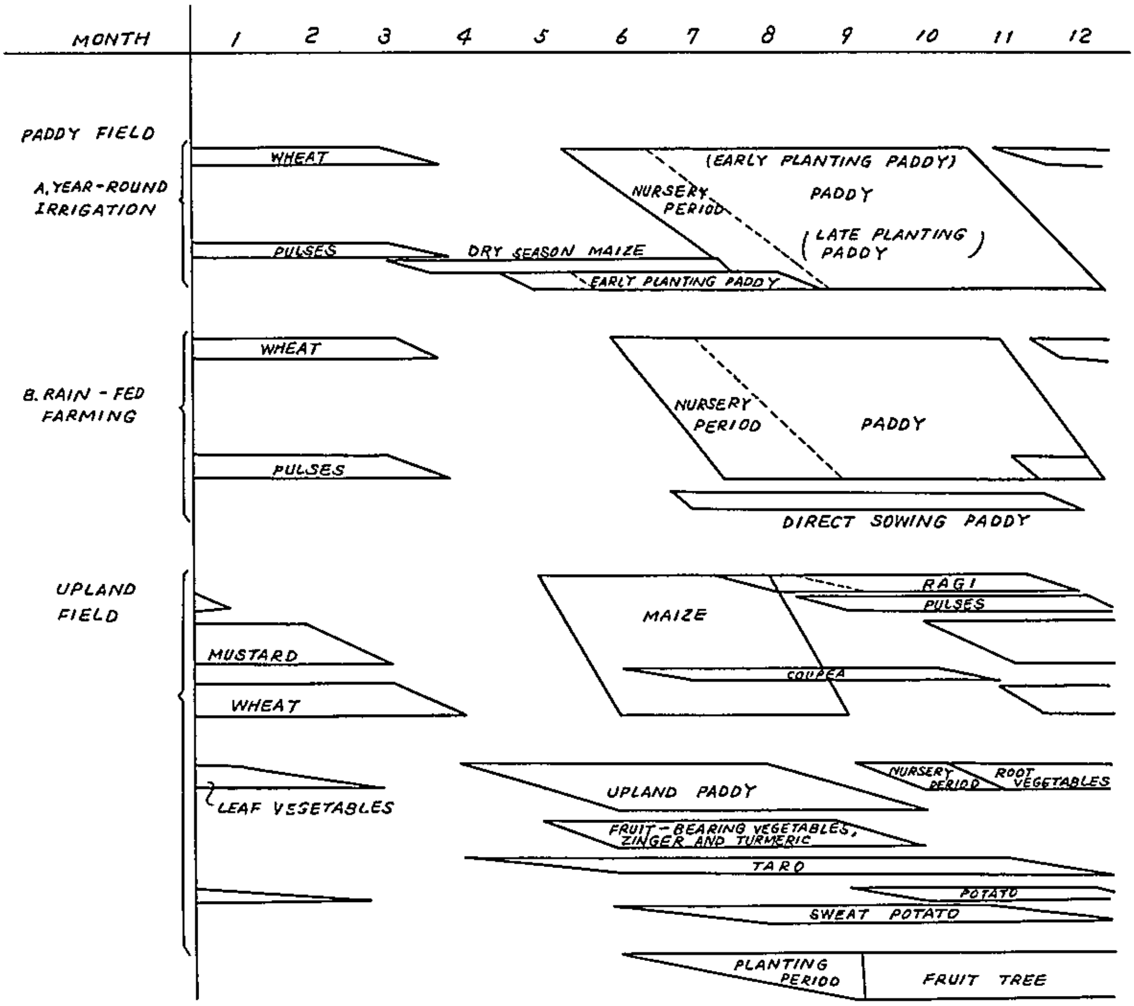
Planted area of sugarcane recorded a sharp expansion since two to three years ago after the construction of a raw sugar factory in Mongerpur Village. The present planted area of sugar cane is already in excess of the processing capacity of this factory. Expansion of planted area cannot be expected unless the capacity of the said factory is expanded or a new factory is established, or farmers carry out the processing on their own.

No noticeable vegetables are cultivated during the wet season excepting those belonging to the gourd family (cucumber, pumpkin, and bottle gourd). From autumn to winter, raddish and leaf vegetables (leaf mustard, cauliflower, and rape seedling) are cultivated for the domestic use of farm households. In the hot and dry season, green vegetables disappear completely. Raddish has come to be cultivated for marketing, and some farmers are conducting trial cultivation of water melon and potato. Vegetables cultivated in the project area other than those mentioned above include taro, egg plant, tomato, red pepper, turmeric, ginger, okra, sweet potato, and lima bean.

Fruit trees are extremely limited in kind. Banana, mango and lemon are the major fruit trees, and papaya, jack fruit and guava are grown for domestic use. A pineapple factory was constructed in 1969 in West Chitwan, but its operation is now suspended due to the shortage of raw material.

The crop rotation currently practised in the project area is as shown in Fig. 4.1-2.

FIG. 4.1-2 EXISTING CROP ROTATION PATTERN



4.1.5-2.2 Cultivation Period

The Cultivation Period in the project area comprises the wet season and dry season. In the dry season, cultivation of crops concentrates in the dry and cool period, and virtually no crops are oultivated in the hot and dry period. The dry season cropping is no more than a secondary and supplementary one to the wet season cropping. Needless to say, the concentrated cultivation in the wet season is due to the abundance of soil moisture. In the hot and dry period of the year, growth of agricultural products excepting deep-rooted fruit trees is totally impossible unless irrigation water is supplied.

Cultivation of the wet season crops is determined by rainfall. Upland paddy and taro are planted from around the middle of April resorting to the drizzling rains that fall before the advent of the wet season. For these two crops, a period of two months is provided for sowing and planting because of the fluctuation of both time and volume of light rainfalls before the wet season. Planting of upland paddy and taro is followed by the successive sowing and planting of maize, fruit-bearing vegetables, ginger and turmeric. Sowing of paddy is conducted after the wet season begins. The period from late June to mid-August is most suited for transplanting of paddy. Yield of paddy decreases if transplanting takes place after late August. It is said that a bumper crop of paddy can be expected if rainfall in July and August is sufficient. In the case of maize, however, bumper crop is brought if rainfall is large in May and June and small in July and August. June to September is the planting period of fruit trees.

Cultivation of the dry season crops starts from around mid-September when the sowing and planting of potato and raddish takes place, which is followed by the sowing of mustard in the October - November period, then by the sowing of whear and pulses in November. Sowing of all crops is completed at least in the beginning of December. Onion and water melon are sown and planted in the January - February period, but their cultivation in the project area is negligible.

Year-round irrigation areas are favoured with rich soil moisture and allow for the cultivation of crops suited for high temperature. In some parts of such areas, early planting maize and paddy are cultivated with the sowing conducted in the March - April period for the former and in May for the latter. However, the planted acreage of these early planting crops is extremely small, and this must be taken into consideration in planning the year-round stable cultivation of crops for the future. In planning the year-round cultivation, account must also be taken of the fact that the single cropping of late planting paddy still predominates in the benefited area of Upper Khageri Canal.

Even when the year-round irrigation has come to be fully practicable, cultivation of crops in the periods divergent from the conventional farming periods will entail a great risk.

Cultivation of early planting maize and paddy in the dry season is advantageous in that their harvesting period coincides with the off-cropping season of major cereals and therefore promises high marketability. However, the dust storm during the flowering and ripening period of these crops not only retards their growth but even prevent their pollen germination. This is the reason why the dry season cultivation of these crops ends in failure except in areas surrounded by jungles in East Chitwan. Further, if the harvesting period coincides with the wet season by advancing or deferring the cropping period, reaping and winnowing work entails an extreme difficulty. With the existing farming techniques, therefore, extensive cultivation of paddy and maize in the dry season is not feasible. Advancing or deferring of the cropping period also incurs many difficulties in plant protection if the planted acreage is small. To be more precise, crops cultivated by such arrangement of cultivation period will be subjected, in the first place, to the attack of pests which will last throughout their growth period, and will also be confronted, in the period immediately after sowing as well as in the ripening period, with the damanges by birds* such as parakeets (mostly Psittacula eupatria) and crows (mostly Corvus splendeus) which sometimes reach the extent that all seeds are picked up to provide no yield at all. Rats will also incur as heavy damages as birds. In the area close to jungles, damages by wild boars, deer, monkeys and even rhinoceroses will be quite serious. Cultivation of early planting paddy in the wet season is subjected to the similar adverse effects. For protection of such early planting crops, use of agricultural chemicals and protective machinery and equipment can be conceived of, but it is not quite advisable from the viewpoint of farm management and is not readily practicable at present for farmers. Primary efforts should therefore be directed to expanding the planting area of crops to be cultivated within a same cultivation period for diversification of risk, with measures also taken for collective plant protection.

Wheat is an important crop ranking next to paddy and maize, but it is cultivated in upland fields as the second cropping of maize. Since irrigation during its growth is not feasible, no large yield can be expected. Considering the need for improved irrigation and maintenance of soil productivity, wheat should be cultivated as the second cropping in the irrigated paddy fields. However, since the best sowing period of wheat is November and the late planting paddy is being cultivated as preceding crop, cultivation of wheat as the second cropping in paddy fields will not be possible unless late or medium planting varieties are introduced for paddy production and the efficiency of plowing work is largely improved.

* See the Report on REMFTUA, p. 24.

4.1.5-2.3 Variety

Paddy rice: Main local varieties cultivated in the northwestern part of Chitwan district number 18. The varieties which are cultivated most widely are Monobhog, Sattari and Achhame-masino. As a special variety, there is Anaudi of glutinous rice group.

All the local varieties are the so-called Indica type paddy and their disadvantages are that they are subject to lodging, have low fertilizer togerability and have low yield. On the other hand, their merits are that they are the drought resistant, disease resistant and insect resistant and insect resistant varieties and the greatest advantage, among others, is that they do not have off-season heading following the extension of nursing period and therefore are easy to cultivate. They also have the palatability likened by the local people and are highly marketable. In particular, the flovorous rice (Basmati) is transacted at high prices at Kathmandu market by brand name of Chitwan Basmati. As there are not many varieties having high water resisting property among Chitwan's local varieties, the variety which is suitable for submerged cultivation is being introduced from other regions (In Chitwan district where drainage is good and rain-fed cultivation is practiced mostly, there has not been any demand for submerged variety. However with the start of irrigation by the upper Khageri canal, this variety is more in demand recently).

Formerly the improved variety used to be introduced from India. In recent years, however, such varieties as IR5, IR8,Taichung (N) I have been introduced with the guidance of USAID and the HMG of Nepal is making efforts for the extension of these varieties. These introduced varieties are far superior to local varieties in respect of yield and moreover, since they are early planting variety, there is a possibility of wheat as a second crop in the paddy field. These varieties, however, are less resistant against drought, water and disease and cause off-season heading if the period of nursery is prolonged. In other words, they are of the type which involves more difficulties in cultivation. As their platability is not likened by the local people and their marketability is not so high, local farmers avoid cultivation of these varieties. Cultivation of these varieties may continue for some time to come because of high yield but the expansion of its cultivated area may not be expected. In the future, development of early maturing variety and middle maturing variety which are easy to cultivate and make it possible to cultivate wheat as a second crop and have higher yield than local variety is expected. The variety which is stable in submerged cultivation and promises high yield is also needed.

Upland rice: The variety of upland rice being cultivated in Chitwan district is not stable and definite but so far, 12 local varieties have been confirmed. The varieties which are most widely cultivated are Aon, Sojani and Mutmulu (also called Karinathi). Experiments on the improved variety of upland rice are being conducted by the Rapti Model Farm and therefore, the extension of that has not been in progress. In this district where rain-fed cultivation is widely practiced, extension of upland crop is considered most appropriate. However, no manuring control method for upland rice has been developed so far and no variety which is equivalent to paddy rice in respect of palatability and yield has been discovered to date. On this point, the results of experiments being conducted at the Rapti Model Farm are expected.

Maize: The local variety of maize being cultivated in Chitwan district is not certain one which is pure and definite and there seem to be no specific variety. However, local farmers classify them into four categories, namely, Tulo-Pahilo, Sano-Pahilo, Tulo-Seto and Sano-Seto. It is said that the white grain variety is slightly inferior to the yellow grain variety in yield but in respect of palatability, the white grain variety far exceeds the other. The varieties most extensively cultivated in this district are Khumal-Yellow (Antigue 2D x Guatemala) and Rampur-Yellow (JI) (both of them are the line of US). In respect of yield, no other varieties can match these two varieties. Both of them have high yield compared with local varieties and for this reason, the cultivated area of these two varieties is steadily increasing. These varieties, however, fall behind the local varieties in respect of palatability. Because of this, the marketability is rather low at present. In addition, their longer growing period makes them unfit for cultivating of local farmers. Though many Nepalese like sweet corn as roasted corn, these varieties which stick to teeth are not fit for their test.

The development of the variety which has the short growing period, high yield and suits the palate of the Nepalese is strongly hoped for.

Wheat: Formerly wheat was not cultivated widely in Chitwan district and accordingly, there was a very few local varieties. At present, only the improved Mexican varieties are being cultivated and local varieties has been completely discontinued. Such varieties as Sonora-64, Lerma Rojo-64 and S331 have excellent disease resistance, fertilizer tolerability and are highly drought resistant with high yield. The farmers of Chitwan district do not like to cultivate the red grain variety, but they like the white grain variety because of the high marketability. In any event, extension of these improved varieties of wheat have been a major factor for the stabilized cultivation of wheat in this district. No other crops in this district have had so much improvement in variety as in the case of wheat.

The majority of other field crops such as ragi, mustard, potato, pulse and vegetables are local varieties and no classification of variety has been tried up to date. The only introduced variety is the Japanese origined watermelon which is cultivated in some part of the district.

4. 1. 5-2. 4 Cultivation and Gardening Techniques

Tillage: For small upland intended for the cultivation of vegetables or for the cultivation of ragi as a intercropping with maize, tillage is provided by human power with the use of a plow. In other cases, tillage is done mostly by bullock-driven plow using a local Halo. Halo provides only V-shape plowing and does not provide soil turn-over. Following Halo plowing, ground breaking is provided by wooden break harrow (Dhande) drawn by two bullocks. Plowing of paddy rice single crop field is provided once in the January - March period, once in the May - June period immediately after rainfall and once by bullock driven plow prior to the planting after watering the paddy field. Surface soil puddling is provided by Dhande. Some farmers omit bullock driven plowing in the January - March period and provide two consecutive bullock driven plowings in the May - June period. Where wheat is cultivated as a second crop in the paddy field the bullock driven plowing in the January - March period is omitted. In case of cultivation of maize as the succeeding crop of a single cropping or mustard, plowing by bullock driven plow is provided once in the February - March period and once in the March - April period and for the land used for cultivation of wheat, bullock driven plowing is provided twice in the March - April period immediately after the harvest of wheat. The third plowing is provided simultaneously with seeding of maize. In case of upland rice, plowing is provided in the same manner as that for maize but some farmers provide one or two additional bullock driven plowings. For cultivation of mustard, the first bullock driven plowing is provided immediately after harvesting maize and 3 or 4 more bullock driven plowings are provided before seeding period. For cultivation of ragi following the harvest of maize, 2 or 3 bullock driven plowings are provided after removing stump root of maize and weeding by hand. For cultivation of wheat following the harvest of maize, plowing is provided in the same manner as that for mustard. However, for cultivation of wheat as a second crop in the paddy field, 3 or 4 consecutive bullock driven plowings are provided immediately after harvesting rice. With the paddy field where soil moisture is great, however, it is difficult to accomplish this work. This is one of the reasons for preventing the cultivation of wheat in the paddy field of the irrigation area.

In recent years, plowing by means of large tractors has been in generally practice. Ordinary farmers also till by renting large tractors. The large tractor, however, is not used in the paddy field but used only in upland. As bullock driven plowing of corn field with standing stumps involves difficulties, there is an increasing tendency toward the use of tractors for plowing in order to ensure timely seeding of maize.

The present bullock driven plow does not provide sufficient turn of soil and gives shallow plowing only sufficient enough for seeding and rice planting. Meanwhile, the use of steel plow driven by two bullocks developed by the HMG of Nepal recently is steadily expanding. In case of steel plow, turning and deep plowing to some extent are possible. In case of tractor, disc harrow is used but plow is not used.

Fertilizer application: The farmers have a belief that cultivation of vegetables and upland rice without suppling of fertilizers and manures is impossible and as a result, they use compost and stable manure. Where no compost and stable manure is used, fertile land around their houses is used for cultivation of these crop. Other crops are cultivated without fertilizer in most cases. In recent years, however, a decrease in soil productivity of upland has become more conspicuous and as a result, some farmers are endeavering to secure compost and stable manure. While the number of live-stocks raised by farmers is relatively large, most of the animals are raised through pasturage and stall-feeding is provided only at night. For this reason, the production of compost and stable manure is very small. Farmers with abundant compost and stable manure use it mainly for the cultivation of maize. The amount of fertilizer used in 600 - 1,200kg per 10 a. In the paddy area, compost and stable manure is used for the cultivation of wheat raised as a second crop in the paddy field. All the farmers know the effect of compost and stable manure and they also realize the need of compost and stable manure. It is said, however, that they are unable to produce compost and stable manure because of a shortage of animal feed and lack of raw materials.

For chemical fertilizer, ammonium sulphate is mostly used and compound synthetic fertilizer (20-20-0) is also used in part. Phosphate and potassium fertilizers are not used by farmers. Though chemical fertilizer is used for wheat and improved varieties of paddy rice, its use is limited to a small group of farmer. Other crops are being raised without fertilizer in most cases.

Farmers are concerned about the risk in providing chemical fertilizers - or capital investment - for the cultivation of paddy rice, mustard and wheat on the ground that cultivation itself is not stable due to unstable water use.

Raising seedling: Upland nursery bed is used as the nursery bed prior to it's transplanting of the paddy rice. One of the methods is to provide first 2-3 plowings and harrowing with the use of Dhande and then make a broadcast seeding of rice in the entire area of nursery and dress the seed with the use of a Dhande. The other method is to sow with the spacing of about 130 cm in width, cover the seed with the soil obtained from ditch, place tree branches and leaves over the soil as a shade and remove them after germination of the seed. The former is the local method originated in Chitwan and the latter is the method originated in the mountain area. The seed is sown after wind selection. The area of nursery per 10 a of paddy field is generally 20 m^2 - 60 m^2 and the rate of seeding is 5 ℓ - 12 ℓ and the amount of seed rice per m^2 is 100 cc - 540 cc. Of course they vary with each farm household, soil productivity, soil moisture and seeding period. Irrigation of nursery is provided at time of transplanting if water is available but when no water is available, irrigation is not provided during the entire period of nursery.

Nursery of ragi is provided in the fertile land selected from around the house or the ground on which live-stock has been raised. The selected ground is tilled with a long handle hoe, weeded and is made to the rather high ridge. No cover of soil is required. The area of nursery per 10 a of paddy field is 15 - 23 m^2 and the rate of seeding is about 420 cc.

Raising seedling of vegetable and fruit tree is not practiced by most of the farmers and the seedlings are purchased from Yagyapuri Farm or Rapti Model Farm. This is mainly due to the lack of raising seedling techniques on the part of farmers.

Sowing: Direct Sowing is provided for upland rice, maize, wheat, pulse, mustard and part of paddy rice. For upland rice, direct sown paddy rice and mustard, broadcast seeding is made after soil preperation and the covering is provided immediately by Dhande. Seed of maize and wheat are sown in the ditch while providing bullock driven plowing with the use of Halo after soil preperation. In case of maize, covering is provided by Dhande after sowing but in case of wheat, the sown seed is left without covering. For wheat, the same sowing method as that for the mustard was employed at the initial stage of its cultivation. However, as the germination ratio was low because of dryness of seed and damage by birds, ditch sowing after plowing has come to be in common practice.

Sowing of pulse cultivated as the intercropping of maize is made at time of last cultivation for maize and that for the pulse cultivated as the intercropping of paddy rice is made by broadcast sowing on standing crop following the full sprouting of ear. For direct sowing of these crops, the method of sowing after providing straight furrows as employed in Japan is not practiced here. For upland rice, maize, and wheat, drill sowing is desirable in some cases but the farming in this district involves problems which must be solved prior to the introduction of techniques of such a method. Transplanting and setting: Planting of paddy rice is made when there is abundant rainwater and sufficient water is impounded in the paddy field. When pulling of rice seedlings without watering nursery bed it is customary with local farmers to beat seedlings against rocks or logs to remove dirt from the root, thus damaging stump root almost completely. Rice planting is provided mainly by women and irregular planting method is being done. Transplanting is made as if to force the seedling into the ground diagonally with a thumb. Spacing in the row is said to be about 16 cm for the field where there is abundant water and about 10 cm for the field with less water. On-the-spot inspection of the field after reaping revealed that there were 30-42 stumps per m^2. The number of seedlings per stump is 1-2 for early planting variety and 4-5 for late planting variety. The standard seedling age is generally 30-40 days but the seedling age for some seeding ranges from 15 to 65 days. The seedling age is determined solely by the timing of rainfall and not by the appropriateness of the seedling.

Best timing for transplanting of ragi is said to be during and immediately after rainfall and continued fine weather after transplanting is said to be undesirable. Planting is made by one-seedling planting method and the stump is forced into the soil with a thumb. Spacing in the row is about 10-15 cm for irregular planting. On-the-spot inspection revealed the number of stumps per m^2 to be between 30 and 59. The seedling age ranges from 20 to 40 days. No transplanting is made for upland rice; maize, wheat and mustard.

Setting of potato, ginger, turmeric, taro, tomato, eggplant and edible flowers is provided by irregular planting and not by drill planting. The spacing in the row is not fixed and it varies depending on the individuals planting them. Recently some farmers have begun to try ridging for planting of potato. Setting of vegetables with soils kept on the root is not practiced and accordingly, cohesion is very unsatisfactory.

Weeding:

Weeding of paddy field is generally provided once on the 15th - 30th day after transplanting. Some industrious farmers provide weeding twice during this period. This work is done manually mainly by women. Some farmers do not provide weeding for their paddy field. The first weeding of corn field is provided 10-15 days after sowing. Though careful intertillage with the use of a long handle hoe is said to be desirable, most farmers use Dhande with claws (Bamboo or wood claws) to comb the entire area of upland. The second weeding is provided on the 20th - 50th day after the first weeding depending on the growth of weed. This time weeding is provided with the use of a long handle hoe and molding is provided simultaneously with intertillage. For maize, two or three intertillage weedings are said to be desirable. However, because of a shortage of labour,plowing between rows with the use of a local hoe is provided once when the weed reaches a height of 30 - 40 cm (30 days after sowing). In such a case, however, it is said that high yield cannot be expected. Felling of maize at time of the first weeding is said to be very effective. For the cultivation of maize, it is generally said, "Intertillage weeding is indispensable even when fertilizer application is neglected". Thinning of maize is provided at time or around the second weeding to reduce the number of plants to 26 to 36 per m^2. Weeding for upland rice is provided carefully with the use of small hoe 20 or 30 days after seeding. When weed is rampant thereafter, the second weeding is alwo provided. Upland rice is said to require more careful weeding than maize.

In some case weeding for ragi cultivation is provided once about 30 days after setting of the plant with the use of a small hoe also for additional purpose of providing intertillage but in some case, weeding is not provided.

Weeding is also provided for mustard and wheat.

Intertillage weeding is provided positively for maize and upland rice but not for other crops. This is probably, due to the fact that, for the crops whose initial growing period falls on the June - July period, the growth of such weed as Digitaria adseendens and Panicum crus-galli is most active and that without weeding, the growth of crops is hampered considerably.

Prevention of damage by blight and insects.

There are many kinds of insects injurious to each crop item. The injurious insects to rice are Chils suppressalis, Leptocorixa sp. Diricularia oryzae and Xanthomons oryzae. For wheat, Puccina sp. inflicts serious damage and for potato, damage by Phytophthora infestans, Virus is extensive. Of many harmful insects, however, the only insect whose name is known to local farmers is Corbett rice bug (Leptocorixa corbetti China). This insect has come to be known by the farmers probably because the damage by the insect is apparent to the eye of the farmers. As far as the disease is concerned, however, local farmers have little knowledge in general. As a result, no measures have been provided for the prevention of diseases. The only countermeasure taken by farmers against Corbett rice bug is that they refrain from growing early variety of paddy whose heading period conincide with the vermination of the insect-early stage of the rainy season and the last stage of the rainy season. Some industrious farmers have begun taking steps for the prevention and extermination of plant pests with the use of such agricultural chemicals as BHC, pholidol and Methasystox against Corbett rice bug (Leptocorixa corbetti China) and Dithane against blast. However, the majority of farmers have little knowledge of plant pests and agricultural chemicals and because of this fact, coupled with lack of funds for the purchase of agricultural chemicals and machines, no measures have been taken up to date for the prevention and extermination of injurious insects.

Irrigation:

Irrigation water for the paddy field with abundant water is drained once 3 or 4 days after transplanting. Thereafter continuous plot-to-plot irrigation is provided. For paddy field which lack sufficient irrigation water (Majority of paddy field lack irrigation water), efforts are being made to impound water of the quantity sufficient enough for transplanting except for the time when heavy rain inundate the paddy field. In actuality, however, the paddy field after transplanting often lacks water. Drainage of irrigation water is made in early October or late October when the ears start drooping.

Irrigation of wheat field is provided once in the January - February period only when irrigation water is available. Almost no irrigation is provided for vegetables grown even in the dry season. This is mainly due to lack of irrigation water.

Harvesting, Threshing and Winnowing:

Reaping of paddy rice is generally provided in early November for early muturing variety and reaping of late maturing variety is completed by late December. Paddy rice cultivated in the dry season is reaped in late August. The rice reaped during the dry season is dried on the field for 4 to 5 days after reaping and transported to the threshing room in big bundle and threshed by beating the ear against dirt floor. In some cases, threshing is made after the bundle of rice heaped has been left in the field for 5 to 7 days. After threshing by beating, the straw is then stamped by several bullocks for further threshing. The rice reaped during the rainy season is threshed only once by beating the ear on the matting such as straw mat immediately after reaping. Rough rice reaped during the dry season is almost completely dry and therefore is stored after wind selection. The rice reaped during the rainy season is dried in the sun when the weather is favorable. Drying skill of rough rice is still poor and notched-belly rice kernal rises frequently. Selection (sorting) is also poor and the ratio of immature ear is considerably high.

Threshing and drying of upland rice practiced are similar to those for the early variety reaped during the rainy season.

Maize is harvested during a period from mid August to mid September. After harvesting the spike is removed from stalk, carried inside the building and sorted out into good spike and waste spike. After being dried in the shade, good spikes are heaped up on the wood stand (Thagura) provided outdoor for storage. Waste spikes, after being dried in the shade, are then removed of kernel. The kernel is then dried in the sun. Removing of kernel is done either by beating with a stick or by hand. Harvested maize is taken out from Thaguri for threshing as necessary.

Ragi is reaped during a period from mid November to mid December and after being dried, is threshed by beating with a stick, sorted out by wind selection and then dried. Mustard is harvested in the February - March period, threshed by stamping by bullocks and then given wind selection. Pulse is harvested in the March - April period and after being dried in the sun with stalks for about a month and threshed by stamping by bullocks. Threshing of red bean is provided by beating with a stick.

Wheat is harvested in the March - April period either through spike reaping or stump reaping and after being dried on the ground for 4 to 7 days, is threshed by beating with a stick. Stamping by cattle would not provide sufficient threshing of wheat. For this reason, tremendous labour is required for the threshing of wheat. After threshing and wind selection, wheat is dried in the sun and then stored. Delays in the threshing of wheat often result in the complete failure of threshing if encountered by rainfall thereafter.

Because of inadequate facility and poor skill in the threshing of cereals, valuable harvested crops have to be threshed on the dirt ground, thus making the grain to sink into the ground. In efficiency delays threshing considerably and often leads to the spiling of grain when encountered by rainfall, causing a considerable damage to the crops.

4.1.5-2.5 Yield

Yield of each crop varies greatly depending on the climate, cultivation techniques and the variety. The average yield of each crop is shown below. Of course there are cases in which yield is nil or close to it.

		md per ha
Paddy rice:	Rain-fed paddy field	0.6 - 1.7
	Irrigated paddy field	1.5 - 2.6
Upland rice		0.6 - 2.2
Maize		1.6 - 2.3
Ragi		0.8 - 1.9
Mustard		0.6 - 0.8
Wheat		1.0 - 1.2

4.1.5-2.6 Storage

Storage of maize has already been discussed in the previous section. The majority of other cereals are stored in Dokase which is a large bamboo basket sealed with clay or in Dokoti which is a section of building partioned with wood panel. Cereals are sometimes kept in Jute bags and stored in the building. Some large scale farmers provide Dokoti separately from the dwellings for specific use. Both Dokose and Dokoti are useful for the protection of grains from outside moisture but fail to prevent damage by pest.

Because of inadequate storage facility, many farmers make hasty sale of their grains. Even the large scale farmers, while planning the sale during the off-crop season, sell their grain at a reduced price for fear of the damage to the stored grain because of incompleted storage facility. Storage method is very unsatisfactory in addition to inadequacy of storage facility.

4.1.6 Rapti Experiment and Model Farm of Tokyo University of Agriculture[1)]

4.1.6-1 Location

This model farm is situated in lat. 27°40' N. and long. 84°25' E., approximately 1.5 km south of Bharatpur airport and its altitude is 191 m above sea level. To the northeast, there is the Narayani River and the model farm situate on the riverside terrace which protrudes in the shape of a fan. As for transportation, regular RNAC flight service from Bharatpur airport to Kathmandu, Gorkha and Pokhora is available during the dry season (October - June). As for land route, Rapti Road links Bharatpur with Hetaura and extends to Kathmandu and then reaches the Indian border. The road, a gravel road, is often disrupted during the rainy season (July - September). The Model Farm is located in the southwest corner of the Yagyapuri Farm operated by the HMG of Nepal.

*1) The Report on Rapti Experiment and Model Farm of Tokyo University of Agriculture (Aug. 28, 1970)

4.1.6-2 Purpose

Through the operation of a small model farm in Chitwan which has been taking the lead in agricultural development in Nepal, it is aimed to introduce agricultural techniques, crop seeds and seedlings and agricultural machines developed in foreign countries including Japan, to participate in the development of agricultural techniques, seeds and seedlings and farm guidance in the improvement of agricultural technique and agricultural assistance in the improvement of agricultural technique and agricultural management. Also by letting the Japanese technicians familiarize themselves with the Nepalese agriculture, understand the Nepalese culture and history and cooperate in the development of agriculture in this country, it is intended to train aggresive and able technicians for the cooperation of overseas agricultural cooperation and at the same time to provide accommodation for the Japanese people visiting Nepal for study and research on agriculture and rural area of the country so that they may be provided with opportunities to familiarize themselves with the country they are visiting.

4.1.6-3 Background

The Nepal Agricultural Academic Survey Mission of Tokyo University of Agriculture made a fact-finding survey on rural area and agriculture in Nepal on two occasions in 1962 and 1964. Upon consultation with the Agricultural Dept. of the HMG of Nepal on the basis of the findings, agreement was reached on the establishment of a Model Farm as a joint project with the Department.

4.1.6-4 Organization

Though the Mode Farm is under the jurisdiction of the Agricultural Education and Research Department, Ministry of Land Reform, Food and Agriculture of the HMG of Nepal, the management is independent and autnomous. The actual operation of the Farm is the responsibility of TUA group and the organization of the Farm is as follows.

Japanese staff	
Director of Farm	1
In charge of food crops	1
In charge of horticultural crops	1
In charge of indistrial crops	1
In charge of agricultural machines	1
In charge of agricultural management	1
Nepalese staff	
Field man	2
Agricultural machine operator	3

Of the Japanese staff, the Director of the farm became a Columbo-Plan expert in 1969 and four of the five Japanese staffs are members of the Japanese Overseas Cooperation Volunteers.

4.1.6-5 Facilities

Land

Classification of the land used by the Farm is as follows (For details, see Fig. 4.1-3)

Total land area	7.65 ha
Arable land	5.27 ha
Farm road and Levee	0.40 ha
Grass land	1.79 ha
Building lot	0.40 ha
Reservoir and irrigation canal	0.15 ha

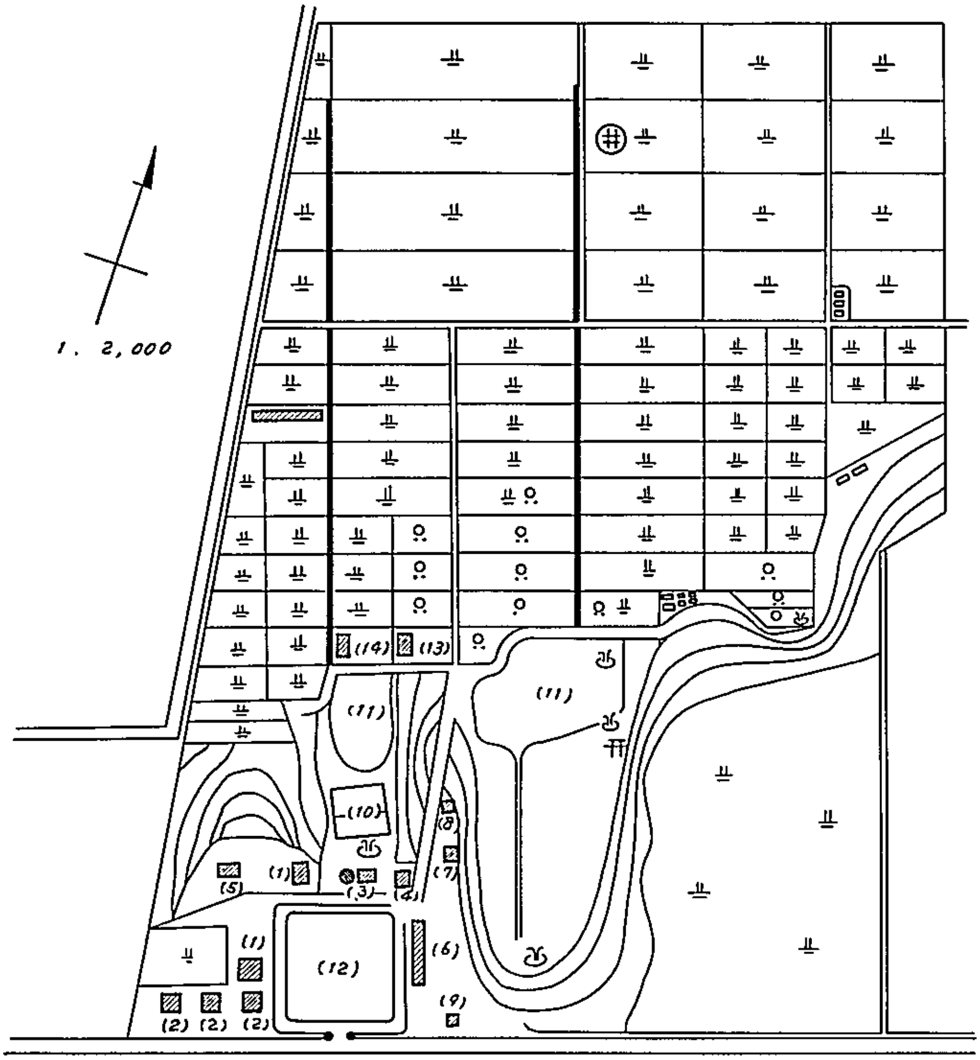
Field (Arable land):

The plot of field is a unit of 10 a in the flat land and 5 a or 2.5 a in the sloped land. In the steep slope, the plot has irregular contour lines. No plot division is made for upland field. 36 brick and mortar lined paddy fields are provided for experiment cultivation of paddy rice and wheat by means of intensive irrigation and one 1 m x 10 m brick and motar lined frame is also provided as a nursery bed.

Irrigation water:

For irrigation, flowing water, apparently the groundwater from the riverside terrace is being utilized. The flowing water is impounded in the reservoir once and then distributed to field. The amount of the water is, however, so small that it is only sufficient enough to irrigate a very small portion of the field. Though the capacity of the reservoir is about 1,400 m^3, the full capacity storage was recorded only at the time of the heavy flood in July and August 1970, and in other years the highest record of storage even during the rainy season was 300 m^3. As water source is not available in the vicinity, the shortage of irrigation water is one of the most serious problems for the Model Farm. Satisfactory execution of the work cannot be expected without the solution of this problem. On the other hand, the soil of the Model Farm consists mainly of sandy soil having a gravel layer at the bottom and no clay layer is observed. The soil has a high permeability as a as a result of this and water cannot be utilized to the fullest extent because of the leakage in the resorvoir and canal.

Fig. 4.1-2 A MAP OF RAPTI EXPERIMENT AND MODEL FARM OF TOKYO UNIVERSITY OF AGRICULTURE



INDEX:

—— : Canal, ═══ : Road, ⛩ : Sacred place, ⊥ : Field (paddy and upland), ♀ : Orchard (banana and pine-apple), ♨ : Spring, ⊕ : Well, ▭ : Compost pit.

(1) Lodging house for the staffs, (2) Lodging house for the labourers, (3) Cleanning-house (cold-bath) and tube-well, (4) Thatched dining-hall, (5) Brick latrine, (6) Store-house cum agriculture machine shed, (7) Thatched agriculture implement shed, (8) Nursery-house (thatched), (9) Cement work-shop, (10) Pond for carp-raising, (11) Reservoir, (12) Barn-yard, (13) Thatched stall, (14) Nursery bed with concrete-flame, (15) Brick-flamed paddy-plot for experiment of rice-culture.

The irrigation canal is lined with brick and has a total length of 150 m. Besides, there is a 350 m earth canal. The lowest spot of the farm is in the concaved land where no drainage is possible. At present a shallow well 6' in diameter is being dug in the low land of the farm and the ultimate depth is expected to be 10 m. It is yet to be seen, however, how much water will be available from this well.

Buildings:

The Model Farm which made its start with a few tents now has the following buildings.

Lodging house for the staffs (Including administrative office and dining hall)	2 buildings - 113 m^2
Store-house	1 building - 172 m^2
Bathing-house	1 building - 8 m^2

The above buildings are made of wooden posts, brick walls and slate roofs. Besides, there are six thatched sheds called "Chapra" with a total floor space of 63 m^2 used for kitchen, agricultural implements shed, lodging house for labourers, etc. The present number of buildings falls short of the minimum requirement.

4.1.6-6 Machinery and Equipment

Agricultural Machines

Power tiller	2	11 HP
	1	6 HP
Irrigation pump	2	7 HP
	1	4 HP
Power sprayer	1	4 HP
Power mist (Back-pack type)	1	
Automatic thresher	1	5 HP
Bush cutter	1	3 HP
Winnowers and minor implements	6	different types
Agricultural tools	1	set

Test apparatus

Soil test equipment	1	set
Crop test equipment	1	set

There are one generator (2 kw/H) and two motor cycles in addition to the above. The farm suffers from the lack of test and experiment equipment and transport vehicles.

Fertilizer:

Consumption of fertilizer in 1970 was 9 t of lime, 70 t of compost, 1,250 kg of ammonium sulphate, 300 kg of urea, 1,300 kg of compound synthetic fertilizer (20-20-0), 750 kg of superphosphate of lime, 950 kg of potassium chloride, 9 kg of borax, 2.5 kg of boric acid, and 3 kg of magnesium sulfate.. Besides, 5 tons of compound synthetic fertilizer (16-20-0) supplied from Japan is being tested in the Farm.

Agricultural chemicals:

Consumption of agricultural chemicals in 1970 was 20 kg of Paithane Z 78, 10 kg of Ziride, 3,600 ml of Methasystox, 8,500 ml of Pholidole and 20 kg of DDT (wettable).

4.1.6-7 Activities

The activities of the Model Farm began with reclamation of grassland and land consolidation.

4.1.6-7.1 Introduction of Seed and Seedling of Various Crop Items and their Experimental Cultivation

The Farm is conducting various experiments on food crops (paddy rice, upland rice, maize, wheat), horticulture crops (potato, sweet potato, watermelon, cucumber, squash, eggplant, tomato, Japanese radish, burdock, cabbage, edible flowers, banana) and industrial crops (Sigar-cane) in an attempt to determine the variety suited best to the region.

4.1.6-7.2 Development of Farming Techniques

The Farm is now taking such measures as the introduction and extension of improved variety, crop protection measures, soil conservation measures, replenishment nurishment of fertilizer, research and experiment on irrigation etc. in an attempt to establish farming techniques. Implementation of these measures is directed specifically toward regional agriculture and emphasis is placed on the development of techniques which may be put into practice by local farmers without difficulty.

4.1.6-7.3 Production of Seed and Seedlings of Improved Variety

The Model Farm is also engaged in the production of seed and seedlings of the varieties most suitable to the region which were determined by the above research and experiment cultivation and is distributing them to the HMG of Nepal and directly to local farmers.

4.1.6-7.4 Extension Service

Extension service is being provided to local farmers for the dissemination of information on the results of research and experiment cultivation and the findings of the experiments conducted in other research institutes through extension service agents by maintaining constant coordination with DADO. Demonstrations of new farming techniques, cultivation of new crop items and improved varieties and the use of agricultural machines are held in the Model Farm and in some of the field owned by local farmers as a means to encourage local farmers and JTA in their attempt to develop new farming techniques.

The Model Farm is also providing instructions on the operation, repair and maintenance of farming machinery of Japanese make for those wishing to learn among the local farmers and for the government employees. Introduced farm machinery of the type which is considered appropriate for use in this country are made available to the HMG of Nepal for trial manufacture with the guidance on the manufacturing method provided by the Model Farm. The Farm also lend agricultural machines to the farmers upon request and provides instructions on the use of the machinery.

4.1.6-7.5 Survey and Analysis of Traditional Farming Method

Development of new farming techniques generally makes its start in the traditional farming practice. In this sense, the Model Farm is conducting a survey on the traditional farming method practiced in Chitwan district for each crop and is making a study on the problems and the matters to be given further attention.

4.1.6-8 Model Farm Operating Expense

The financial status (1965 - 1969) of the Model Farm is shown in Table 4.1-1.

Table 4.1-1 Financial Report of REMF of TUA (in Rs., NC)

	1965	1966	1967	1968	1969
I. Income					
Farm product			6,019.89	4,599.87	10,660,55
Donation					
1. OXFAM		30,075.75	31,730.30	33,133.47	26,199.28
2. F. F. Foundation			12,415.53	5,050.00	
3. N. Kishi				27,600.00	27,600.00
4. T. Shimada					18,000.00
5. Others	10,571.90	11,133.41	9,691.43		
Balance carried forward from the last year account		2,037.26	1,103.96	1,477.98	2,655.75
Total	10,571.90	43,246.42	60,970.11	71,861.32	84,645.65
II. Expenditure					
Maintenance					
senior technician	1,379.55	10,678.70	11,867.96	12,000.00	7,200.00
junior technician		3,830.30	2,855.28	5,000.00	8,997.51
Correspondence	126.90	928.90	573.45	598.53	433.41
Recording	118.61	238.54	198.68	144.35	67.25
Transportation				1,149.46	1,762.40
Seed & nurseling	180.00	562.31	1,002.58	795.84	1,086.25
Fertilizer	254.04	1,310.08	2,572.22	3,091.55	8,141.66
Agri. machine & tool	246.15	1,446.02	1,692.67	1,842.25	7,048.90
Insecticide & fungicide		443.66	187.92	730.07	2,016.45
Live-stock		625.00	824.65	432.75	189.50

4.2 Agricultural Extension Plan

4.2.1 Basic Conception

The following are problems to be solved for the purpose of promoting agricultural development in the project area..

(1) Unskilled agricultural technology

(2) Deteriorated soil condition

(3) Poor-equipped irrigation facilities

(4) Insufficient extension activities

(5) Undeveloped distribution system for agricultural materials and agricultural products

(6) Unskilled agricultural credit works

Solution of these problems will promote agricultural development and achieve the expected obejcts.

The present plan shall be implemented with the following basic concepts for the purpose of solving these problems.

1. The present plan is to be implemented, in cooperation with Chitwan DADO Office which is engaged in agricultural development project of Narayani Zone and Chitwan district, for the purpose of extending the improved farming system through agricultural extension works to the project area, elevating the agricultural productivity of the area and improving the standard of living of the farmers.

2. The plain area of Chitwan district is the main objective of the present plan, and not the whole arable area of 32,800 ha is subject to the plan but only the area selected by the DADO and the competent authorities in charge shall be the objective.

One agricultural extension area shall be an area equal to one village Panchyat of the same area, and the total number of village Panchyat shall be determined according to the number of JTA to be despatched by DADO. The number shall be ten village Panchyat or less. It is advisable not to concentrate all village Panchyat in a particular area but to scatter them all over the entire Chitwan area (plain area). According to the traffic condition, however, locations will be selected at such places as Bharatpur, Yagyapuri, around the road from Bharatpur through Gitanagar to River Rapti and around Rapti Highway.

3. The concept of extension works in the present plan is in principle equal to that of Janakpur.

4. All farm households in the project area are subject to the agricultural extension works and the extension works are exercised to benefit many farm households from the agricultural extension works. Meanwhile, efforts are made to foster farmers who endeavor positively for development of the local agriculture in villages and play an influential role in technical improvement of farmers in general. It is natural that agricultural development is to be promoted by the farmers themselves, and guidance by native farmers especially conscientious farmers makes it possible to develop farming system unique to the area with a considerable effect. In general, only a few progressive farmers are found in Nepal, and they have no influence upon other farmers. Fortunately there are many farmers who can be progressive farmers in Chitwan. The present plan has an aim to guide those farmers to become progressive farmers with instructive ability to other farmers.

5. Objective product under the present agricultural development plan is not limited to such main cereals as paddy rice, wheat, maize and etc. but guidance is made also for every product which farmers can raise among many varieties of horticultural and artificial products. Furthermore, comprehensive guidance for farm management will be made, including improvement of various environments around farm management. Such a guidance will be conducted especially for fostering future progressive farmers.

6. Agricultural technique to be applied for agricultural extension works should be of a certain level which farmers of various categories can apply, and not be of such a level as a leap.

7. Mutual self-training is required for JTA, JT and Japanese experts through cooperation in activities for extension works for the purpose of developing their own ability to answer farmers' questions and assist

them. Re-training also will be given to JTA and JT through training at extension farms. This is not a general technical training course, but a special course to train and foster leaders who will be able to tackle and solve various difficult problems (inclusive of credit supply of materials, distribution system of agricultural product and etc.) which will turn up during extension activities.

8. Rapti Experimental Farm of Tokyo University of Agriculture situated in Yagyapuri which is around the center of the present project area shall be utilized as agricultural extension farm. It is expected that utilization of the said Farm will bear an early effect for the present plan.

9. Japanese experts to participate in the present plan must be in principle junior experts. Junior experts, however, must be university or college graduates with B. Sc. Agr. with specialized knowhow. Experts will be selected from among those volunteers from the Government of Japan and also from universities, unofficial organizations and those private volunteers who are considered to be needed for the present plan, and will be despatched, as a right man in a right place. These Japanese experts will be headed by a Japanese senior expert who will act as the manager of Extension Farm.

4.2.2 Agricultural Basis Improvement Plan

Based upon the results of the initial survey, the Survey Team recommended that irrigation water be secured and instructions must be given for planting system in development of Chitwan Valley, for this purpose a project of an appropriate scale must be enforced, and four Schemes must be taken into consideration for the purpose at present.
(RJASM, P 36 --)

As sufficient survey and research work about irrigation plan for Chitwan District could not be executed in the present survey activity, it is necessary to conduct a further detailed operational design during the survey and research for implementation of the project. It is advisable to adopt the third Scheme for pumping up of irrigation water from River Narayani among the four Schemes recommended by the initial Survey Team.

As shown in Fig. 4.2-1, Irrigation route must be connected from a point suitable for pumping up of water along the tributary of River Narayani straight to TUA Experimental Farm for the purpose of irrigating the area in the downstream side.

The area is a river terrace with fertile soil, and it is easier to conduct guidance and training in farm management in this area. A perfect water control can be introduced with a new farm pond.

FIG. 4.2-1(1) OUTLINE OF POMPED IRRIGATION FROM NARAYANI RIVER

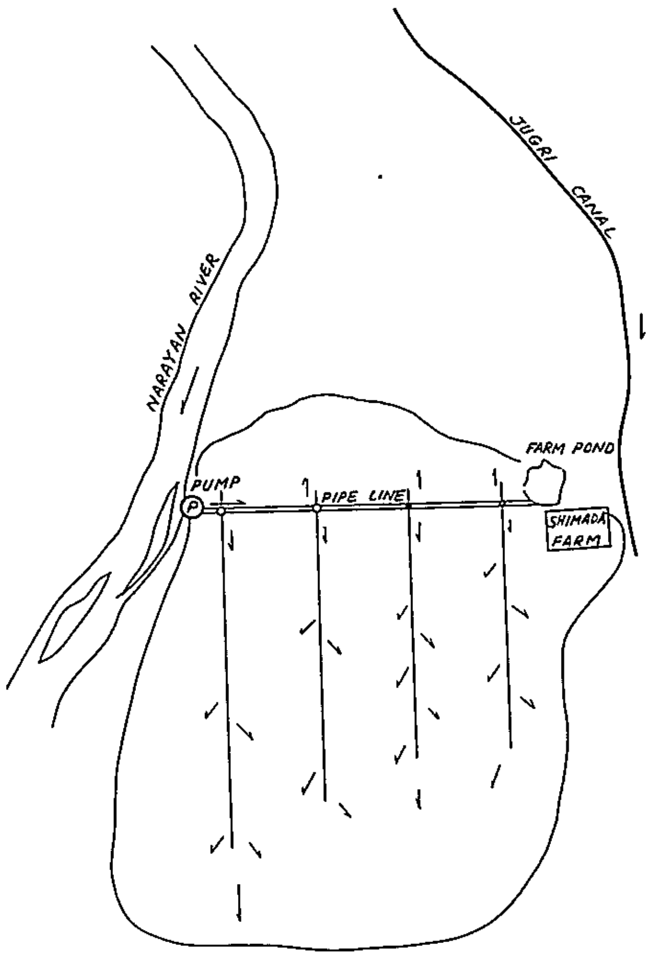
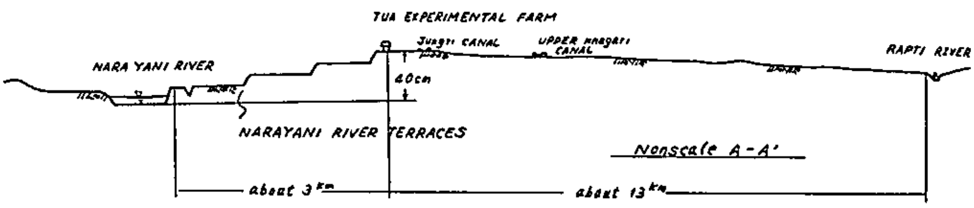


FIG 4 2-1 (2) CROSS SECTION OF TUA EXPERIMENTAL FARM



4. 2. 3 Farm Management Plan

As for the farm management plan in the present plan, an equal plan cannot be applied to all farmers because locational conditions for agriculture in various villages and economic scales of farmers are different. Especially there is a principal difference between irrigated areas and the meteoric-water areas. In the present plan, project will be planned with distinction between irrigated area and other areas, and such a plan is only a pattern for project. Practical device must be made up for extension activities.

4. 2. 3-1 Irrigation Model Area

4. 2. 3-1. 1 Basic Composition of Farm Management Plan

1) At present paddy rice is the main product at irrigated farms and paddy rice cultivated during the rainy season is the most stabilized product. Development of farm management will be planned by strengthening farmers' economy be means of increase and stabilization of paddy rice crops and furthermore improving some commercial products among horticultural and artificial products.

2) Dairy farming with buffalo is indigenous to the area. It is recommended to promote cultivation of feed all the year round for securing fodder for buffalo and increase in the amount of milk so that farmers' income be increased and the soil condition be improved by increasing production of barnyard manure.

3) As the charge for irrigation water is rather higher, it is advisable to rationalize water utilization by means of intensive water management for the purposes of stabilized crops and soil conservation.

4) It is estimated that cultivated land be utilized more by 1. 5 or 2 times than the present area and demand for labor be concentrated for a certain season. Therefore, it is necessary to strengthen labor means. Judging from the present farmer's economy and their technical level, however, it is a problem to promote a rapid mechanization of agriculture. Plan for cropping must be reviewed so that demand for labor is not concentrated.

5) Feed trees are at present raised along ridges for the purpose of securing feed for buffalo. These trees play a role as windbreak forest, however, these may be cut down in the future due to rationalization of cultivation of fodder crops. It is necessary to keep those trees as windbreak forest and introduce other profitable trees including fruit-trees.

6) The relationship between irrigation and upkeep of soil conditions in irrigated areas is shown by such a sequence as "irrigation → paddy rice cultivation → repeated cultivation of paddy rice, or cultivation of wheat → deterioration of soil condition → decrease in production." It is necessary to convert this sequence into the following: "irrigation → increase in production of main edible crops → introduction of green manure crops and fodder crops and fodder crops → raising of cattle in pen → production of cattle-shed manure → improvement of soil conditions → further increase in production."

4.2.3-1.2 Planting System

1) Paddy rice shall be the main crop to be cultivated in rainy season, to be planted for about two-thirds of the total cultivated area. Concentration of demand for labor and shortage in irrigation water can be avoided with combination of such varieties as early ripening, mid-season rice and late rice.

2) Other crops to be cultivated in rainy season are maize, upland rice by direct sowing, fodder crops, vegetables and etc. Irrigation water must be supplied to maize and upland rice upon request and if possible. Green maize and climbing kaupie are main fodder crops. Vegetables to be cultivated are those of the gourd family, taro, sweet potato, tomato, egg plant, cayenne-pepper, okra, ginger, turmeric and etc.

3) Crops to be cultivated in low-temprature dry season are mainly wheat, mustard and potato as well as pulses, vegetables, fodder crops and etc. Pulses are kaupie for seed, mas been and kesari bean, and vegetables are egg plant, tomato, radish, cabbage, cauliflower, cayenne-papper, leaf vegetables and etc. Fodder crops are also cultivated in this season.

4) Only a few varieties such as the gourd family and egg plant are suitable for cultivation in high-temperature dry season. Among those of the gourd family, water melon can be one of the maic cash crops. Amarautus among leaf vegetables is suitable for cultivation in this season. Tomato cultivated in this season is damaged by high temperature. - Green leaf vegetables and fodder crops seriously lack in this season, and it is necessary to cultivate green maize and climbing kaupie. Area to be utilized for paddy field must be provided with green manure for cultivation of daicha.

5) Such perennial crops as sweet potato, pineapple, banana, mango, ritchi, guwaba, lemon and etc. are cultivated. Nepial grass is suitable for perennial fodder.

6) It is the most important problem in planting system to make up a plan for increase in agricultural earnings without deterioration of soil conditions and difficulty in farm management caused by concentration of labor.

7) Table 4. 2-1 shows the crops available for cultivation at irrigated farms and suitable seasons.

8) Table 4. 2-2 shows basic examples of crop rotation system in consideration of stabilization of soil conditions and various problems in farm management.

9) Table 4. 2-3 shows examples of planting system by land utilization of standard farm households in irrigated areas. Habitual system includes maize as the main produce as well finger millet and mustard. Improved system includes paddy rice as the main variety as well maize, upland rice, wheat and pulses. Especially Improved A-system emphasizes vegetables. As the A-system requires high-level technique and some funds, many farmers adopt the B-system.

4. 2. 3. -1. 3 Selection of Crops to be Cultivated

1) Among edible crops, rice, wheat, maize, mas bean, kaupie and etc. are easy to cultivate and these have high marketability. Although pea and kidney bean have high marketability, these are not available for cultivation due to damage by diseases and blight. Economic cultivation is impossible for peanuts due to lack in lime and nematozer and for Raha and Chana

Table 4.2-1 Cultivating Periods of Crops in Irrigated Cultivated land

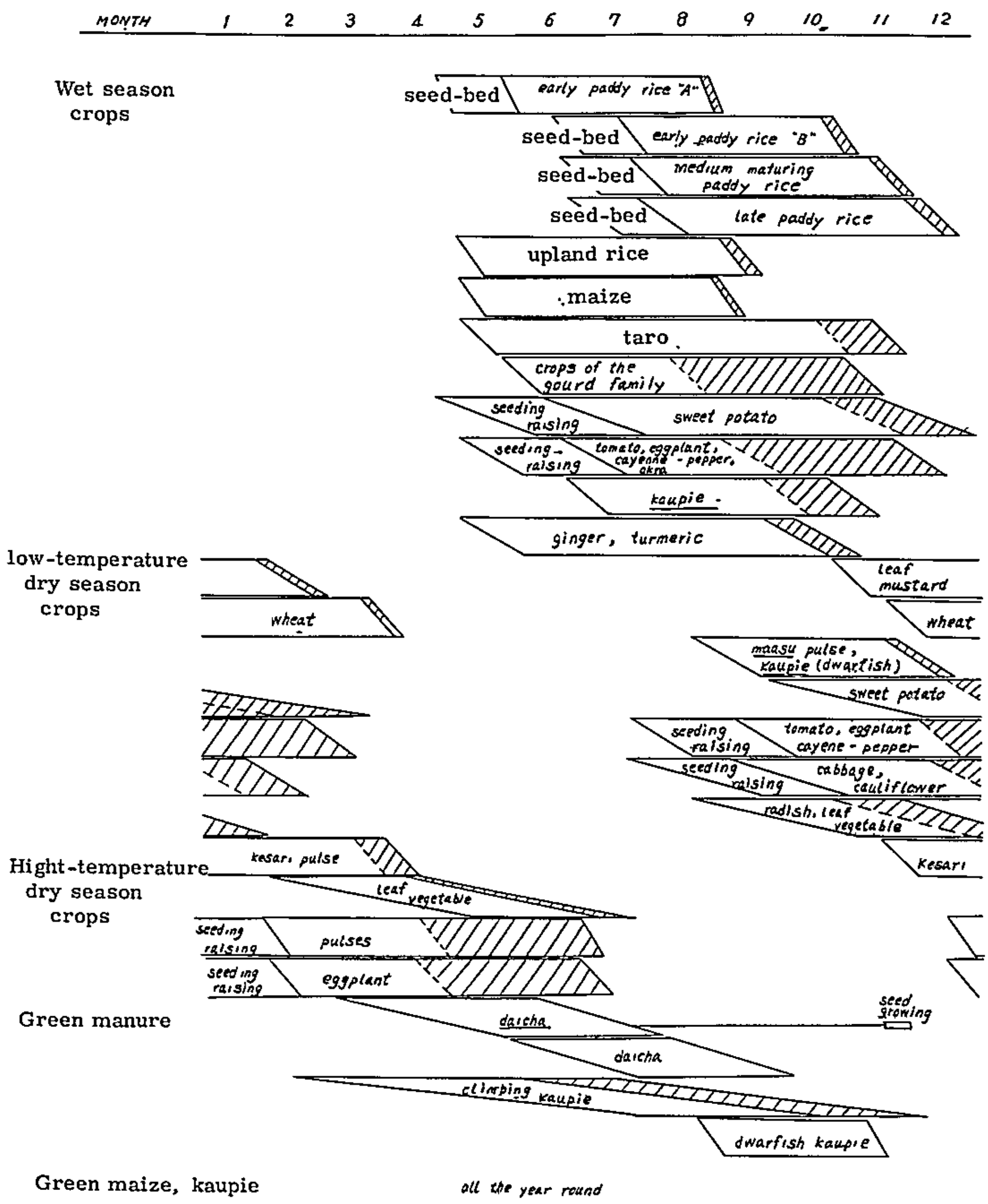


Table 4. 2-2 Examples of Plans for Crop Rotation in Irrigated Area

a. Cereals as main varieties:

Example 1.	1st year	daicha - early paddy rice "B" - wheat
	2nd year	daicha - late paddy rice
	3rd year	pulses - early paddy rice "B" - potato
	4th year	green maize, - maize or upland rice - kaupie- kaupie green menure - wheat
	5th year	maize or upland rice - maasu or dwarfish kaupie
Example 2.	1st year	daicha - medium maturing paddy rice - wheat
	2nd year	daicha - lste paddy rice - kesari
	3rd year	daicha - late paddy rice
	4th year	eggplant - medium paddy rice - wheat
	5th year	green maize and kaupie - late paddy rice - kesari
Example 3.	1st year	daicha - early paddy rice - wheat
	2nd year	green maize, kaupie - medium paddy rice - wheat
	3rd year	daicha - late paddy rice - kesari
	4th year	deicha - medium paddy rice - wheat
	5th year	green maize, paupie - late paddy rice - kesari

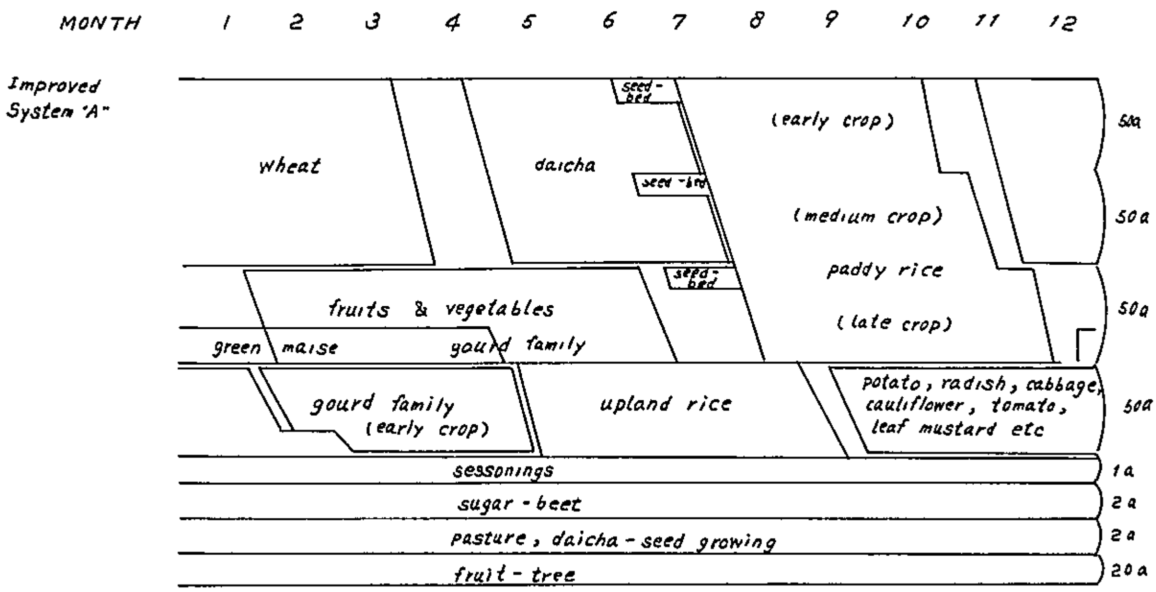
b. Cereals and Vegetables:

Example 4.	1st year	daicha - early paddy rice - potato
	2nd year	gourd family - early paddy rice - cabbage, cauliflower
	3rd year	daicha - maize - radish (early crop)
	4th year	tomato - upland rice - cabbage, cauliflower
	5th year	daicha - early paddy rice - wheat

c. Horticulture:

Example 5.	1st year	eggplant - gourd family - radish
	2nd year	leaf vegetable - early sweet potato - cabbage, caulifower
	3rd year	leaf vegetable - early paddy rice "A" - tomato, pepper
	4th year	gourd family - okra - cabbage, cauliflower
	5th year	leaf vegetable - ginger, turmeric - leaf vegetable

Table 4. 2-3 Examples of Cropping System of Standard Farm Household in Irrigated Area



beans due to low temperature.

2) Potato, onion and garlic among horticultural crops have high marketability and most of these products are consumed in local areas. Onion and garlic, however, are not economically cultivated yet even at Rapti Model Farm. It is estimated to be caused by the lack in nutrient in soil, however, the reason is not confirmed yet. Potato cultivated in the early season (around December) will be more profitable because December is the off-crop season of potato. Sweet potato, taro, radish, ginger, turmeric and water melon have high marketability and these are easy to cultivate. Especially as for water melon, if a new variety suitable for transportation for long distance is introduced, it will be a special agricultural product of the area with a large market. Tomato, egg plant, cayenne-pepper and cauliflower have high marketability with large demand by local markets and distant markets, however, it cannot be cultivated without sufficient fertilization because of the lack in nutrient in soil and damage by nematozer. Thus these varieties are difficult to cultivate. As for fruit-trees, mango, lemon and banana are popular in cultivation, and leech, guwaba and pineapple are promising. Nagpur orange and papaya are not favorable for cultivation. Especially papaya is largely damaged by nematozer, and it is impossible to cultivate it for more than two years.

3) Among artificial crops, mustard is traditional and stabilized crop. There will be no demand for sweet potato unless it is processed (for fruit sugar). When starch industry is promoted, sweet potato will be promising as the material for starch.

4.2.3-1.4 Varieties

Paddy Rice : Among early rice, such improved varieties as 1R8 and Jaya will bear expected result by good management of irrigation, however, these varieties are not suitable for cultivation in large areas under the present poor management of growth. It is necessary to popularize the settled varieties (Dudh-Raj and etc.) which can be cultivated with a less amount of water.

Among mid-season rice, 1R5, 1R20 and 1R22 will bear large profit, and Malinja and Masuri are standard varieties.

Late varieties for cultivation will be selected from among traditional varieties, and Monobhog, Sattari, Achame-masino, Gola and etc. will be standard varieties. Especially T141 is suitable for low land.

Upland Rice : Conventional varieties such as Aon, Sojani, Mutumulu and etc. are standard varieties for the time being, however, other varieties of high yield must be introduced.

Maize : Rampur-Yellow, Khumaltar-Yellow are standard varieties.

Wheat : There are many suitable varieties such as Lerma Rojo 64. Sonora 64, P. D. 6, NP852, S331, Mexi-Pak, Pitie 64 and RR21. The variety RR21 has high yield and marketability and this variety must be the standard one.

Potato : There is no suitable improved variety. Red variety among conventional Kathmandu varieties is an early crop and easy to cultivate.

Sweet Potato : There is no suitable local variety, and Japanese Tamayutaka is so suitable.

Water Melon : Every Japanese variety is suitable, and it is advisable to adopt such varieties with hard rind and red flesh as to be bearable for transportation. Such varieties as Fumin and ShinYamato will be better.

Cucumber : Japanese varieties in general are climbing early crops with high yield and good taste. Most of them are of green long shape, and people in Nepal mistake them for snake gourds, therefore, these are not preferred by the people in the early stage of popularization. It is advisable to adopt early crops of Katmandu varieties and quarterfoil type of Japanese variety.

Tomato : Such Japanese varieties as Fukuju, Super Natsu Tomato, Kurihara and NatsuTakane have high yield and good taste.

Radish : White Neck which is considered as Nerima type of Japanese variety is popular. Other popular varieties are Risc, Mino early race and Japanese summer radish.

Cabbage : Habuka and Shiki of Japanese varieties are suitable.

Cauliflower : Meigetsu of Japanese variety is suitable for early crop. Local Kathmandu varieties are suitable for late crop.

4.2.3-1.5 Self-supplying Manure

Although farmers can purchase, through ASC, chemical fertilizers and organic fertilizers, farmers should promote production of self-supplying manure for the purposes of upkeeping the soil condition and replenish nutrient to crops.

1) Green Manure

Production of green manure is the easiest method of self-supply of manure. Daicha is the best for green manure to be made before cultivation of paddy rice. Some of the farmers cultivate kesari after paddy rice crop, and this is an advisable method. It is recommendable to cultivate kaupie after maize or upland rice crops. This will be useful for cultivation of wheat. Although farmers understand the effect of green manure, they do not cultivate it at present for the following reasons: (1) they like to cultivate crops which are direct sources of income under such condition as available for cultivation of green manure; (2) green manure will be damaged by grazing cattle; (3) seed of green manure is expensive; (4) it is difficult to plow in green manure with plows of Nepalese conventional type. All of these reasons can be overcome with extensive guidance, and cultivation of green manure must be carried out together with irrigation work.

2) Compost and Staple Manure

In the project area it is easy to raise cattle in pens by introduction of fodder crops, and it is necessary to extensively promote production of compost and staple manure. These days farmers make staple manure by heaping excrement of cattle outside cattle houses, however, this is a natural result from livestock raising. In case of cultivation of green manure also, an area of one hectare should produce annualy 10 tons at least of compost and staple manure. Such a volume of manure can be produced with a pit of 2-meter width, 1-meter depth and 5-meter length. It is naturally hetter to install a grass roof.

3) Ash

It is very easy for farmers in the area to produce ash, because they usually use firewood for fuel. Potassic component required for vegetables cultivated in a small land can be supplied with such a self-supplying ash.

4. 2. 3. -1. 6 Agricultural Machinery

As for farm appliances, it is necessary to promote popularization of the improved appliances (including those appliances by means of animal power) now in production by the HMG of Nepal, and also agricultural machinery which is planned to be popularized through ASC as far as various circumstances of farmers permit. Expensive machinery which require high-level technique will be taken care by extension farm by loan system.

4. 2. 3-1. 7 Cultivation Management

1) Paddy Rice

The objective yield of paddy rice in average per hectare is 4 tons for improved varieties and 3 tons for local varieties.

Cultivating method : to be carried out by transplanting method. Disorderly planting will be continued for the coming years, and it must be gradually changed to row transplanting for the purpose of making weeding and other works easier for better growth of rice.

Supply of manures and fertilizers : At present manures and fertilizera are scarcely supplied for cultivation. This must be improved to supply manures and fertilizers. First, cultivation of green manure must be popularized, to be used as organic manure. Fertilizing quantity will be different according to varieties, however, Table 4. 2-4 shows rough standard for fertilizing. In addition, lime of 2 or 3 tons will be supplied. Extension Farm will be in charge of examination of adequate amount of manure to be applied under irrigation in the area.

Weeding : Manual weeding will be usually carried out in the early stage, and weeding work by means of weeders will be gradually adopted as row transplanting is popularized.

Control of diseases and insects : Many diseases and injurious insects are observed. Especially, it is necessary to set up countermeasure for Piricularia oryzae, Kauthomons oryzae, Chilo suppressalis and Leptocorisa sp. Intensive control must be conducted under the guidance of Extension Farm. Such chemicals as BHC, Sankel and Daisen are to be applied.

Table 4. 2-4 Standard for Fertilization (unit : kg.)

		Total amount	Basic manure	10 days after trans-planting	Period of very young head	Earring period
1R8, 1R5, Jaya and green ma-nure	N	40	-	-	20	20
	P_20_5	80	80	-	-	-
	K_20	60	40	-	20	-
1R8, 1R5, Japa without green manure	N	40	-	-	20	20
	P_20_5	80	80	-	-	-
	K_20	60	40	-	20	-
Masuri, malinja, T141 with green manure	N	40	-	-	20	20
	P_20_5	80	80	-	-	-
	K_20	60	40	-	20	-
Masuri, malinja, T141 without green manure	N	100	40	20	20	20
	P_20_5	80	80	-	-	-
	K_20	60	40	-	20	-
Local varieties with green ma-nure	N					
	P_20_5					
Local varieties without green manure	N	60	20	20	10	10
	P_20_5	60	60	-	-	-
	K_20	40	30	-	10	-

Water Control : In principle, water-saving cultivation is adopted for the purpose of reasonable utilization of water. While irrigation is required for the whole vegetation period 1R8, 1R5, Jaya and T141, Masuri, Malinja and other local varieties can be cultivated by water-saving system. Sufficient irrigation, however, must be carried out during tillering period, earing time and milk ripe stage.

2) Upland Rice

Average yield of upland rice per hectare will be 3 tons.

Cultivating Method : In habitual direct sowing method the scattered sowing method is continued, but it must be drill sowing for the purpose of promoting efficiency in weeding work. The direct sowing system must be changed to transplanting system for better weeding in the early vegetation stage and for higher drought resistance.

Supply of manures and fertilizers : Compost and staple manure of 8 tons and lime of 2 or 3 tons will be supplied to every area of one hectare. Chemical fertilizers will be supplied according to the standard in the following Table. Extension Farm will examine the adequate amount of fertilizer to be supplied.

(unit : kg)

		Total amount	Basic fertilizer	25 days from direct sowing	10 days from transplanting	Young head growing period	Ear growing period
Direct sowing	N	60	10	30	-	10	10
	P_2O_5	60	30	30	-	-	-
	K_2O	40	15	15	-	10	-
		60	20	-	20	10	10
	N	60	60	-	-	-	-
	P_2O_5	40	30	-	-	-	-
	K_2O						

Weeding : In direct sowing system, weeding is carried out 2 or 3 times with spades for also intermediate tilling. In transplanting system, the first weeding is carried out by means of spades for intermediate tilling and the second is done by manual work.

Control of diseases and insects : Countermeasures for Chilo suppressalis and Leptocarira sp. must be promoted. Its method is the same as the case of paddy rice.

Irrigation : In transplanting system, irrigation must be made during the planting and for about 10 days thereafter. In direct sowing system, the first irrigation must be made for one month before sowing (for the purpose of promoting the sprouting of weeds, however, only in case where no previous crop is in cultivation), the second irrigation during sowing and the third irrigation for 25 days after sowing. Irrigation must be made enough for earing and blooming periods.

3) Maize

The objective yield in average of maize per hectare is 3 tons.

Cultivating method : to be based upon traditional farming, and it is advisable to adopt row planting method for easier management.

Supply of manures and fertilizers : Farmers are doing their best in supplying compost and staple manure, and this practice must be further promoted so that they will be able to supply compost and staple manure of 8 tons per hectare in the future. Lime of 2 or 3 tons must be also supplied. Standard amount of chemical fertilizers to be supplied is as follows:

(unit : kg)

	Total amount	Basic manure	After one month from sowing (at the second weeding work)
N	140	90	50
P_2O_5	90	90	-
K_2O	50	30	20

Weeding : The first weeding must be done at 10 or 15 days after sowing, the second weeding is 20 days after the first one, and the third one is done 20 days after the second. The first weeding work is carried out by means of Dhande with edge, and the third one is done by means of plow for a combined purpose with intertillage, and together with molding.
After manure is supplied at the second weeding work.

Irrigation : Irrigation water must be supplied before sowing when soil moisture is not sufficient for sowing. Requirement of irrigation after that is subject to drynees. Like in the case of upland rice, irrigation made one month ahead of sowing will promote sprouting of weeds and make weeding work after sowing easier.

4) Wheat

The objective yield in average of wheat per bectare is 3 tons.

Cultivating method : to be plough soil sowing by means of Nepalese plough.

Supply of manures and fertilizers : Compost and staple manure of 8 tons must be supplied for a hectare and lime of 2 or 3 tons must be also supplied. Chemical fertilizers will be supplied according to the following standard.

(unit : kg)

	Total amount	Basic manure	One month after
N	150	70	80
P_2O_5	70	70	-
K_2O	70	70	-

Weeding: Weeding must be done for the purpose of intertillage around the first and middle parts of January by means of plough and others. Polygonum sp. and Chenspodium are main varieties.

Control of diseases and insects : Countermeasures must be set up for Microsiphum aranae, Ropalosiphum maidis, Puccinia sp. and Erysiphe graminus. It is advisable to use parathion, methasistox and etc.

Irrigation : Though irrigation is subject to the amount of soil moisture, sprinkling must be done just after sowing when the soil is so dry, and usually water must be supplied for three times, namely, in the first and middle parts of December, the first and middle parts of January and the first and middle parts of February. Especially sprinkling in the first and middle parts of January is important.

5) Mustard

The objective yield in average of mustard per hectare is 1. 3 tons.

Cultivating method : To be subject to the traditional method, and drill sowing is better for intensive cultivation at farms of a small area.

Supply of manures and fertilizers : Compost and staple manure of 5 tons and lime of 2 or 3 tons must be supplied to an area of one hectare. Standard of quantity of chemical fertilizers to be applied is as follows:

(unit : kg)

	N	P_2O_5	K_2O	Borax (to be mixed with mature compost and staple manure of 10 times volume)
Total amount	60	40	20	10
Basic manure	60	40	20	1

.6) Potato

The objective yield in average of potato per hectare is 15 tons.

Cultivating method : To be drill sowing so that low ridge is made by setting and covering and it is made high ridge by molding. It is better to make ridges 10-meter long for easier irrigation work. Covering must be shallow for early planting and a little deep for late planting.

Supply of compost and staple manure : Mature compost and staple manure of 10 tons and lime of 2 or 3 tons must be supplied. Standard amount of chemical fertilizers to be supplied is as follows:

(unit : kg)

	Total amount	Basic manure	10 days after sprouting	40 days after sprouting
N	120	40	40	40
P_2O_5	80	80	-	-
K_2O	120	120	-	-

Intertillage : When the top is hardened by rain water or sprinking in the early stage of growth, soil must be lightly plowed and weeds must be removed.

Molding : to be done two or three times, together with after manuring and intertillage. The last after manuring must be done just before the budding season.

Irrigation : Though the number of irrigation work is different according to the soil moisture, irrigation work is conducted usually 3 to 6 times. Dryness of soil will directly influence upon the growth of potato.

Control of diseases and insects : Countermeasures must be promoted especially for Phytophthora infestaus. Disinfectation must be done with Daisen next day to rainfall or once in 15 - 20 days even if there is not rainfall.

7) Vegetables

Cultivating method : Vegetables are cultivated at present for only domestic use, and cultivating method is not established yet. Cultivating methods for various crops are developed at Rapti Model Farm and developed methods will be introduced to farmers.

Supply of manures and fertilizers : Compost and staple manure of 8 - 10 tons per hectare must be supplied for each crop. Standard volume of chemical fertilizers for each crop is as follows. Lime of 2-4 tons must be applied to crops.

	N	P_2O_5	K_2O	Borax	Magnesium sulfate, to be applied to leaf surface 3 - 4 times
	(kg)	(kg)	(kg)	(kg)	(g)
sweet potato	100	50	140		
water melon	280	170	250	10	90 - 120
cucumber	270	150	220	10	90 - 120
pumpkin	170	100	170	10	90 - 120
bottle gourd	150	90	150		
eggplant	250	100	200		
tomato	250	170	230	10	90 - 120
radish	180	110	170	10	90 - 120
cabbage	250	150	200	10	90 - 120
cauli-flower	200	100	200	10	90 - 120

Weeding : More labor is required for cultivation of vegetables in rainy season. Weeds can be somewhat prevented by means of grass mulch.

Irrigation and drainage : As rainy season is subject to high humidity, drainage is very important for this season. Contrarily it is necessary to upkeep soil moisture by means of sufficient irrigation.

Control of diseases and insects : Damage is caused by such many pests and insects as Phylotreta sp., Agrotis sp., Lipaphis erysimi. Aulacophore femorolis, Margaronia sp., Virus, Bacterial wilt, Late blight, Bacterial soft rot, Anthracnose etc. It is necessary to strengthen countermeasures for these pests and insects. Pesticides, particularly those for insects must be examined at Extension Farm so that no public nuisance be caused by them.

Seedling raising : Most of farmers have no technique of raising seedlings. It is natural that technical guidance is required for them, and such guidance will be conducted by Extension Farm for the time being.

4. 2. 3-1. 8 Revenue and Expenditure of Standard Farmers

The total cultivated area of a standard farm household is 2. 7 hectares, the whole area will be irrigated under irrigation plan. The improved B-system will be adopted for planting plan.

1) Agricultural gross income

Gross income of a standard farm household will be 15, 200 Rs. by cultivation of paddy rice for 1. 5 hectares, maize for 0. 5 hectare, upland rice tor 0. 2 hectare, wheat for 1. 0 hectare, mustard for 0. 7 hectare, beans for 0. 5 hectare and other crops for 0. 5 hectare by means of reasonable utilization of water, promotion of soil condition, introudction of new imporved varieties and improvement of cultivation control.

Crops	Planted area (hectare)	Gross income (Rs.)
Paddy rice	1. 5	4, 500
Upland rice	0. 2	480
Maize	0. 5	1, 350
Wheat	1. 0	3, 600
Mustard	0. 7	1, 610
Beans	0. 5	1, 500
Fruits, etc.	0. 5	2, 160
Total	4. 9	15, 200

2) Agricultural running expenses

Agricultural running expenses will be 7, 600 Rs.

Farm management costs : 7, 200 Rs.

Cost for seeds and seedings	340
Cost for fertilizers	2, 490
Cost for farm chemicals	440
Cost for farm appliances	960

Cost for various materials		150	
Wages for employment of labor		2,150	
Interest		330	
Miscellaneous		340	
Public taxes	400 Rs.		
Total	7,600 Rs.		

Notes : 1. Wage for employment of labor was estimated with 3 Rs. per capita per day.

2. Interest was estimated as 10% of costs for seeds, fertilizers and chemicals.

3. Other items were estimated with 5% of management cost.

4. Public taxes include charge for water.

5. Cost for farm appliances include the charge for borrowing of farm appliances.

3) Farm household income

Agricultural income will be 7,600 Rs. If farm labor can be covered by domestic labor force, agricultural income will be increased, and increase in production of self-supplying fertilizers will reduce the cost for fertilizer and increase the agricultural income. This agricultural income will include benefits from land, water and etc. as well as the income from self-labor.

4.2.3-1.9 Plan for Irrigation Association

1. Object

Irrigation facilities for whole-year use will be established for the purpose of increasing the productivity of the project area, and irrigation association will be organized for reasonable utilization of irrigation water and management of irrigation facilities. This irrigation association will be a model for other associations to be organized in other areas in the future.

2. Function

Irrigation association will be in charge of maintenance and management of irrigation facilities, drawing of water-supply plan and its enforcement, guidance in farm management, espscially planting plan.

3. Activities

1) Maintenance of irrigation facilities : all maintenance and repairing works of irrigation facilities.

2) Operation of irrigation pumps : to operate irrigation pumps according to the water-supply plan.

3) Establishment of water-supply and distribution plan : Irrigation plan will be made up for each cultivated crop and water will be distributed according to the plan.

4) Planning of planting system and its enforcement : In order to utilize water in an intensive system, crop cultivating plan must be made up for areas in consideration of water requirement and guidance will be made for implementation of the plan.

5) Collection and management of water utilization charge : Costs for maintenance of irrigation facilities and operation of irrigation pumps and other purposes will be borne with the water utilization charge which members of the association will pay according to their benefited land area, and the association will collect and manage the water utilization charge.

4. Organization

Members of association : consist of benefited farmers, Yagyapuri Horticulture Centre and Rapti Model Farm.

Managing Committee : to be in charge of guidance of the whole business of irrigation association and also be responsible for management. Members of the Committee will be selected from among the members of the association. It is advisable that the Committee members have reasonable understanding and knowledge of irrigation association, sense of responsibility and power of execution. Directors of Yagyapuri Horticulture Centre and Rapti Model Farm of their deputies will join the Committee.

Planning & Research Division : to be in charge of making research and plans required for irrigation system.

Business Division : to execute irrigation plan according to the research and plans of the Planning & Research Division. Full-time staff will be in charge of the business. Staff members will be employed with reasonable pay according to their capability and qualification.

Farm Management Guidance Division : to be in charge of giving instructions for farm management to all farm households in the project area. JTA and Japanese experts will be in charge of the activitiy. It is planned to organize farm management groups (small-scale producers' cooperations) with a total area of about 10 hectares as a unit. These management groups will be unit for execution and management of all research, planning and farm management.

Loan Division : to be in charge of services for funds for farm management, control and management of funds of irrigation association and cost for water utilization. This Division will have come fulltime staff. The staff members must be capable and reliable for the duty. They will be employed with resonable pay.

4. 2. 3. -2 Other Areas Than Irrigated Area

4. 2. 3. -2. 1 Basic Principles of Farm Management Plan

1) Conditions of agricultural foundation are well improved in some areas and are not consolidated in some other areas, and also the project will cover an extensive area, therefore, suitable farming system with appropriate crops must be adopted for each area.

2) Paddy rice crop will be the main item for irrigated area and upland crops will be the main for meteoric-water areas. Main upland crops will be maize, mustard and upland rice. It is planned to introduce wheat, horticultural crops and artificial crops in accordance with condition of location and farmers' condition for the purpose of developing farm management.

3) Countermeasures for upkeeping the soil condition and others must be positively promoted. Particularly in irrigated area, intensive guidance must be promoted to check deterioration of the soil condition and convert it to reinforcement of the soil condition.

4. 2. 3. -2. 2 Planting System

In irrigated area, planting will be done according to A-system in conformity to B type. In meteoric-water area, it will depend upon the traditional farming method. It will be possible to cultivate green manure before the wet season in the future.

4. 2. 3. -2. 3 Selection of Crops to be cultivated

While selection can be made according to System-A in irrigated area, crops to be cultivated in dry season will be so limited in meteorio-water area. Wheat can be cultivated in areas which include soil moisture, however, it is generally difficult to cultivate horticultural crops. Transplanting cultivation of upland rice rather than paddy rice will be promoted.

4. 2. 3. 2. 4 Varieties

Varieties will be adopted for irrigated area according to System- A, however, it is necessary to select varieties of high drought resistance of any variety for meteoric-water area. Therefore, it is advisable to adopt local varieties of paddy rice. As for maize and wheat, improved varieties must be adopted.

4. 2. 3. -2. 5 Self-supplying Fertilizers

Production of self-supplying fertilizers must be intensively promoted according to System-A.

4. 2. 3. -2. 6 Agricultural Machinery

It is the same as the case of System-A.

4. 2. 3. -2. 7 Cultivation Management

It will be conducted in accordance with System-A in irrigated area. In meteoric-water area, attention must be paid to the following:

Paddy rice, uplan rice :

1. Healthy seedings must be raised, by means of this rate seeding, supply of manure and control of diseases and insects.

2. Compost and staple manure and lime and also chemical fertilizers especially for ear manuring must be supplied.

3. Weeding and control of diseases and insects must be intensively promoted.

4. An for irrigation, in case where there is water source in the neighborhood, water must be secured by means of small irrigation pumps in transplanting and earing periods.

Maize : To be in accordance with System-A, however, its cultivating period will be changed somewhat by rainfall.

Wheat · Tobe in accordance with System-A, however, amount of manure to be supplied must be reduced by 30%.

Mustard : To be in accordance with System-A.

4. 2. 4 Extension Plot Plan

4. 2. 4. -1 Basic Conception

Extension Plot Plan is of a conception similar to Janakpur Project. In the project area Japanese experts will cooperate as much as possible with JTA and JT for giving instructions and guidance direct to farmers.

4. 2. 4-2 Project Plan

1) Extension Plot will be established at 4 - 8 places by selecting some points of similar soil condition, condition of irrigation and googra-phical condition in an Agricultural Extension area. In irrigation model area, Extension Plot will be established at 2 - 3 places for each farm management group.

2) The area per Extension Plot will be about 10 ha.

3) Extension Plot will be set at fields of farmers who will become progressive farmers in the future.

4) Local farmers' farming technique will be improved by means of demonstration of improved farming technique for various crops at Extension Plots and training of farmers, and also instructions and guidance about over-all farm management will be given to the farmers who offered their fields for the Plots for the purpose of fostering them to become technical leadars for neighhoring farmers in the future.

4. 2. 5 Extemsion Farm Plan

4. 2. 5-1 Basic Conception

1) In principle, it is of a similar conception to Hardinath Exten-sion Centre.

2) Rapti Experimental and Model Farm of Tokyo University of Agriculture (R E M F) will be utilized as Extension Farm.

4. 2. 5-2 Operational Plan

Systems of research and tests, exhibition and demonstration, production of seeds and seedlings and maintenance and repair of farm appliances will be the same as Hardinath Extension Centre, and the following two activities will be also executed :

4.2.5-2.1 Agricultural Training

Basic Conception :

The basic conception of training plan is similar to that of Hardinath Extension Centre.

Plan for training courses:

A. Training courses for experts

1. Extension Worker's Training Course
2. Extension Worker's Seminar by season
3. Technical Course
4. Training by Observation
5. Seminar

Details of the above training courses are similar to those of Hardinath Extension Centre, and only several applicants will be accepted for the Extension Worker's Training Course.

B. Training Courses for Farmers

1. Technical Training Course
2. Technical Consultation
3. Seminar
4. Training by Observation

Details of the above training courses are similar to those of Hardinath Extension Centre.

4.2.5-2.2 Loan of Agricultural Machinery

Farm appliances of the Extension Farm will be loaned for pay to farmers for the purpose of reinforcing the farming labor means of farm households. Though the main objective will be the farmers in the irrigation model area, farmers in other areas also can borrow small-power pumps for collective control of diseases and insects and irrigation work with pumps.

4.2.5-3 Composition

The following personnel composition is required for management and research and testing works of the Extension Farm :

Japanese experts:

1.	Director of the Farm	1
2.	Agronomist	2
3.	Horticulturist	2
4.	Agro-mechanical engineer	1
5.	Soil-scientist	1
6.	Agro-irrigation engineer	1
7.	Plant protectionist	1
8.	Short-term technical helper (total number per year)	4

Successors must arrive at their posts 2 - 3 months before the termination of offices of Japanese experts. And they should take over office work, technical matters and other duties from their predecessors.

Nepalese personnel:

1.	Agro-mechanic	1
2.	Office assistant cum accountant	1
3.	Field man	2
4.	Agro-machine operator	5
5.	Guardman	1

4.2.5-4 Plan for Facilities

Following facilities are required for management of the field, research tests and maintenance of farm appliances:

4.2.5-4.1 Consolidation of Field

(1) Subsoil compacting

Subsoil compacting will be made for the purpose of preventing leakage of water from paddy field. Its area will be 330 ares.

(2) Framed paddy fields and Netted house

Framsed paddy fields and a netted house will be constructed for the use of test cultivation and training. Its dimensions are 19.8m x 25.2m, with vinyl-coated nets over steel frame and its floor will be arranged with brick mortar. There are 36 framed paddy fields of 1m x 2m at present, and other 36 new ones will be constructed. Those also will be made of brick mortar. (Fig. 4.2-2)

(3) Reclamation of sloping grasslands

Sloping grasslands will be reclamated to be cultivated lands. The area will be 70 ares.

4.2.5-4.2 Water Utilization

(1) Year-round irrigation facilities (by Mr. Iwamoto)

(2) Water-supply and drain ditch in fields

Following facilities will be established for the purpose of intensive irrigation system.

Water tank -------------- to be made of brick mortar with dimensions of 4m x 5m x 2m

Feed-water pipe --------- vinyl chloride pipe of 3-inch diameter and 500m length

Sprinkler ----------------trunk feedwater pipe --- 3-inch diameter, 300m.

sprinkling pipe --- 12 pipes of 2-inch diameter and 10m length with couplers.

stand pipe --- 12 units (with valves) for sprinkling pipes.

Nozzle ------------------ 12 units of 5/32" x 3/32" (with stand joints and supports)

Pump ------------------- to be of a caliber 50 - 60mm (200 - 250 1/min.) (with engine)

Pressure gauge

4.2.5-4.3 Cattle House (Fig. 4.2-3)

(1) Cattle house

To be used for raising draft animals, with 2 sections of 3m x 3m. The floor will be made of brick mortar and the roof will be slated over steel frame.

FIG. 4.2.2 NETTED HOUSE

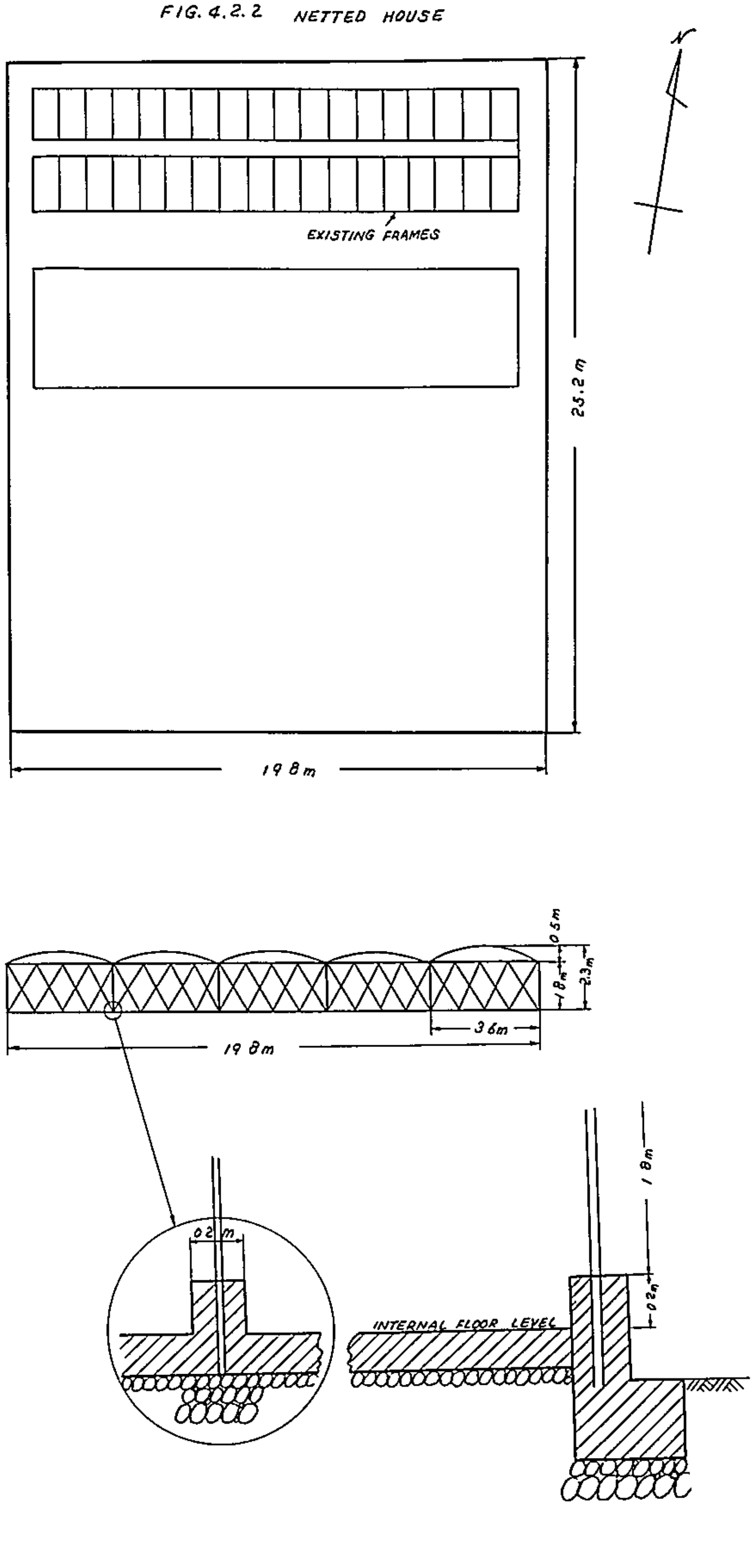
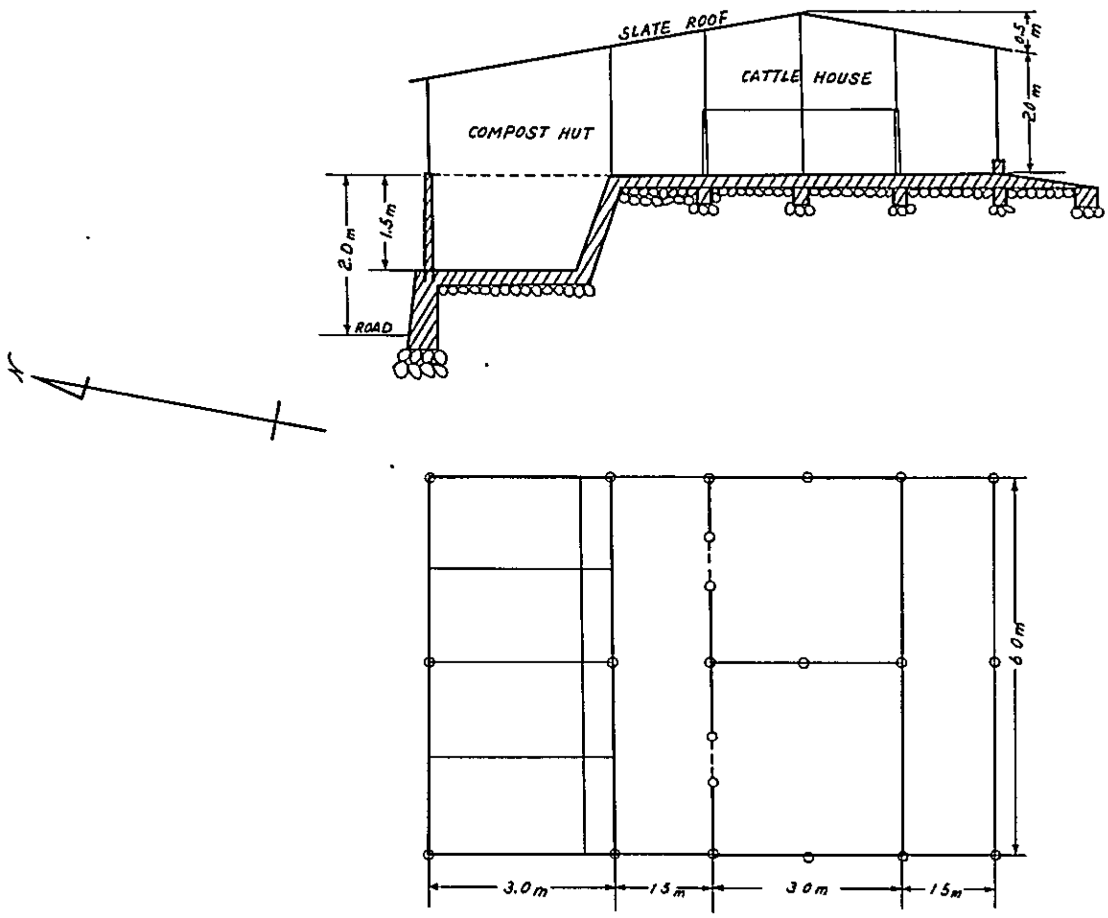


FIG. 4.2-3 CATTLE HOUSE, COMPOST HUT



(2) Compost hut

To be used for production of compost and staple manure.

Four huts of brick mortar and dimensions of 1.5m x 3m will be constructed.

4.2.5-4.4 Seed-bed

To be used for raising seedlings of horticultural and artificial crops.

(1) Seed raising bed for extension purpose

This will be made with steel frame and plastic corrugated plates.

The foundation will be covered with brick mortar. Plastic boards will be applied for panels for the purpose of preventing rain water. Two buildings of an area 9m x 11.8m will be constructed. (Fig. 4.2-3)

(2) Outdoor seed raising bed

Ten framed beds of an area 1m x 10m will be made of brick mortar.

4.2.5-4.5 Warehouse (Fig. 4.2-5)

(1) Seed storehouse

To be used for storing seeds. Its area will be 14.4m x 9m, with steel frame, slated roof and brick mortar. Its inside will be made of polypropilene refractory. A heat-proof door is fixed to the entrance. It will be equipped with a glass window, and its floor will be set at 90cm over the ground level and to be made of brick mortar. A boarded table will be set at 30cm over the floor.

(2) Storehouse

This will be used for storage of farm produce especially cereals. Its area will be 14.4m x 9m with stee) flame, mortared wall and slated roof. The floor will be made of brick mortar. A shutter will be applied for the entrance. A boarded table will be set at 30cm over the floor. A glass window will be installed.

(3) Materials warehouse

This will be used for storage of materials. This will be of an area 14.4m x 18m, with steel frame, mortared wall and slated roof. The

FIG. 4.2-4 SEED RAISING BED

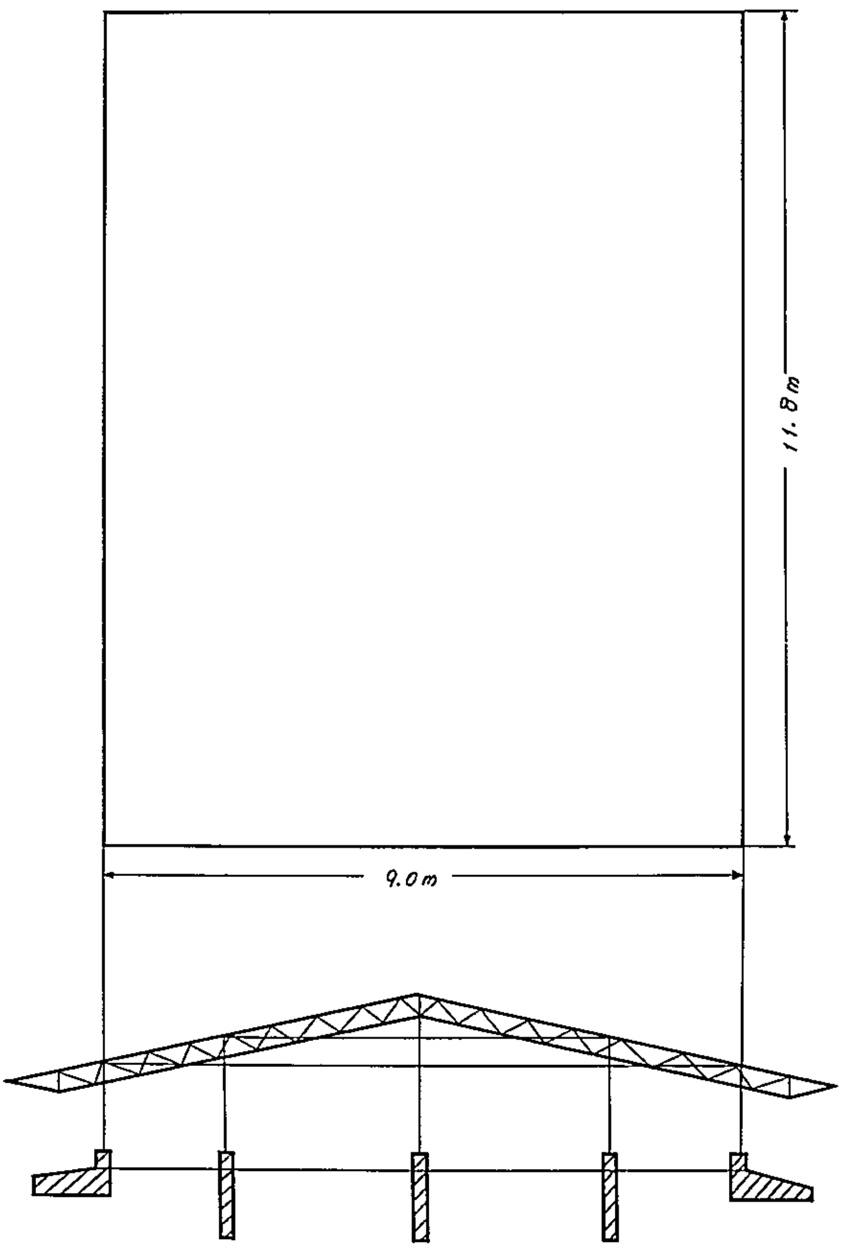
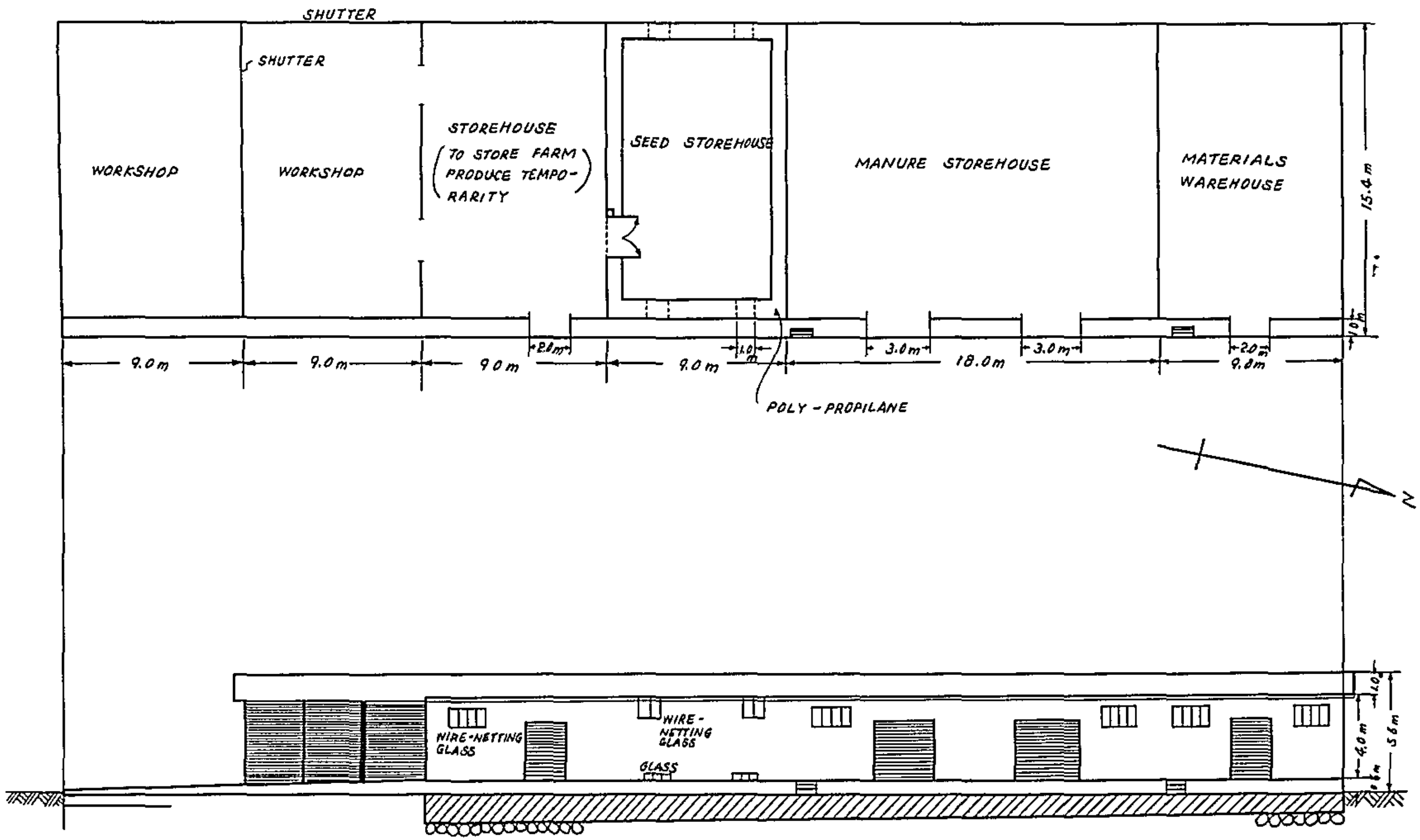


FIG 4.2-5 LAYOUT OF WAREHOUSE



floor will be set at 90cm over the ground level and to be made of brick mortar. A shutter will be fixed to the entrance. It will be equipped with a glass window.

(4) Manure store-house.

This will be used for storing fertilizers, and also agricultural chemicals. This will be of an area 14. 4m x 9m. with steel frame, mortared wall and slated roof. The floor will be set at 90cm over the ground level with brick mortar. A boarding table is set at 30cm over tbe floor.

4. 2. 5-4. 6 Workshops

This will be used for regulation of farm produce.

(1) Workshops

This will be of an area 14. 4m x 9m with steel frame and slated roof. Its floor will be made of brick mortar and the entire flank will be provided with shutters.

(2) Working area

This will be constructed with brick mortar for an area 14. 4 x 9m.

4. 2. 5-4. 7 Storehouse for Farm Appliance (Fig 4. 2-5)

(1) Car cleaning stand

This will be used for cleaning farm appliances. Its area will be 12. 4m x 5. 4m, to be made of brick mortar. This will be installed in front of the storehouse.

(2) Supplies & equipment room

This will be used for maintenance and repair of farm appliances. This building will be of an area 9m x 9m with steel frame, slated roof and brick-mortar wall. The floor will be made of brick mortar. Class windows will be provided under them with working tables of 90cm high and 60cm wide. Inside the building, a compartment will be made for an area 3. 6m x 9m for storage of tools and spare parts.

(3) Storehouse

This will be used for storing farm appliances. The building will be of an area 17. 8m x 9m with steel frame, slated roof and brickmortar wall. Shutters will be installed for two sides of the building.

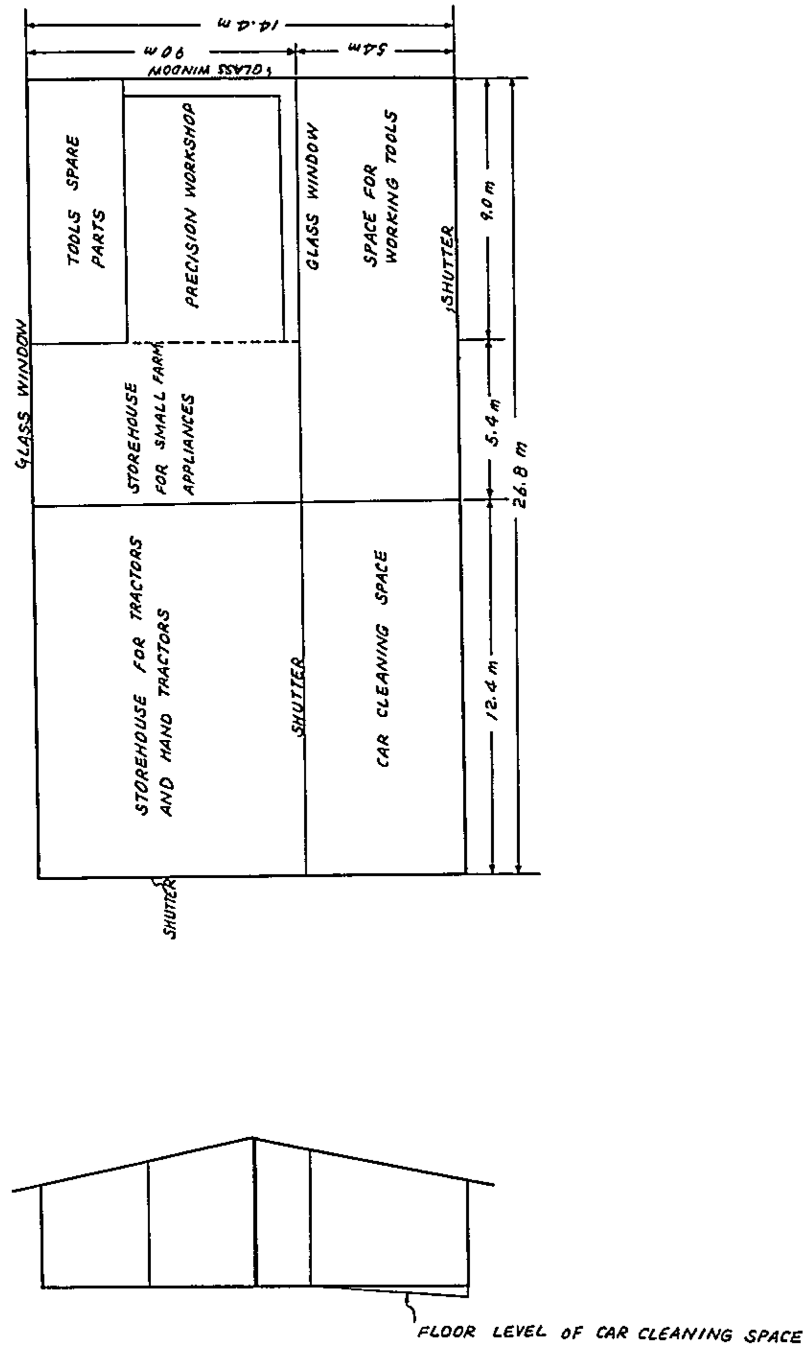


FIG. 4.2 - 6 LAYOUT OF STOREHOUSE FOR FARM APPLIANCES

4. 2. 5-4. 8 Training Institute

(1) Lecture room and auditorium

This will be of an area 18m x 9m with steel frame, brick-mortar wall and slated roof, and equipped with ceiling and glass windows.

(2) Research room for training use

This will be of an area 9m x 7. 2m with steel frame, brick-mortar wall and slated roof, and equipped with ceiling and glass windows.

(3) Library and specimen room

This will be made of an area 9m x 9m with steel frame, brick-mortar wall and slated roof, and equipped with ceiling and glass windows.

Note: In case where the facilities of Yagyapuri Tractor Station of the HMG of Nepal which are now neglected are utilized, some of the above installation will be unnecessary, however, funds for remodeling are necessary.

(5) Materials and supplies and equipment

Following materials and supplies and equipment will be required for management of the Farm and research work and tests:

(1) agricultural machinery
(2) farm appliances
(3) equipment and instruments for measuring and research for training use
(4) Fertilizers and agricultural chemicals
(5) materials for transportation
(6) appliances for office work
(7) generator

4. 2. 6 Plan for Cooperation with DADO

As the extension work under the present plan will be conducted in cooperation with DADO of Chitwan area, liaison and coordination meeting for extension works will be organized for the purpose of smooth execution of the project plan.

The liaison and coordination meeting for extansion works will be organized, centering around DADO and REF and with Rampur Agricultural

Station, Yagyapuri Horticultural Center, USAID advisor, ASC, ADB, LRSC, CS and other cooperating organizations concerned as occasion demands. The meeting will perform the following function :

1) to harmonize related works with other organizations concerned with the extension works to be executed under the present plan, especially to remove duplication of works which will be possible found between related organizations for the purpose of adequate execution of the expected work:

2) to discuse about selection of extension area to be covered by the present plan:

3) to discuss about problems of institutional and technical cooperation in execution of the present plan; and

4) to discuss about cooperation with the present plan for settlement of some problem occurred in an area which is not under the present plan.

CHAPTER V COST ESTIMATE

5.1 General

This project, being a type of agricultural extension development project, has many phased works as its components.

Estimation of its costs has been done in each category of investment as follows.

- Total Investment (unit: '000 Rs) (16,444.6)
  - Direct Investment (8,556)
    - Tube Well Scheme (8,556)
      1. Tube well facilities
      2. Land arrangement
      3. Initial input for agriculture
  - Indirect Investiment (3,911.3)
    - Hardinath Extension Center (1,916.5)
      1. Water management
      2. Input for better farm management
      3. Training and facilities
    - Areawise Extension Service (568.8)
      1. Infrastructural renovation
      2. Agro-input
      3. Extension works
    - Chitwan Extension Station (1,426)
      1. Lift irrigation facilities
      2. Agro-input
      3. Management and facilities
  - Public investment (1,961.9)
    - Transportation Service (1,760)
      1. Railway construction
      2. Road improvement
    - Better Living Scheme (201.9)
      1. Domestic water facilities
      2. Medical care
      3. Guidance for better living
  - Others (2,015.4)

5.2 Manners of Investment

Direct investment is made only for the Tube Well Scheme of about 800 ha. On the contrary, indirect investment covers the Areawise Extension Service Area of the entire Janakpur Zone, and is also made for the establishment of the Hardinath Extension Center and the improvement of the Chitwan Extension Station.

Public investment is directed to the Transportation Service and the Better Living Scheme.

Estimation of its cost is based upon the following terms and conditions:

1) This Extension Service Development Project will run for full five years, starting from April 1972 and ending in March 1976.

2) Principal machinery, equipment and material such as tube well drilling machinery, construction machinery, pumps, steel materials, major structures, cement, wires, etc. will be supplied from Japan by the foreign exchange currency portion, and local labor, wooden materials, bricks, etc. will be supplied by His Majesty's Government, Nepal by the local currency portion.

3) All estimates are exclusive of any import duties or other taxes on equipment, materials and supplies, that might be payable in Nepal and India during transit, and of any taxes which might be levied in Nepal on engineers.

4) Works for the establishment of the tube well facilities will be completed until March 1976.

5) For the implementation of the Tube Well Scheme, the reasonable initial input for agriculture should be provided.

5.3 Total Investment

Total investment for the project is estimated at Rs 16,444,600, comprising Rs 11,771,700 of foreign exchange currency and Rs 4,672,900 of local currency as summarized in Table 5. 3-1

Table 5.3-1 Total Investment

('000 Rs)

Kind of Investment	Foreign Exchange Currency Component	Local Currency Component	Total
Direct investment	6,527	2,029	8,556
Indirect investment	2,760	1,151.3	3,911.3
Public investment	1,557.7	404.2	1,961.9
Other investment	927	1,088.4	2,015.4
Total	11,771.7	4,672.9	16,444.6

The break-down of the cost is given in Table 5.3-2 and 5.3-3

5.4 Annual Fund Requirement

On the basis of the implementation schedule of this project described in chapter 7, the annual fund requirement for each year is given in Table 5.4.

Table 5.4 Annual Fund Requirement

('000 Rs)

	Foreign Exchange Currency Component	Local Currency Component	Total
1st year	4,708.6	934.6	5,643.2
2nd year	3,531.6	1,401.8	4,933.4
3rd year	2,354.3	934.6	3,288.9
4th year	1,177.2	934.6	2,111.8
5th year	0	467.3	467.3
Total	11,771.7	4,672.9	16,444.6

Table 5.3-2 Cost Estimate

('000 Rs)

Item	Description of Item	Total Cost	Currency Component Foreign	Local
Tube Well Scheme	Tube well facilities	4,865	4,396	469
	Land arrangement	1,980	520	1,460
	Initial input for agriculture	1,711	1,611	100
	Total	8,556	6,527	2,029
Hardinath Extension Center	Water management	90	35	55
	Input for better farm management	827.6	825.6	2
	Training and facilities	998.9	508	490.9
	Total	1,916.5	1,368.6	547.9
Areawise Extension Service	Infrastructural renovation	20	4	16
	Agro-input	242.8	241.3	1.5
	Extension works	306	100	206
	Total	568.8	343.3	225.5
Chitwan Extension Station	Lift irrigation facilities	513	350	163
	Agro-input	440.1	437.1	3
	Management and facilities	472.9	261	211.9
	Total	1,426	1,048.1	377.9
Transportation Service	Railway construction	1,660	1,360	300
	Road improvement	100	20	80
	Total	1,760	1,380	380
Better Living Scheme	Domestic water facilities	146.9	122.7	24.2
	Medical care	40	40	-
	Guidance for better living	15	15	-
	Total	201.9	177.7	24.2
Others	Transportation	810	676	134
	Living quarter for experts and others	1,205.4	251	954.4
	Total	2,015.4	927	1,088.4
	Grand-total	16,444.6	11,771.7	4,672.9

Table 5.3-3 Detailed Break-Down of Estimated Cost

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Tube Well Scheme								
Tube well facilities	Tube well drilling, casing and setting up	20	Nos.	40,000	800	500	300	
	Pumping test	20	Nos.	2,000	40	35	5	
	Setting up pump and motor with accessories	10	Nos.	18,000	180	160	20	
	Building (50 m^2)	2	Nos.	60,000	120	30	90	
	Contingency		%	10	114	60	54	
	Sub-sub-total				1,254	785	469	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Construction machinery	Angle dozer	1	No.	172,000	172	172	-	With ripper, D60H-3
	Back hoe	1	No.	168,000	168	168	-	With cramshell, UHO-3
	Concrete mixer	1	No.	7,000	7	7	-	TD-8, diesel engine, 5ps
	Concrete vibrator	1	No.	3,000	3	3	-	EFK-327, gas engine, 3ps
	Air compressor	1	No.	27,000	27	27	-	AMR-125, diesel engine 3ps
	Belt conveyor	1	No.	1,000	1	1	-	KE-5, 7m, gas engine, 3ps
	Miscellaneous	L. S.		1,000	1	1	-	
	Contingency		%	10	38	38	-	
	Sub-sub-total				417	417	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Local	Remarks
Well drilling machinery	Well drilling machine with accessories	1	set	806,000	806	806	-	
	Generator	1	set	270,000	270	270	-	
	Test pump	1	set	165,000	165	165	-	
	Tools	1	set	180,000	180	180	-	
	Casing, screen, etc.	1	set	613,000	613	613	-	
	Turbine pump with engine	10	No.	75,000	750	750	-	
	Miscellaneous	L. S.			120	120	-	
	Contingency		%	10	290	290	-	
	Sub-sub-total				3,194	3,194	-	
	Sub-total				4,865	4,396	469	
Land arrangement	Irrigation canals	40	km	40,000	1,600	400	1,200	
	Drains	5	km	40,000	200	60	140	
	Contingency		%	10	180	60	120	
	Sub-total				1,980	520	1,460	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Initial Input for Agriculture								
Farm inple-ments and tools	Hand sprayer	500	Nos.	278	139	139	-	
	Hand duster	500	Nos.	108	54	54	-	
	Weeder (hand-worked)	500	Nos.	69	35	35	-	
	Farmer's tools	500	Sets	42	21	21	-	
	Sub-sub-total				259	259	-	
Chemical fertilizers	Ammonium sulphate	200	Tons	240	48	48	-	
	Concentrated superphos-phate	150	tons	400	60	60	-	
	Muriate of potash	80	tons	380	304	304	-	
	Concentrated synthetic fertilizer	120	tons	450	540	540	-	
	Sub-sub-total				952	952		
Agricultural chemicals	Pesticides Insecticides Weedicides	L. S.			350	350		
	Sub-sub-total				350	350		

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Foreign	Component Local	Remarks
Improved seeds	Paddy	L. S.			150	50	100	
	Wheat							
	Sub-sub-total				150	50	100	
	Sub-total				1,711	1,611	100	
	Total				8,556	6,282	2,604	
Hardinath Extension Center								
Water management	Irrigation facilities	500	m	100	50	20	30	
	Drainage facilities	L. S.			40	15	25	
	Sub-total				90	35	55	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Local	Remarks
Input for Manage- ment Farm Machinery, Implements and Tools	4 wheel tractor, 35 HP	2	Nos.	52,782	105.5	105.5	-	Engine: D1900A, 35 HP/ 2,500 RPM
	The above accessary							
	Float wheel	2	Nos.	5,556	11.1	11.1	-	
	Dump trailer, (2 tons)	2	Nos.	18,224	36.4	36.4	-	
	Rotary equipment	2	Nos.	18,334	36.6	36.6	-	
	Bottom plow (12 x 3)	2	Nos.	12,224	24.4	24.4	-	
	Disc harrow (18 x 24)	2	Nos.	10,278	20.5	20.5	-	
	Tooth harrow (30 x 3)	2	Nos.	5,834	11.7	11.7	-	
	Front loader	2	Nos.	22,390	44.8	44.8	-	
	Rear grader	2	Nos.	5,834	11.7	11.7	-	
	Grain drill	2	Nos.	23,890	47.8	47.8	-	
	Broad caster (350ℓ)	2	Nos.	5,278	10.6	10.6	-	
	Vacuum car (2,000ℓ)	2	Nos.	25,002	50	50	-	
	Manure spreader	2	Nos.	24,446	48.9	48.9	-	
	Cultivator (5 x 3)	2	Nos.	4,722	9.4	9.4	-	
	Ridger	2	Nos.	7,500	15	15	-	
	Trailer (2 tons)	2	Nos.	13,334	26.7	26.7	-	
	4 wheel tractor, 45 HP	1	No.	34,725	34.7	34.7	-	Engine: 853,000, 45 HP/ 2,400 RPM
	The above accessory							
	Float wheel	1	No.	3,056	3.1	3.1	-	
	Dump trailer (2 tons)	1	No.	9,723	9.7	9.7	-	
	Rotary equipment	1	No.	9,667	9.7	9.7	-	
	Bottom plow (12 x3)	1	No.	6,112	6.1	6.1	-	
	Disc harrow (18 x 24)	1	No.	5,139	5.1	5.1	-	
	Tooth harrow (30 x 3)	1	No.	2,917	2.9	2.9	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Input for Better Farm Management	Front loader	1	No.	11,807	11.8	11.8	-	
Farm Machinery Inplements and Tools	Rear grader	1	No.	2,917	2.9	2.9	-	
	Grain drill	1	No.	11,945	11.9	11.9	-	
	Broad caster (350ℓ)	1	No.	2,639	2.6	2.6	-	
	Vacuum car (2,000ℓ)	1	No.	12,501	12.5	12.5	-	
	Cultivator	1	No.	3,750	3.8	3.8	-	
	Ridger	1	No.	1,361	1.4	1.4	-	
	Trailer (2 tons)	1	No.	6,667	6.7	6.7	-	
	Hand tractor, 5 - 6 HP	4	Nos.	4,305	17	17	-	Kubota, Engine: ER50, 5 - 6 HP/2,200 RPM
	The above accessory							
	Plow	4	Nos.	486	1.9	1.9	-	
	Harrow	4	Nos.	128	0.5	0.5	-	
	Trailer (500 kg)	4	Nos.	1,667	6.7	6.7	-	
	Iron wheel	4	Nos.	222	0.9	0.9	-	
	Paddy field wheel	4	Nos.	250	1	1	-	
	Ridger	4	Nos.	136	0.5	0.5	-	
	Rotary weeder	4	Nos.	1,278	5.1	5.1	-	
	Automatic thresher	3	Nos.	2,917	8.8	8.8	-	JT-N540, width 540 mm 550 - 600 RPM
	Power sprayer	2	Nos.	3,778	7.6	7.6	-	SD-40, Engine: ER50N
	Engine duster	2	Nos.	4,334	8.6	8.6	-	
	Engine powered duster with mist sprayer	5	Nos.	667	3.3	3.3	-	
	Straw cutter	2	Nos.	3,375	6.8	6.8	-	
	Irrigation pump	10	Nos.	2,695	27	27	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
	Power lawn mover	2	Nos.	1,250	2.5	2.5	-	
	Hand sprayer	20	Nos.	278	5.7	5.7	-	
	Hand duster	20	Nos.	108	2.2	2.2	-	
	Thresher with diesel engine	2	Nos.	3,500	7	7	-	
	Rice shelling and pearling machine	1	No.	6,112	6	6	-	
	Weeder for paddy field by hand	40	Nos.	28	1.1	1.1	-	
	Thresher by hand	10	Nos.	347	3.5	3.5	-	
	Rice planter	10	Nos.	389	3.9	3.9	-	
	Diesel engine, 5.5 HP	5	Nos.	2,778	13.9	13.9	-	
	Kerosene engine, 4 HP	5	Nos.	1,389	6.9	6.9	-	
	Petrol engine, 4.5 HP	6	Nos.	556	3.4	3.4	-	
	Corn sheller	3	Nos.	833	2.5	2.5	-	
	Implements for maintenance	2	Nos.	1,500	3	3		
	Minor agricultural implements and tools	4	Nos.	1,200	4.8	4.8	-	
	Sub-sub-total				798.1	798.1	0	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Chemical fertilizers	Ammonium sulphate	12	ton	240	2.9	2.9	-	
	Concentrated superphosphate	12	ton	400	4.8	4.8	-	
	Muriate of potash	6	ton	380	2.3	2.3	-	
	Concentrated synthetic fertilizers	10	ton	450	4.5	4.5	-	
	Sub-sub-total				14.5	14.5	-	
Agricultural chemicals	Pesticides Insecticides Weedicides	L.S.			12	12	-	
	Sub-sub-total				12	12	-	
Improved seeds	Paddy Wheat	L.S.			3	1	2	
	Sub-sub-total				3	1	2	
	Sub-total				827.6	825.6	2	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Training facilities								
Training and facilities	Horticultural control room	50	m^2	280	14	3	11	
	Roofed and outdoor nursery bed	120	m^2	290	35	5	30	
	Stable and compost shed	145	m^2	310	45	5	40	
	Warehouse	42	m^2	350	15	5	10	
	Workshop	20	m^2	350	7	2	5	
	Laboratory	25	m^2	450	12	6	6	
	Access road	1,200	m	130	156	40	116	
	Weather station	1	set	63,150	63.1	50	13.1	
	Domestic water supply No. 1	1	No.	69,250	69.3	56	13.3	
	do. No. 2	1	No.	27,780	27.8	22	5.8	
	Wireless service	1	No.	105,260	105.3	80	25.3	
	Power house, No. 1	1	No.	38,650	38.7	31	7.7	
	do. No. 2	1	No.	33,240	33.2	27	6.2	
	Fuel tank	1	No.	13,850	13.9	11	2.9	
	Head office (150 m^2)	1	No.	53,250	53.3	15	38.3	
	Office facilities	1	set	51,000	51	44	7	
	Miscellaneous	L.S.		10,000	10	6	4	
	Contingency		%	15	112	50	62	
	Sub-sub-total				760.8	458	302.8	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Operation	Labor	5	year	8,500	42.5	-	42.5	
	Material	5	year	10,800	54.0	30	24	
	Petrol, diesel oil, etc.	5	year	20,000	100	-	100	
	Miscellaneous	L.S.		20,000	20	10	10	
	Contingency		%	10	21.6	10	11.6	
	Sub-sub-total				238.1	50	188.1	
	Sub-total				998.9	508	490.9	
	Total				1,916.5	1,368.6	547.9	
Areawise Extension Service								
Infrastructural Renovation	Rearrangement of field	L.S.			20	4	16	
	Sub-total				20	4	16	
Agro-input								
Farm inplements and tools	Hand sprayer	200	No.	278	55.6	55.6	-	
	Hand	200	No.	108	21.6	21.6	-	
	Weeder	200	No.	69	13.8	13.8	-	
	Farmer's tools	200	No.	42	8.4	8.4	-	
	Sub-sub-total				99.4	99.4	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Chemical fertilizers	Ammonium sulphate	100	tons	240	24	24	-	
	Concentrated superphosphate	50	tons	400	20	20	-	
	Muriate of potash	30	tons	380	11.4	11.4	-	
	Concentrated synthetic fertilizer	80	tons	450	36	36	-	
	Sub-sub-total				91.4	91.4	-	
Agricultural chemicals	Pesticides, Insecticides, Weedicides	L.S.			50	50	-	
	Sub-sub-total				50	50	-	
Improved seeds	Paddy, Wheat	L.S.			2	0.5	1.5	
	Sub-sub-total				2	0.5	1.5	
	Sub-total				242.8	241.3	1.5	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Extension works								
Facilities	Warehouses (30 m^2)	9	Nos.	12,000	108	40	68	
	Office with lodge (30 m^2)	9	Nos.	12,600	113	50	63	
	Sub-sub-total				221	90	131	
Operation	Labor	5	years	10,000	50	-	50	
	Material	5	years	7,000	35	10	25	
	Miscellaneous and contingency	L. S.						
	Sub-sub-total				85	10	75	
	Sub-total				306	100	206	
	Total				568.8	343.3	225.5	
Chitwan Extension Station								
Lift irrigation facilities	Pumping station	1	set	320,000	320	224	96	
	Piping	1,500	m	70	105	80	25	
	Canal	200	m	70	14	4	10	
	Farm pond	1,200	m^3	10	12	2	10	
	Related structure	L. S.			10	3	7	
	Miscellaneous	L. S.			5	1	4	
	Contingency		%	10	47	36	11	
	Sub-total				513	350	163	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Agro-input								
Farm Machinery, implements and tools	4 wheel tractor, 35 HP	1	No.	52,782	52.8	52.8	-	Engine: D1900A, 35 HP/ 2,500 RPM
	The above accessory							
	Float wheel	1	No.	5,556	5.6	5.6	-	
	Dump trailer, 2 ton	1	No.	18,224	18.2	18.2	-	
	Rotary equipment	1	No.	18,334	18.3	18.3	-	
	Bottom plow	1	No.	18,224	18.2	18.2	-	
	Disc harrow	1	No.	10,278	10.3	10.3	-	
	Tooth harrow	1	No.	5,834	5.8	5.8	-	
	Front loader	1	No.	22,390	22.4	22.4	-	
	Rear grader	1	No.	5,834	5.8	5.8	-	
	Grain drill	1	No.	23,890	23.9	23.9	-	
	Broad caster	1	No.	5,278	5.3	5.3	-	
	Vacuum car	1	No.	25,002	25.0	25.0	-	
	Manure spreader	1	No.	24,446	24.4	24.4	-	
	Cultivator	1	No.	4,722	4.7	4.7	-	
	Ridger	1	No.	7,500	7.5	7.5	-	
	Trailar	1	No.	13,334	13.3	13.3	-	
	Hand tractor, 5 - 6 HP	3	Nos.	4,305	12.9	12.9	-	Kubota, Engine: ER50, 5 - 6 HP/2,200 RPM.
	The above accessory							
	Plow	3	Nos.	486	1.5	1.5	-	
	Harrow	3	Nos.	128	0.4	0.4	-	
	Trailer	3	Nos.	1,667	5.0	5.0	-	
	Iron wheel	3	Nos.	222	0.7	0.7	-	
	Paddy field wheel	3	Nos.	250	0.8	0.8	-	
	Ridger	3	Nos.	136	0.5	0.5	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
	Rotary weeder	3	Nos.	1,278	3.8	3.8	-	
	Automatic thresher	3	Nos.	2,917	8.8	8.8	-	
	Power sprayer	2	Nos.	3,778	7.6	7.6	-	
	Engine duster	2	Nos.	4,334	8.7	8.7	-	
	Engine powered duster with mist sprayer	5	Nos.	667	3.3	3.3	-	
	Straw cutter	2	Nos.	3,375	6.7	6.7	-	
	Irrigation pump	5	Nos.	2,695	13.5	13.5	-	
	Power lawn mover	2	Nos.	1,250	2.5	2.5	-	
	Hand sprayer	15	Nos.	278	4.2	4.2	-	
	Hand duster	15	Nos.	108	1.6	1.6	-	
	Thresher with diesel engine	2	Nos.	3,500	7	7	-	
	Rice shelling and pearling machine	1	No.	6,112	6.1	6.1	-	
	Weeder for paddy field by hand	25	Nos.	28	7	7	-	
	Thresher by hand	7	Nos.	347	2.4	2.4	-	
	Rice planter	10	Nos.	389	3.9	3.9	-	
	Diesel engine,5.5 HP	5	Nos.	2,778	13.9	13.9	-	
	Kerosene engine, 4 HP	5	Nos.	1,389	6.9	6.9	-	
	Petrol engine, 4.5 HP	6	Nos.	556	3.3	3.3	-	
	Corn sheller	3	Nos.	833	2.5	2.5	-	
	Implemants for maintenance	2	Nos.	1,500	3	3	-	
	Minor agricultural implements and tools	3	Nos.	1,200	3.6	3.6	-	
	Sub-sub-total				404.1	404.1	-	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total cost	Currency Component Foreign	Currency Component Local	Remarks
Chemical fertilizer	Ammonium sulphate	15	tons	240	3.6	3.6	-	
	Concentrated superphosphate	10	tons	400	4	4	-	
	Muriate of potash	5	tons	380	1.9	1.9	-	
	Concentrated synthetic fertilizer	10	tons	450	4.5	4.5	-	
	Sub-sub-total				19	19	-	
Agricultural chemicals	Pesticides, Insecticides, Weedicides	L. S.			12	12	-	
	Sub-sub-total				12	12	-	
Improved seeds	Paddy, Wheat	L. S.			5	2	3	
	Sub-sub-total				5	2	3	
	Sub-total				440.1	437.1	3	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Management and Fertilities								
Management and facilities	Green house	50	m^2	280	14	3	11	
	Indoor nursery bed	50	m^2	290	14.5	4	10.5	
	Stable and compost shed	60	m^2	310	18.6	3	15.6	
	Laboratory	15	m^2	450	6.8	3	3.8	
	Domestic water supply	1	No.	35,000	35	15	20	
	Wireless service	1	No.	105,000	105	80	25	
	Power house	1	No.	25,400	25.4	20	5.4	
	Fuel tank	1	No.	9,500	9.5	5	4.5	
	Head office	1	No.	36,000	36	15	21	
	Office facilities	1	set	30,000	30	25	5	
	Miscellaneous	L.S.		7,000	7	3	4	
	Contingency		%	10	30.2	10	20.2	
	Sub-sub-total		%		332	231	101	
Operation	Labor	5	year	4,500	22.5	-	22.5	
	Material	5	year	7,600	38	18	20	
	Petrol, diesel oil, etc.	5	year	10,000	50	-	50	
	Miscellaneous	L.S.		12,000	12	6	6	
	Contigency		%	10	18.4	6	12.4	
	Sub-sub-total				140.9	30	110.9	
	Sub-total				472.9	261	211.9	
	Total				142.6	1,048.1	377.9	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Transporta tion Service								
Railway con-struction	Trolly car	2	sets	130,000	260	260	-	
	Wagon	8	sets	50,000	400	400	-	
	Rail and its laying	10,000	m	100	1,000	700	300	
	Sub-total				1,660	1,360	300	
Road improve-ment	Road	1,000	m	100	100	20	80	
	Sub-total				100	20	80	
	Total				1,760	1,380	380	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Better Living Scheme								
Domestic water facilities	Tube well	2	Nos.	41,700	83.4	66.7	16.7	
	Drilling and casing pumping test							
	Delivery facilities	2	Nos.	13,900	27.8	25	2.8	
	Delivery pipe							
	Delivery tank							
	Supply facilities	2	Nos.	9,340	16.7	15	3.7	
	Main pipe							
	Distribution pipe							
	Outlet and water tap	2	Nos.	2,780	5.6	5	0.6	
	Miscellaneous and contingency		%	10	11.4	11	0.4	
	Sub-total				146.9	122.7	24.2	
Medical care	Medicine	L.S.			25.0	25.0	-	
	Medical instrument	L.S.			15.0	15.0	-	
	Sub-total				40.0	40.0	-	
Guidance for better living	Instrument for guidance	L.S.			15.0	15.0	-	
	Sub-total				15.0	15.0	-	
	Total				201.9	177.7	24.2	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Others								
Transporta-tion	Internal travel charge	5	year	8,000	40	-	40	
	Repair charge for vehicle	5	year	12,000	60	20	40	
	Jeep	4	Nos.	30,000	120	120	-	
	Truck	2	Nos.	35,000	70	70	-	
	Truck with crane	1	No.	39,000	39	39	-	
	Station wagon	1	No.	42,000	42	42	-	
	Fuel, etc.	5	year	70,000	350	350	-	
	Miscellaneous	L. S.		15,000	15	5	10	
	Contingency		%	10	74	30	44	
	Sub-total				810	676	134	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Living Quarter								
Experts' quarter	A type of quarter (80 m^2)	2	Nos.	47,280	94.5	20	74.5	
	B type of quarter (50 m^2)	3	Nos.	29,550	88.7	18	70.7	
	C type of quarter (50 m^2)	5	Nos.	23,650	118.3	24	94.3	
	D type of quarter (150 m^2)	1	No.	70,950	71.	14	57	
	E type of quarter (150 m^2)	1	No.	70,950	71	14	57	
	Guest house (150 m^2)	1	No.	93,000	93	14	79	
	Trainees' quarter (1,000m^2)	1	No.	440,000	440	88	352	
	Farm employee's quarter							
	No. 1 (40 m^2)	7	Nos.	17,600	123.2	25	98.2	
	No. 2 (30 m^2)	3	Nos.	13,200	39.6	8	31.6	
	No. 3 (100 m^2)	1	No.	44,000	44	9	35	
	Sub-sub-total				1,183.4	234	949.4	
Facilities for living quarter	Facilities	1	set	22,000	22	17	5	
	Sub-sub-total				22	17	5	
	Sub-total				1,205.4	251	954.4	
	Total				2,015.4	927	1,088.4	

CHAPTER VI ECONOMIC JUSTIFICATION

6.1 General

In the economic justification, the costs required to construct and operate the project are compared with the benefits attributable to the project.

Investment under the following six headings is being visualized for implementation of this project.

No.	Scheme
1	Tube Well
2	Hardinath Extension Center
3	Areawise Extension Service
4	Chitwan Extension Station
5	Transportation Service
6	Better Living

Investment which will be made for Scheme No. 1 is expected to bring direct benefits in terms of increased agricultural production. That for Scheme No. 2, 3 and 4 will generate more or less added value through their operation on self paying basis but estimation of their benefits is rather difficult at preinvestment stage. Investment for Scheme No. 5 and 6 is primary for improvement of transportation service and betterment of living conditions of the residents and, therefore, are not meant for creation of any direct benefits.

In this connection, benefit-cost analysis for economic justification of this project will possibly be made only for the tube well scheme, through tentative comparison between the total inputs such as construction cost, and the operation and maintenance cost and their total outputs like increase net farm income.

6.2 Benefit

6.2.1 Direct Benefit

Benefits to be realized consist of the net value derived from the project whether they accrue to individuals, groups, districts, regions or to Nepal. These benefits may be classified into two major categories: primary or direct benefits and secondary or indirect benefits.

Based on the farming pattern of land use proposed in the Tube Well Scheme, it is estimated that the average annual gross income in the year after beginning of irrigation farming will increase up to Rs 10,212 per 1.7 ha-unit farm from the present income of about Rs 3,367 per the same unit farm as shown in Table 6.2-1.

According to the rough estimation, in the whole scheme area of about 800 ha, the increase in agricultural products in the 5th year after beginning of irrigation farming is estimated at Rs 1,048,708 including 1,886 tons of paddy, 828 tons of wheat, 45 tons of pulses, 736,000 pieces of eggs, etc.

Such increase in agricultural production will make a great contribution to the regional economy of Janakpur Zone, especially of Danusha and Mahotari Districts.

6.2.2 Indirect Benefit

In addition to the increase in the value of goods and services, some economic effects are expected. Such effects are difficult to measure in monentary term, these will be brought about and contribute to the well-doing of people of the scheme area.

After implementation of this Tube Well Scheme, the stability of agricultural production could be secured due to a reliable supply of water. Hence, the stability of local farmers' livelihood will be enhanced.

Table 6.2-1 Summary of Farm Budget of Typical Farmer (1.7 ha-Farm Unit) in and after the 5th year of Irrigation Farming

Gross income

Crop production

Kind of crops	Cropped area (ha)	Unit yield (ton/ha)	Total yield (ton)	Unit price (Rs/ton)	Total price (Rs)
1st paddy	0.3	4.0	1.2	920	1,104
2nd paddy	1.4	3.5	4.9	870	4,263
Wheat	0.6	3.0	1.8	1,000	1,800
Pulses	0.5	1.1	0.55	1,100	605
Mustard	0.2	1.5	0.3	1,600	480
Sub-total					8,252

Livestock production

Kind of livestocks	Number sold	Unit price (Rs)	Total value (Rs)
Poultry	35	16	560
Eggs	1,600	0.75	1,200
Goat	4	50	200
Sub-total			1,960
Total (A)			10,212

Production cost

	Total (Rs)
Operation cost	
Crop	3,310
Livestock	1,020
Sub-total	4,330
Living expenses	3,450
Sub-total	3,450
Total (B)	7,780
Capacity to pay (A - B)	2,432
per hectare	1,430

Note: Gross income without irrigation: Rs 3,367 per 1.7-ha unit farm

6.2.3 Benefits from Indirect and Public Investment

a. Hardinath Extension Center, Chitwan Extension Station and Areawise Extension Service

These will help establishing definite patterns of farming in the project area of Janakpur Zone. It is needless to say that these will contribute for development of agriculture in this Zone.

b. Better Living Scheme

In Nepal as well as in other tropical and sub-tropical countries, many kinds of diseases such as malaria, bacillary diseases, diseases due to viruses, etc. are found.

Out of all the transmissible diseases in Nepal, malaria is the most important. Since a decade, activities for malaria eradication are being effectively conducted by the government also in the project area.

Basedow's disease is also important in the project area. This was found in Ramdaiya Village, Danukha District during our field survey. It is clear that this is due to lack of iodine. In the development plan, a certain medical care will be treated toward any patients suffered from such diseases.

On the other hand, availability of water of the project area will be very much facilitated by installation of conventional domestic water supply equipment.

These will also contribute for theliving conditions of residents.

6.3 Annual Equivalent Benefit

As shown in Table 6. 2-1 of the preceding paragraph, the annual net profit derived from the tube well irrigation farming will increase year by year and attain its possible maximum in the 5th year of the operation as follows:

Table 6. 3-1 Annual Net Profit

Year	Without Irrigation (A) (Rs)	With Irrigation (B) (Rs)	Increased Net Profit (B - A) (Rs)
1	70,012	101,016	31,004
2	do.	404,938	334,926
3	do.	587,328	517,316
4	do.	877,036	807,024
5	do.	1,118,720	1,048,708
6	do.	do.	do.
°	do.	do.	do.
°	do.	do.	do.
20	do.	do.	do.

From the above table, the present worth at zero point /1 of the total increased net profits in 20 years from the 1st to the 20th year is estimated at Rs 13,241,153. The annual equivalent benefit is, therefore, obtained as about Rs 889,805 as shown in Table 6. 3-2

/1: Zero point is the time when the construction works are completed.

Table 6.3-2 Annual Equivalent Benefit

Year	Increased Net Profit (Rs)		Present Worth/1 (Rs)	
1	31,004		30,102	
2	334,926		315,701	
3	517,316		473,396	
4	807,024		717,041	11,704,011
5	1,048,708	16,779,328		
6				
°				
°				
20				
Total			13,241,153	

Annual equivalent benefit (increased)/1
= Rs 13,241,153 x 0.0672 = Rs 889,805

/1: The increased net profit is converted to the present worth at zero point by multiplying the conversion factor " 1/(1+i) ". In this formula, "i" denotes annual interest rate (0.03) and "n" is the original number of the year (20).

6.4 Cost

As described already, benefit-cost analysis for economic justification of the Agricultural Extension Development Project will possibly be made only for the Tube Well Scheme.

Although the total investment for the scheme is as shown in Table 5. 3-2 of the preceding chapter, for the benefit-cost analysis the investment is rearranged as shown in Table 6. 4-2

On the basis of the implementation schedule of the scheme, the annual fund requirement for each year is given in Table 6. 4-1.

Table 6. 4-1. Annual Fund Requirement

('000 Rs)

Year	Foreign Exchange Currency	Local Currency	Total
1st year	770	426	1,196
2nd year	578	426	1,004
3rd year	384	639	1,023
4th year	193	426	619
5th year	0	213	213
Total	1,925	2,130	4,055

Table 6.4-2 Estimate of Construction Cost

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Tube Well Scheme	1. Tube well drilling casing and setting, up	20	Nos.	40,000	800	500	300	
	2. Pumping test	20	Nos.	2,000	40	35	5	
	3. Setting of pump and motor with accessory	10	Nos.	18,000	180	160	20	
	4. Building (50 m^2)	2	Nos.	60,000	120	30	90	
	5. Irrigation canals	40	km	40,000	1,600	400	1,200	
	6. Drains	5	km	40,000	200	60	140	
	7. Farm roads	10	km	10,000	100	30	70	
	8. General expenses and engineering services	L. S.			500	400	100	
	9. Contingency		%	10	355	150	205	
	10. Interest during construction				160	160	0	
	Sub-total				4,055	1,925	2,130	

(continued)

('000 Rs)

Item	Description of Item	Q'ty	Unit	Rate (Rs)	Total Cost	Currency Component Foreign	Currency Component Local	Remarks
Initial Input for Agriculture Farm imple-ments and tools	Hand sprayer	500	Nos.	278	139	139	-	
	Hand duster	500	Nos.	108	54	54	-	
	Weeder (hand-worked)	500	Nos.	69	35	35	-	
	Farmer's tool	500	Nos.	42	21	21	-	
	Sub-sub-total				259	259	-	
Chemical fer-tilizers	Ammonium sulphate	200	tons	240	48	48	-	
	Concentrated super-phosphate	150	tons	400	60	60	-	
	Muriate of potash	30	tons	380	304	304	-	
	Concentrated synthetic fertilizer	120	tons	450	540	540	-	
	Sub-sub-total				952	952	-	
Agricultural chemicals	Pesticides Insecticides Weedicides	L. S.			350	350	-	
	Sub-sub-total				350	350	-	
Improved seeds	Paddy Wheat	L. S.			150	50	100	
	Sub-sub-total				150	50	100	
	Sub-total				1,711	1,611	100	
	Total				5,766	3,536	2,230	

6.5 Annual Equivalent Cost

6.5.1 Annual Equivalent of Construction Cost

The above said benefit is due to direct investment meant for construction cost and initial input for agriculture in the Tube Well Scheme. The input for agriculture, in fact, assumes the form of the annual production cost in calculating the annual net profit. Then, construction cost alone stands as annual cost involved in this estimation.

The annual equivalent of construction cost is estimated as follows based on annual fund requirement shown in Table 6.4 in the preceding paragraph.

Table 6.5-1 Annual Equivalent of Construction Cost

('000 Rs)

Year	Annual Fund Requirement	Interest Rate	Total Cost
1st year	1,196	1.1593	1,387
2nd year	1,004	1.1255	1,130
3rd year	1,023	1.0927	1,118
4th year	619	1.0609	657
5th year	213	1.0300	219
Total	4,246		4,511

Then, annual equivalent of construction cost in 20 years is as follows:
Construction cost x C.R.F. = Rs 4,511,000 x 0.0672 = Rs 303,140

/1: This is computed by using the following formula.

$$\text{Capital recovery factor} = \frac{i(1+i)^n}{(1+i)^{n-1}} = 0.0672$$

6.5.2 Annual Operation and Maintenance Cost, and Replacement Cost

The costs for operating and maintaining the irrigation system include the expenses needed for field staffs and the maintenance costs of tube wells, pumps, roads, etc. The replacement cost is mainly needed for structures of pumps, canals, roads and their related structures. These costs are given in Table 6.5-2 and 6.5-3

Table 6.5-2 Annual Operation and Maintenance Cost of Tube Well Irrigation Works for the Janakpur Zone

Item	Total Annual Amount (Rs)
Salaries/1	49,800
Office expense	6,000
Fuel expense	70,000
Repairing cost	25,000
Miscellaneous and contingency	15,000
Total	156,800

Table 6.5-3 Replacement Cost/2

('000 Rs)

Construction Cost	Sinking Fund/2 Factor	Replacement Cost
1,000	0.03722	37

/1: Next page.

Item	Annual Pay per Capita (Rs)	Number of Personnel	Total Annual Amount (Rs)
Manager (Agronomist)	12,000	1	12,000
Assist. irrigation engineer	8,400	1	8,400
Mechanist	7,200	1	7,200
Accountant	7,200	1	7,200
Laborer	300/man-month	50	15,000
Total			49,800

/2: Sinking fund factor (S. F. F.) $= \dfrac{i}{(1+i)^n - 1}$

From Table 6.5-2 and 6.5-3, it is estimated that the operation and maintenance costs and replacement cost for the scheme amount to Rs 193,800 per annum.

6.5.3 Total Annual Equivalent Cost

The total annual equivalent cost is the sum of the amortization of initial investment and the annual operation, maintenance and replacement costs of the scheme as follows:

Table 6.5-4 Total Annual Equivalent Cost

('000 Rs)

Item	Cost
Annual equivalent of construction cost	303,140
Annual operation and maintenance cost	156,800
Annual replacement cost	37,000
Total	496,940

6.6 Benefit-Cost Ratio

The benefit-cost ratio of possible irrigation development from the economic point of view is evaluated by the following formula.

$$\text{Benefit-cost ratio} = \frac{\text{Annual equivalent benefit}}{\text{Annual equivalent cost}}$$

$$= \frac{889,805}{496,940} = 1.8$$

The benefit-cost ratio is 1.8. Then, this Tube Well Scheme is economically feasible.

The other direct and indirect benefits such as the increase of land value, increase of livestock raising, etc. are not included in this benefit-cost ratio. Therefore, the benefit can be more enlarged if the intangible social benefits as well as the above benefits are taken into account.

6.7 Economy from the Farmer's Viewpoint

The loan must be repaid either by public funds or by the scheme beneficiaries. To meet the repayment obligation satisfactorily, a policy should be established by the Government in the most feasible way. In view of the difficulties of repayment by public funds raised in Nepal, it is assumed that the loan will be repaid from the scheme revenues.

Irrigation revenues as a financial source for the repayment of capital comes from the net increase in agricultural products creditable to this scheme. In some countries, no charge is levied in the farmers to recover the capital cost of the irrigation facilities according to the national policy to promote the irrigation agriculture.

However, in case of Nepal, certain charge will have to be levied on the irrigation water users in the form of water rate, carefully determined according to their ability to pay.

When the irrigation system comes into operation, it will thus be declared that the water rate will be collected from farmers through farmer's co-operatives. In view of an insufficient water application in the initial stage of the operation, in first five years only the costs of operation and maintenance of the irrigation system will be charged. After the 6th year full rate will be levied.

6.8 Financial Feasibility

Besides the construction cost, the initial input for agriculture is required for the smooth management of the Tube Well Scheme. Then, the initial investment for this irrigation scheme is estimated at Rs 4,055,000 as itemized below.

Construction cost:	Rs4,055,000
Initial input for agriculture:	Rs1,711,000

In general, it is not possible to big return from the irrigation farming during the initial stage of production. Although the entire cost incurrable for implementation of this scheme will be borne by two governments of Japan and Nepal, evaluation of the economicalities of the scheme on the part of the farmers will need to treat such cost as if it were due to a long term loan advanced on behalf of the beneficiary farmers.

On the assumption, the cost to be taken into account will be confined to such investments which increase directly farm profits.

Construction cost:	Rs 4,055,000
Initial input for agriculture:	Rs 1,711,000
Farm implements and tools:	Rs 259,000
Chemical fertilizers:	Rs 952,000
Agricultural chemicals:	Rs 350,000
Improved seeds:	Rs 150,000

In this Scheme, the initial input for agriculture is to be paid for year after year as crop production cost and, accordingly, do not necessarily require long term loan for their annual application. Under the financing system established in Nepal to facilitate for paddy cultivation, chemical fertilizers, agricultural chemicals, etc. are provided in kind as a part and parcel of the crop cultivation loan. In our estimation of crop production cost, 10% of their cost has been appropriate for interest payable. Consequently, the works supposed to be undertaken by long term repayment on the part of the farmers would be:

Construction cost:	Rs 4,055,000
Initial input for agriculture:	0
Total	Rs 4,055,000

In securing, the above amount of money required for the execution of this kind of development work, the following loan facilitation will be possibly arranged for;

Table 6.8) Repayment Plan

Case No.	Repayment Condition	Average Annual Interest Rate	Repayment Period
1	Unredeemable for the first 5 years (only interest is to be paid)	6%	10 years
2	do.	do.	20 years
3	do.	do.	25 years
4	do.	3.5%	10 years
5	do.	do.	20 years
6	do.	do.	25 years
7	do.	do.	30 years

Under the condition of Case No. 7 shown above, the amount loanees will have to pay per hectare per annum will be about Rs 382. As shown in Table 6.1, the annual net income of a unit farm is expected to be about Rs 2,432 per 1.7 ha unit farm in and after the 5th year of irrigation farming. Therefore, the net reserve of the farmers in the scheme area will be Rs 1,782 after payment of the above water rate of Rs 650 from the capacity to pay.

Then, the proposed tube well scheme is profitable from the farmer's economic point of view.

/1: Next page.

The terms and conditions on which long-term loans might be available for the construction cost and input for agriculture as mentioned above would have considerable influences on the farmers' financial position. Marginal propensity to save among the Nepalese farmers would account for another important factor in this connection. In case, for instance, the ratio of amortization out of increase net income should be less than their marginal propensity to save, this type of agricultural development scheme would become less burdenous on the part of the individual farmers and, accordingly, more acceptable. Any subsidies offerable by the Government on behalf of the farmers willing to undertake this type of development work will proportionately bring down the ratio of amortization out of the increased income derived from the investiment for development.

As mentioned already, the benefit-cost ratio shows that the Tube Well Scheme is economically feasible. On the other hand, the scheme is financially justfiable under the normal financial conditions. On the assumption that a loan would be available in terms of the annual interest rate of 3.5% and the matunity period of 30 years including grace of 5 years, the financial benefit-cost ratio becomes 1.3.

/1: The term "Capacity to pay" means the amount remaining to operate after all costs except water charges have been met and after an allowance has been made for family living. It represents the amount the farmer can afford to pay for water.

CHAPTER VII ANNUAL SCHEDULES FOR IMPLEMENTATION OF THE PROJECT

7.1 Implementation Programme (1972 — 1976)

Tentative schedule for implementation of the project extending for full five years from the budgetary point-of-view is given on Table 7. 1-1 (Budgetary Operation Schdule) and Table 7. 1-2 (Time Schedule)

Table 7.1-1 OPERATION SCHEDULE OF BUDGET

Item	Total	Period					Remarks
		1972	1973	1974	1975	1976	
	('000Rs)						
Tube Well Scheme	8,556	3,017	2,567	1,711	1,058	203	
Hardinath Extension Centre	1,916.5	657	575	383.5	246	55	
Areawise Extension Service	568.8	182.3	171	114	79	22.5	
Chitwan Extension Station	1,426	495	428	285	180	38	
Transportation Service	1,760	628	528	352	214	38	
Better Living Scheme	201.9	76	60.6	40.4	22.6	2.3	
Others	2,015.4	588.5	604.6	403.1	310.4	108.8	
Total	16,444.6	5,643.8	4,934.2	3,289	2,110	467.6	

Table 7.1-2 TIME SCHEDULE

Item		Cost ('000Rs)	1972	1973	1974	1975	1976
Tube Well Scheme	Tube well facilities	4,865					
	land arrangement	1,980		rainy season			
	Initial input for agriculture	1,711					
Hardinath Extenion Center	Water management	90					
	Input for better farm management	827.6					
	Training and facilities	998.9					
Chitwan Extension Station	Lift irrigation facilities	513					
	Agro-input facilities	440.1					
	Management and facilities	472.9					
Transportation Service	Railway construction	1,660					
	Road improvement	100					
Better Living Scheme	Domestic water facili-	146.9					
	Medical care	40					
	Guidance for better living	15					
Others		2,015.4					

A P P E N D I X

(1) The Questionaire of the Feasibility Survey

Strictly Confidential

CODE NO.

FEASIBILITY SURVEY FOR
AGRICULTURAL DEVELOPMENT
PROJECT IN NEPAL

Name of Interviewer

Date of Enumeration

Name of Panchayat

Name of Village
(Word Number)

House Number
(Field Number)

Race (or Caste)

Language

Religion

FAMILY COMPOSITION AND WORK FORCE (STAYING WITH THE HEAD ONLY)

Members of the household as an Economic Unit	Relationship to Head	Sex	Age	Education (Class reached) in School	Work Force (occupation)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					

* a. Land-Lord
b. Owner Cultivator
c. Tenant Cultivator
d. Agricultural Labourer
e. Unpaid family worker
f. Employee (Non-agricultural Sector)
g. Attending School
h. No job
i. Other (in detail)

LAND TENURE

(a) Jestha (Kharif) in 1970 (Unit Bigha)

	Extent Cultivated	Extent Uncul-tivated		Land Ownership (extent)		
			Land given to Tenants	Owner Culti-vation	Land Obtained for tenancy (mohi)	Total
Low-Land (Khet)						
Up-land (Pakho)						
Shifting Cultivation						
Other						
Total						
(b) Marga (Rabi) in 1969/70						
Low-Land (Knet)						
Up-Land (Pakho)						
Shifting Cultivation						
Other						
Total						

L I V E S T O C K

(a) Kind, Number and Transactions in 1970

KIND	NUMBER	SALE		PURCHASE		BIRTH AND EGGS
	(End of 1970)	Number	Value	Number	Value	Number
(i) BULLOCK						
(ii) COW						
(iii) CALF(Below 6 months Old)						
(iv) BUFFALOE (SHE)						
(v) BUFFALOE (HE)						
(vi) BUFFALOE(CALF)						
(vii) GOAT AND SHEEP						
(viii) PIG						
(ix) POULTRY (6 Months Old)						
(x) OTHER						

(b) Please write one name of livestock and its number you want to rear immediately.

4. AGRICULTURAL MACHINERY, EQUIPMENT AND TOOLS

(a)

ITEM	PUMP SET	CART	PLOUGH	SPRAYER	KODAL	SICKIE	THRE-SHER	HARROW	RID-GER	KUTO	KH-URPI	OTHER
NUMBER												
YEARS USED												

(b) Please write a name of machine or tool you want to have immediately.

5. EXTENT PLOUGHED BY TRACTORS

(a) Jestha (Kharit) in 1970

(i) Low-Land

(ii) Up-Land

(b) Marga (Rabi) in 1969/70

(i) Low-Land

(ii) Up-Land

6. Agricultural Production and Sale in 1970 (Kharit & Rabi)

Item	Extent (Bigha)	Production	Sale (quantity)	Price (Rs.)	Remarks
*Paddy from Low-Land (a) Jestha		maund	maund		
(b) Marga					
Paddy from Upland					
Wheat					
Banana					
Chilies					
Tobacco					
Potato					
Mustard					
Onion					
Mango					
Sesame					
Kodo					
Buck Wheat					
Tomato					
Maize					
Sugarcane					
Rahar					
Jute					
Others					

* Should include paddy for the settlement of debt.

7. Durable Goods

(a)

Inventory of durable goods	Number	Year of Purchase	Purchased Price	Remarks
(a) Bicycle				
(b) Radio				
(c) Sewing Machine				
(d) Lamp Petromax				
(e) Wall Clock				
(f) Wrist Watch				
(g) Umbrella				
(h) Torch				
(i) Beds				
(j) Chairs				
(k) Tables				
(l)				
(m)				
(n)				
(o)				
(p)				

(b) If you have extra money Rs-500, for what are you going to spend?

8. Indebtedness

Rs.

(a)

Loans to be repaid	Rate	Amount	Purpose	Interest (%)	Remarks
1st Loan					
2md Loan					
3rd Loan					
4th Loan					

(b) Comment regarding the status of person or organization who lent:

(1) 1st ....

(2) 2nd ....

(3) 3rd ....

(4) 4th ....

9. Have you any plan to increase the extent of cultivation in Future ? If so, please write the names of crops and extent with reasons.

(a) Crops to be increased

(Unit Bigha)

Crops	Extent

(b) Reasons

1. because of good price
2. because of high yield
3. for labour saving
4. because of less damage by disaster
5. other reasons

....

....

....

10. What are you going to do for the development of your farm?

Please select two answers for each field out of the following.

1. To increase the extent of paddy
2. To have agricultural implements (machines)
3. To improve roads in fields
4. To improve drainage
5. To improve irrigation facilities
6. To finance the cultivation (fertilizer, Seed paddy rent etc.)
7. To learn improved technics
8. To get enough number of agricultural labourers
9. To get good price at the market for agricultural products
10. To grow new crops
11. To improve animal husbandry
12. To increase the extent of cash crop (   )
13. Others ....

    ....

    ....

    ....

    ....

    (a) Low-Land

    (b) Up-Land

11. BACKGROUND OF RE-SETTLERS

1. (1) Village of Origin: ....
   (2) Date when you came: ....

2. Sources of income you derived from your livelihood in the home Village:

   (1) Main: ....
   (2) Others: ....

3. If you have property in the original village -

   (1) Relationship of caretaker: ....
   (2) Way of utilization of the property: ....
   ....

4. If you derived any income from non-agricultural pursuits, when you were in the home Village -

   (1) Self-employed: ....
   (2) An employee: ....
   (3) Monthly income from it: ....

5. Main reasons why you left the village ....
   ....

6. How much of your expectation at the time of resettlement has been fulfilled ? ....

12. <u>Labour Force in 1970</u>

Serial Number of family member	Days worked in Your own field	Days worked in other's field	Days worked in non-agricultural sector
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			

13. Cost of production in respect of total extent cultivated in the last agricultural year (payment only)

(1) Seeds

(a) Jestha 1970

Crops & Variety							
Quantity							
Value per unit							
Total amount							

(b) Marga 1969/70

Crops & Variety							
Quantity							
Value per unit							
Total amount							

(2) Fertilizer

(a) Jestha 1970

Variety'							
Crops							
Quantity							
Value							
Amount							

(b) Marga 1969/70

Variety							
Crops							
Quantity							
Value							
Amount							

(3) Agro-chemicals

(a) Jestha 1970

Variety							
Crops							
Quantity							
Value (per Unit)							
Amount							

(b) Marga 1969/70

Variety							
Crops							
Quantity							
Value (per unit)							
Amount							

(4) AGRICULTURAL TOOLS

TOOLS	Kodal	Sickle	Plough			
NUMBER						
VALUE						
AMOUNT						

(5) COST FOR CATTLE

	FEEDING	TREATMENT	INSEMINATION	
LIVESTOCK				
VARIETY				
QUANTITY				
AMOUNT				

(6) FUEL & KEROSENE OIL (ONE FOR PRODUCTION)

ITEM				
QUANTITY				
VALUE				
AMOUNT				

(7) Cost of boras for harvested grains

Number: .... Amount: ....

(8) Fees paid for cattle, tractors and other agricultural equipments:

(a) Jestha 1970.

ITEM	BUFFALOES	TRACTORS	CARTS			
NUMBER						
CROPS						
AMOUNT						

(b) Marga 1969/70

ITEM	BUFFALOES	TRACTORS	CARTS			
NUMBER						
CROPS						
AMOUNT						

(9) Rent paid to landlords

(a) In Cash

i. Rs. (Jestha 1970)

ii. Rs. (Marga 1969/70)

(b) In kind

	Jestha 1970	Marga 1969/70
CROP		
QUANTITY		
VALUE		

(10) Repair of machines

ITEM	TRACTOR	PLOUGH	SICKLE		
AMOUNT					

(11) Wage for agricultural labourers (give number of people obtained by aruma-paruma system in brackets)

(a) Jestha 1970

	Number	Wage (Cash, Kind and Food)	Total
MAN OR WOMAN			
MANURING			
PLOUGHING			
SOWING			
TRANSPLANTING			
WEEDING			
HARVESTING			
THRESHING			
WINNOWING			
TRANSPORTING			

(b) Marga 1969/80

MANURING			
PLOUGHING			
SOWING			
TRANSPLANTING			
WEEDING			
HARVESTING			
THRESHING			
WINNOWING			
TRANSPORTING			

14.

COST OF LIVING (1970)

		AMOUNT
1.	FOOD (Per Week)	
	(1) Rice	....
	(2) Wheat flour and bread	....
	(3) Egg, Fish and Meat	....
	(4) Vegetable, Oil	....
	(5) Tea, Sugar Salt and spices	....
	(6) Cigarette, beedi, etc.	....
	(7) Others	....
2.	CLOTHES AND FOOT WEAR (IN 1970)	
	(1) Dhoti	....
	(2) Shirts, Towels, Sheets. etc.	....
	(3) Saree, Faria	....
	(4) Foot Wear (Chappal)	....
	(5) Others	....
3.	HOUSE (IN 1970)	
	(1) Rent	....
	(2) Cost of Construction	....
	(3) Maintenance	....
	(4) Other	....
4.	EDUCATION (Including fees, textbooks, stationery etc.)	
	(1) Primary	....
	(2) Middle	....
	(3) Higher Education	....
5.	OTHER EXPENSE	
	(1) Litigation	....
	(2) Fuel and Kerosene Oil	....
	(3) Transportation (Travelling)	....
	(4) Soap, Tooth paste, etc.	....
	(5) Plate, Bowl, Pot, Jar etc.	....
	(6) Drugs and Treatment	....
	(7) Others	
6.	CEREMONIAL EXPENCES	
	(1) Festivals	
	(2) Marriage	
	(3) Funeral (Including sraddha)	
7.	SAVINGS	

15.

INCOME FROM OTHER SOURCES IN THE LAST AGRICULTURAL YEAR

(1) Wage (agricultural Sector):

(2) Wage (non-agricultural sector):

(3) Salary:

(4) Sale of products from non-agricultural sector:

Item			
Quantity			
Value per Unit			
Total Amount			

(5) Sale of Land property and house:

(6) Remittance from outside (relative or friends)

16. Expenditure for non-agricultural sector

Item	
Quantity	
Value per Unit	
Total Amount	

17. Miscellaneous expense:

ITEM	AMOUNT
LAND TAX	
IRRIGATION RATE	
COMPULSARY SAVING	
CO-OPERATIVE SOCIETY	
EDUCATION TAX	
INCOME TAX	
PANCHAYAT TAX	
TOTAL	

18. Please write down the cropping pattern for each land from May to April (Baisakh to Chaitra)

(a) Low-Land

(b) Up-Land

19. What do you practice for the maintenance of the soil productivity in your farm?

1. Composits md per bigha
2. Chemical Fertilizen md. per bigha
3. Chief factors to degenerate the soil conditions.
4. No change from the time immemorial.
5. Traditional method to preserve soil conditions
6. Liming practice

20. What are the hardest or most roublesome works for cultivation?

1.

2.

3.

21. Co-operation of Farmers for Development

1. Are you a member of the following organizations?
   (a) Village Panchayat
   (b) Co-operative Society
   (c) Word Committee
   (d) Krishak Samiti
   (e) Class Organizations (class)
   (f) Others (in detail)

2. Are you ready to co-operate each other in the village for the controle and management of irrigation water if it comes to be available regularly through tube wells or canals?

3. How much can you pay water rate as maximum amount if supplied regularly?

a)	Less than	Rs.	5/-	per bigha / year
b)	Rs. 5/-		Rs. 15/-	,,
c)	Rs. 16/-		Rs. 30/-	,,
d)	Rs. 31/-		Rs. 50/-	,,
e)	Rs. 51/-		Rs. /00/-	,,
f)	More than Rs. 101/-			,,

4. To what extent can you extend the co-operation with fellow farmers in the village?
   (a) Joint purchase of seeds, fertilize, agro-chemicals and other daily use goods.
   (b) exchange of labour for cultivation.
   (c) Joint use of agricultural machines like tractors.
   (d) Collaboration for the sale and transport of agricultural products to the market porp.
   (e) Finances of loan porproduction to the fellow farmers when required.

5. Are you ready to accept the guidance of DADO regarding the varieties of crops to be sown and the method of cultivation in your field?