NO. 4

BASIC DESIGN STUDY REPORT
ON
THE CONSTRUCTION PROJECT OF FOODGRAIN STORAGE
IN
THE KINGDOM OF NEPAL

JUNE 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Kingdom of Nepal, the Government of Japan decided to conduct a Basic Design Study on the Construction Project of Foodgrain Storage and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Kingdom of Nepal study teams headed by Mr. Takeshi SAITO, Director, Import Department, Chiba Food Agency Office, Ministry of Agriculture, Forestry and Fisheries, from February 24 to March 20 and from May 28 to June 7, 1985.

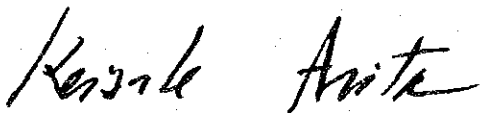
The teams had a series of discussions on the Project with the officials concerned of the Government of the Kingdom of Nepal and conducted a field survey in Terai area.

After the teams returned to Japan, further studies were made and the present Report has been prepared.

I hope that this Report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

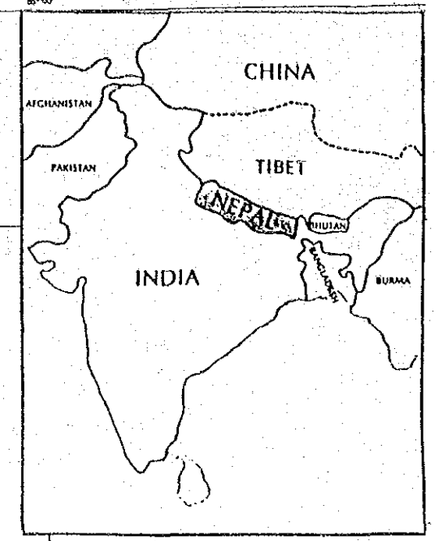
I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Nepal for their close cooperation extended to the teams.

June, 1985



Keisuke ARITA
President,
Japan International Cooperation Agency

NEPAL



MAHENDRANAGAR
DANGADHI
RAJAPUR
NEPALGANJ
KATHMANDU

MOUNTAINEERING ADVENTURE FOUNDATION
NEPAL POLICE
NPMAF

LEGEND

BOUNDARIES

International, Zonal, District

HEADQUARTERS

CONTOUR INTERVAL 2000 FEETS

NEPAL

Scale 1 : 750 000

Kilometres 20 10 0 20 40 60 80 100 Kilometres

·CONTOUR INTERVAL 2000 FEETS

29° 00'

28° 00'

Mahakali River

Seti River

Karnali River

Bheri River

Sani Bheri R.

Mohana R.

Kanar R.

Babai River

Man River

Rapati River

Sharda River

Mahendranagar

KANCHANPUR

DADELDHURA

BAITADI

DOTI

ACHHAM

KAILALI

Dhangadhi

Rajapur

BARDIYA

BANKE

KALIKOT

MUGU

JUMLA

DAILEKH

JAJARKOT

SURKHET

Birendranagar

SALYAN

ROLPA

DANG

SUMMARY

With the agricultural population comprising 90% of the total, agricultural products of Nepal account for approximately 60% of the gross national product. Nepal has been an agricultural country with a surplus of foodgrains available for export. However, productivity growth in foodgrains has been unable to keep pace with the population increase of 2.65% per annum. Recently, Nepal was found itself in a situation where serious shortages of food supplies arise in years of poor crop, necessitating measures for food security. The agricultural productivity increase and stable foodgrain supplies have therefore become one of the nation's most important concerns.

Geographically, the land of Nepal consists of three long and thin zonal belts running in the west-east direction.

Although the Terai area was originally dense forest, 30-year of deforestation and rapid settlement have led to an increase in agricultural production. Currently, the Terai area yields a surplus of foodgrains, while the hilly and mountainous areas are deficit areas, in particular, the latter is suffering a serious shortage.

Generally speaking, transportation means to the food-deficit areas are poor. Porter and airway are the only two methods of transporting goods. This causes a problem that the market and distribution mechanism of the private sector does not function well.

On the other hand, in the Terai where the traditional traffic and trade has been closely related to the Indian Terai, most of the foodgrain distribution is handled by Indian merchants who possess rice and/or storages. The socio-economic structure in Terai has been built-up virtually on the premises of free exchange of goods and people across the border. It would not be overstating to say that the foodgrain market in Nepal Terai is controlled by the power and profits of Indian merchants.

Because of this, in a year of a good harvest, farmers in Terai have been forced to sell out grain to Indian merchants at a lower price. In a year of a poor harvest, foodgrains flow out to the Indian market, not being distributed to deficit areas within Nepal.

In these situations, for the food deficit areas, His Majesty's Government (HMG) of Nepal is running a policy to distribute foodgrains to the areas by a governmental organization on subsidized prices, with the transportation costs being borne by HMG. HMG is also considering to increase the stock amount for the National Food Security from the present 15,000 tons to 40,000 tons.

For improvement of agricultural productivity, HMG sets up a floor price in each district, the lowest line of purchase price secured by HMG, as an incentive to farmers.

The undertaking for these -- the distribution to food-deficit areas, the stocks on the National Food Security Plan, the purchases on the floor price -- are executed by Nepal Food Corporation (NFC), which is organized under the Ministry of Supplies.

In a year of a poor crop, NFC must compete with Indian merchants in order to purchase the necessary quantities, necessitating enough storage capacities to gain a dominant position in the competition. In a year of a heavy crop, NFC is obliged to buy a quantity at floor prices. In either case, enough capacities are required.

The warehouse construction of NFC has been carried out not only by HMG, but also financed by UNDP and Great Britain. At present, NFC owns storage with a total capacity of 55,300 tons, with an additional 27,000-ton capacity now under construction and a 5,000-ton capacity under planning, both financed by IDA. Since the present storage facilities are not sufficient, NFC borrows warehouses from the former RECs(Note),Sajha (agricultural cooperatives) and the private sector on a rental basis.

In accordance with its unique geographical conditions, Nepal is divided into 5 Development Regions, each seeming to be cut by lines running south and north. Parts of Terai area which belongs to Mid-west Development Region (MWDR) and Far-west Development Region (FWDR) have particular characteristics.

These areas are the least developed area with Nepalese Terai. Likewise, the development of rice mills and foodgrain warehouses in the private sector lag behind compared with other Terai areas. In such a situation, private facilities are not available to NFC, forcing it to stock foodgrains in the open air at the peak time of collection. Furthermore, NFC will have to collect more foodgrains following the completion of ongoing irrigation projects and the expected increase in foodgrain production.

These areas were initially included in the aforementioned IDA project plan. However, they were excluded at the final stage of the decision, because of shortage of funds.

Speaking of the current situation concerning rice mill facilities in the Bardia District of MWDR, there is a conspicious lack with only one private mill in Rajapur, having a capacity of 2 tons per hour. Even rice for consumption in this area must be brought to Nepalganj which is a 2-day journey by bull cart, and brought back again. In considering the transportation, it is more economical to process paddy at Rajapur, since the weight of the cargo can be reduced to approx. 75%, if processed before shipping, resulting in the reduction of the transportation cost. Considering the proportion of the foodgrain production and rice milling facilities, establishing a rice mill at the area is reasonable.

With this background and these necessities, HMG has planned the construction of a foodgrain storage in Rajapur of MWDR and in Dangadhi and Mahendrangar of FWDR respectively, and also a rice milling facility in Rajapur, with a view to promoting NFC's operations.

In order to implement the plan, HMG of Nepal requested a grant aid cooperation of the government of Japan. In response to this request, the government of Japan decided to conduct a basic design study of the project through Japan International Cooperation Agency (JICA). And a mission for the survey was dispatched by JICA to Nepal from February 24 to March 20, 1985, to conduct talks with the people concerned and to carry out surveys of the project sites. On the basis of the findings, further study was made thereafter to determine the adequacy of the plan as a grant aid cooperation project. The adequacy was thereby confirmed, and the study report was prepared.

The project aims at solving the deficiency of storage capacity and rice milling facilities in the project areas, and also at promoting the effectiveness of NFC's operations. The footgrain storages to be constructed will bear the function of these of the producing districts. Regarding the construction sites, for Rajapur, lands in the village will be purchased, and for Dangadhi, a site in a rice milling premises of former Seti Mahakali Paddy REC.*, and for Mahendranagar, a site adjacent to the premises of an NFC storage site are prepared, respectively.

The contents of the facilities and equipment required are as follows:

Rajapur:	Foodgrain warehouses -- total 5,500 tons
	Rice milling plant -- paddy 2 tons per hour
	Parboiled rice plant -- paddy 2,000 tons per year, max. 20 tons per day
	Auxiliary buildings for the plants and administration facilities
Dangadhi:	Foodgrain warehouses -- total 4,000 tons
	Administration facilities
Mahendranagar:	Foodgrain warehouse -- total 1,000 tons
	Administration facilities

The total floor area of the buildings of these facilities is approx. 8,300 m^2. Regarding the equipment, storage equipment for quantity and quality control and for storing are required for each of the three sites. The Rajapur site requires equipment for the rice milling plant and parboiled rice plant.

As for the construction work some difficulties are anticipated, concerning transportation, traffic and communications. Essential points

* There existed eight Rice Esport Companies (RECs) jointly established by the government and private sector, which had dissolved following the fading of a purplus for export, and is now under the legal process.

in the work execution are; (1) work progress attained by the start of rainy season; (2) to continue the works under the conditions of traffic stoppage during the rainy season; and (3) the way of construction management. Regarding the construction period, 16.5 months is required for the Rajapur site, 14.5 months for the Dangadhi site and 11 months for the Mahendranagar.

Regarding the management and operation, as the storage at Dangadhi will be directly under the management of its Zonal Office and the Mahendranagar also under that of its Branch Office, they will be used for the operations of the respective office. As to the Rajapur, a new organization will be formed, and the storage and the rice milling facilities are to be managed under the control of the Nepalganji Zonal Office. There will be no problem in securing required personnel and the required funds for these operations.

Regarding the effectiveness of this project, NFC's capability of foodgrain collection will increase by 125% to a total of approx. 10,300 tons in Dangadhi, by 50% to a total of approx. 4,300 tons in Mahandranagar, and by a great extent to approx. 7,900 tons in total in Rajapur. These collection capabilities account for 15 - 20% of the total distribution amount in each respective area. These capabilities will enable NFC to fulfill the need for facilities necessary in the planned districts to carry out distribution to food deficit areas, stock against crisis, and the floor price policy as an incentive to farmers.

Because of these, the grant aid cooperation of Japan is judged to bear a great significance. Therefore, the project is hoped to be implemented as soon as possible.

CONTENTS

Chapter 1 INTRODUCTION

Nepal Food Corporation (NFC), as a state enterprise under the control of the Ministry of Supplies (MCS), is responsible for the stable supply of foodgrains to the Nepalese people.

The balance between supply and demand of food in Nepal has made a turn for the worse in recent years. In accordance with this situation, the amount of foodgrains which NFC deals with shows a trend to be increased. Thereby it becomes difficult for NFC to carry out its duty because of a shortage of storage facilities.

In order to cope with this situation, His Majesty's Government (HMG) of Nepal has formed a plan to construct foodgrain storage at Rajapur in the Mid-west Development Region and Dangdhi and Mahendranagar in the Far west Development Region, both of which are areas which have great need of storage facilities. To implement the plan, HMG of Nepal made a request to the government of Japan for a grant aid cooperation for the construction of the storages.

In response to this request, the government of Japan decided to conduct a basic design study of the project through Japan International Cooperation Agency (JICA). JICA then dispatched a mission for the survey headed by Mr. Takeshi Saito, Director of the Import Department of the Chiba Food Agency Office of the Ministry of Agriculture, Forestry, and Fisheries, to the Kingdom of Nepal for 25 days from February 24 to March 20, 1985, to conduct talks with people concerned and to make investigations of the proposed sites. The items which are mutually agreed upon stand as summarized in the minutes. On the basis of the facts and findings clarified by the survey, a further study was made thereafter to determine adequacy of the plan as a grant aid project. The adequacy was thereafter confirmed, and a draft final report on the project was prepared which included a basic design, a schedule of the project execution, evaluations and recommendations. A second mission was dispatched to the Kingdom of Nepal from May 28 to June 7, 1985, where both parties held discussions on the draft report. The results which were mutually agreed upon are summarized in minutes.

The organizations of the missions, the lists of people concerned

on the Nepalese side, schedules of the missions and texts of the minutes can be referred to in the Appendices.

Chapter 2 BACKGROUND OF PROJECT

2-1 Foodgrain Production and Distribution

(1) Topography

The Kingdom of Nepal is a laterally narrow country with an area of about 140,000 km^2. It is approximately 220 km from north to south and approximately 880 km from east to west, and is located between 26°20' N. Lat. and 30°10' N. Lat. and between 80°15' E. Long. and 88°05' E. Long.

The country consists of the southern region with its subtropical monsoon, the hilly region with warm weather to the north, and the Himalayan mountain region with cold weather to the extreme north. Geographically, the country has three distinct belts running east to west. The lower southern region called the Terai Plain is adjacent to India. Since olden times, the middle, hilly region has been the core of Nepal, with the mountain region forming the third belt to the north.

The government of Nepal divided the land into 5 development regions according to the border lines running north to south. This is attributed to the fact that it is relatively easy to travel from north to south. Traffic from east to west is handicapped by mountains and rivers. The 5 development regions consist of 14 zones, which are subdivided into 75 districts.

(2) Foodgrain Production and Consumption

The total area of cultivated land in Nepal is about 2,330,000 ha, which consists of 62% for paddy, 25% for maize, 9% for wheat and 4% for others. The total production volume of foodgrain in a normal year is 3,350,000 to 3,550,000 tons, about two thirds of which comes from the Terai Plain, the grainery of Nepal. While a surplus of foodgrain is produced in the Terai Plain, there is a chronic shortage in the mountain region, where only a third of the total production volume of foodgrain is produced. Surplus foodgrain produced in the Terai Plain is not only sent to the other regions of Nepal where foodgrain is scarce, but it is also exported

to India, the neighboring country to the south. This exporting acts as an important source of foreign currency for major exportable products in the country.

The consumption volume of foodgrain in Nepal is about 3,200,000 tons, and as far as the figure shows the rate of self-sufficiency is 104 to 110%. Recently, however, a drastic increase in population has led to a decrease in exportable foodgrain.

Currently, the production volume of foodgrain in Nepal is roughly equal to domestic demand, but there exists a large regional gap in the supply of foodgrain. The topography and natural conditions of Nepal have inevitably created regional differences in the production of agricultural products. In addition, the geographical distribution of population does not coincide with the distribution of foodgrain production, resulting in an imbalance between production and consumption as shown by Table 2-1(1).

(3) Agricultural Policy

According to the sixth Five-year Plan (1979/80 - 1984/85), emphasis was placed on an increase in agricultural production, and employment, continuance of foodgrain exports and a stable supply of raw materials to the industries related to agriculture. The target growth of production for major agricultural products is 3.0% per year; specifically, 2.8% for foodgrain and 3.9% for cash crops (sugar cane, potatoes and oil seeds). The specific items of the seventh Five-year Plan (1985/86 - 1990/91) are currently under discussion.

(4) Foodgrain Distribution

The inter-regional distribution of foodgrain in Nepal runs basically from south to north as shown by Figure 2-1(2), or from the Terai Plain, the producing region with surplus, to the mountaneous region, the area in short supply. Some lots are transported between east and west in the Terai Plain with relatively favorable transporting conditions, but they are intended to regulate the local flow of products from south to north.

Table 2-1(1)

FOOD BALANCE SHEETS

Quantity: M.T.

S. No.	Place	1981-1982			1982-1983		
		Production	Requirement	S/D	Production	Requirement	S/D
	THE KINDOM OF NEPAL	2,508,593	2,247,624	+260,973	2,196,526	2,307,768	-111,242
1.	EASTERN DEVT. REGION	626,870	477,874	+148,996	530,694	490,296	+ 40,398
	a) MECHI ZONE	146,496	123,895	+ 22,601	134,259	127,113	+ 7,146
	1. Taplejung	13,420	17,542	- 4,122	12,907	17,997	- 5,090
	2. Panchthar	18,358	19,605	- 1,247	13,908	20,114	- 6,206
	3. Ilan	32,905	20,768	+ 12,137	20,500	21,307	- 807
	4. Jhapa	81,813	65,980	+ 15,833	86,944	67,695	+ 19,249
	b) KOSHI ZONE	296,882	197,050	+ 99,832	248,351	202,170	+ 46,174
	1. Dhankuta	38,658	20,352	+ 18,306	29,670	20,882	+ 8,795
	2. Morang	107,165	83,706	+ 23,459	95,755	85,884	+ 9,871
	3. Bhojpur	24,788	23,851	+ 937	15,184	24,472	- 9,288
	4. Sunsari	75,489	43,044	+ 32,445	65,870	44,164	+ 21,706
	5. Tehrathum	28,401	12,193	+ 16,208	21,925	12,510	+ 9,415
	6. Sankhuwasabha	22,381	13,904	+ 8,477	19,940	14,265	+ 5,675
	c) SAGARMATHA ZONE	183,492	156,929	+ 26,563	148,084	161,006	- 12,922
	1. Siraha	68,432	47,020	+ 21,403	47,893	48,242	- 349
	2. Saptari	57,284	41,727	+ 15,557	52,519	42,811	+ 9,708
	3. Khotan	8,673	17,496	- 8,823	6,559	17,951	- 11,392
	4. Solukhumbu	5,672	8,307	- 2,635	4,354	8,522	- 4,168
	5. Okhaldunga	15,582	16,641	- 1,059	12,429	17,072	- 4,643
	6. Udayapur	27,858	25,738	+ 2,120	24,330	26,408	- 2,078

S. No. Place	1981-1982			1982-1983		
	Production	Requirement	S/D	Production	Requirement	S/D
2. CENTRAL DEVT. REGION	908,744	778,279	+130,465	742,480	799,616	- 57,136
a) JAHAKPUR ZONE	268,050	242,255	+ 25,795	168,361	249,654	- 81,293
1. Mohattari	83,354	50,549	+ 32,805	28,047	51,863	- 23,816
2. Dhanusha	71,445	59,955	+ 11,490	45,838	61,513	- 15,675
3. Sarlahi	55,144	72,401	- 17,257	50,453	75,385	- 24,932
4. Sindhuli	28,243	29,455	- 1,212	19,465	30,221	- 10,756
5. Ramechhap	20,901	16,390	+ 4,511	14,097	16,816	- 2,719
6. Dolakha	8,963	13,505	- 4,542	10,461	13,856	- 3,395
b) NARAYANI ZONE	397,343	260,565	+136,778	325,311	267,338	+ 57,973
1. Makawanpur	42,537	47,154	- 4,617	44,958	48,379	- 3,421
2. Bara	109,867	60,269	+ 49,598	73,479	61,836	+ 11,643
3. Parsa	94,659	52,692	+ 41,967	83,683	54,061	+ 29,622
4. Chitwan	77,085	53,175	+ 23,910	74,805	54,557	+ 20,248
5. Rautahat	73,195	47,275	+ 25,920	48,386	48,505	- 119
c) BAGMATI ZONE	243,351	275,459	- 32,108	248,808	282,624	- 33,816
1. Kathmandu	60,995	113,947	- 52,952	59,425	116,910	- 57,485
2. Bhaktapur	32,234	18,741	+ 13,493	28,505	19,230	+ 9,335
3. Lalitpur	23,453	34,700	- 11,247	24,914	35,602	- 10,688
4. Sindhupalchok	21,181	24,966	- 3,785	19,325	25,615	- 6,290
5. Nuwakot	30,616	21,219	+ 9,397	38,587	21,771	+ 16,816
6. Rasuwa	2,028	5,728	- 3,700	1,789	5,878	- 4,089
7. Dhading	23,739	21,030	+ 2,709	28,592	21,577	+ 7,015
8. Kabhrepalanchok	49,105	35,128	+ 13,977	47,611	36,041	+ 11,570

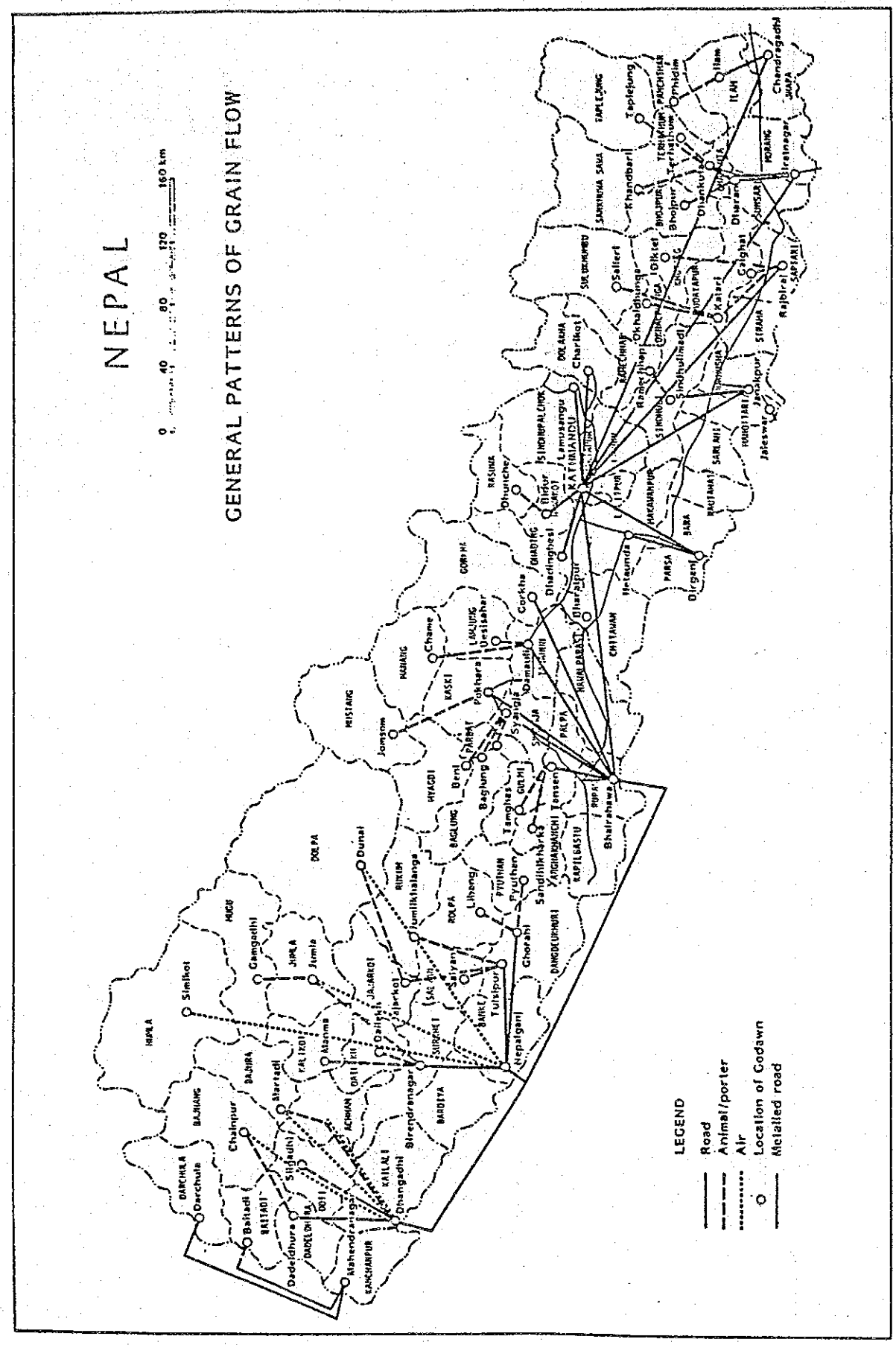
S. No. Place	1981-1982			1982-1983		
	Production	Requirement	S/D	Production	Requirement	S/D
3. WESTERN DEVT. REGION	480,780	478,561	+ 2,219	467,380	490,895	- 23,515
a) LUMBINI ZONE	296,037	270,537	+ 25,500	273,290	277,468	- 4,178
1. Nawalparasi	59,181	69,421	- 10,240	58,834	71,225	- 12,391
2. Rupandehi	100,434	49,886	+ 50,548	84,677	77,797	+ 6,880
3. Kapilvastu	81,753	75,825	+ 5,928	79,922	51,183	+ 28,739
4. Arghakhanchi	15,775	22,315	- 6,540	13,258	22,893	- 9,635
5. Gulmi	18,318	35,139	- 16,821	14,009	35,952	- 21,943
6. Palpa	20,576	17,951	+ 2,625	22,590	18,418	+ 4,172
b) GANDAKI ZONE	144,623	157,705	- 13,082	149,218	161,801	- 12,583
1. Shyangja	27,145	29,368	- 2,223	28,885	30,131	- 1,246
2. Kaski	40,152	54,376	- 14,224	47,724	55,790	- 8,066
3. Tanhu	38,242	33,019	+ 5,223	34,773	33,876	+ 897
4. Manang	1,728	1,297	+ 431	1,606	1,330	+ 276
5. Lamjung	20,289	16,979	+ 3,310	20,510	17,419	+ 3,091
6. Gorkha	17,067	22,666	- 5,599	15,720	23,255	- 7,535
c) DHAWALAGIRI ZONE	40,120	50,319	- 10,199	44,872	51,626	- 6,754
1. Mustan	2,731	1,876	+ 855	2,586	1,925	+ 661
2. Parbat	10,769	9,704	+ 1,065	10,874	9,957	+ 917
3. Myagdi	10,669	15,067	- 4,398	9,599	15,458	- 5,859
4. Baglung	15,951	23,672	- 7,721	21,813	24,286	- 2,473

S. No. Place	1981-1982			1982-1983		
	Production	Requirement	S/D	Production	Requirement	S/D
4. MID WESTERN DEVT. REGION	309,499	333,516	- 24,013	282,777	342,900	- 60,123
a) RAPATI ZONE	138,482	141,839	- 3,357	131,623	145,525	- 13,902
1. Rukum	7,690	19,245	- 11,555	5,798	19,745	- 13,947
2. Rolpa	7,833	17,203	- 9,370	7,545	17,651	- 10,106
3. Salyan	23,817	27,404	- 3,587	25,700	28,116	- 2,416
4. Puythan	19,087	25,395	- 6,308	20,478	26,054	- 5,576
5. Dang	80,055	52,592	+ 27,463	72,102	53,959	+ 18,143
b) BHERI ZONE	155,489	150,997	+ 4,492	138,313	155,222	- 16,909
1. Surkhet	34,086	24,547	+ 9,539	32,355	25,185	+ 7,170
2. Banke	44,552	42,793	+ 1,759	32,787	43,905	- 11,118
3. Bardiya	50,904	41,259	+ 9,645	48,375	42,332	+ 6,043
4. Dailekh	14,501	24,932	- 10,431	13,555	25,880	- 12,325
5. Jajarkot	11,446	17,466	- 6,020	11,241	17,920	- 6,679
c) KARNALI ZONE	15,532	40,680	- 25,148	12,841	42,153	- 29,312
1. Jumla	5,522	4,557	+ 965	3,385	5,088	- 1,703
2. Humla	1,828	2,680	- 852	1,747	2,751	- 1,004
3. Mugu	2,668	6,770	- 4,102	2,274	6,947	- 4,673
4. Dolpa	2,754	4,136	- 1,382	2,623	4,244	- 1,621
5. Kalikot	2,760	22,537	- 19,777	2,812	23,123	- 20,311

S. No. Place	1981-1982			1982-1983		
	Production	Requirement	S/D	Production	Requirement	S/D
5. FAR WESTERN DEVT. REGION	182,700	179,394	+ 3,306	173,195	184,061	- 10,866
a) SETI ZONE	109,499	99,794	+ 9,705	99,668	102,391	- 2,723
1. Doti	21,892	19,642	+ 2,250	21,754	20,153	+ 1,601
2. Achham	8,806	17,491	- 8,685	8,052	17,946	- 9,894
3. Bajura	5,374	8,129	- 2,755	5,052	8,340	- 3,288
4. Bajhang	6,939	12,748	- 5,809	6,747	13,080	- 6,333
5. Kailali	66,488	41,784	+ 24,704	58,063	42,872	+ 15,191
b) MAHAKALI ZONE	73,201	79,600	- 6,399	73,527	81,670	- 8,143
1. Baitadi	10,318	17,590	- 7,272	9,141	18,047	- 8,906
2. Darchula	8,004	11,425	- 3,421	7,274	11,722	- 4,448
3. Dadeldhura	13,201	15,427	- 2,226	15,255	15,828	- 584
4. Kanchanpur	41,670	35,158	+ 6,520	41,868	36,073	+ 5,795

Source: FAMSD (Food and Agricultural Marketing Services Dept., Ministry of Agriculture)

Fig. 2-1(2)



Source: FAO Food Security Assistance Scheme 1984

The distribution volume may be regarded as the amount of products received by the foodgrain-deficit regions from the foodgrain-surplus regions. Therefore, the distribution volume may be estimated from the balance sheet of the foodgrain production and consumption. The total of the surplus or the scarce amounts is about 20% of the production volume, as shown by Table 2-1(3).

Table 2-1(3) Total of the Food Surplus and Scarce amounts as per Food Balance Sheets

Year	Production Volume (Edible)	Total Surplus Volume	Total Scarce Volume
1981/82	2,508,593 tons	549,489 tons	288,516 tons
1982/83	2,196,526	290,244	401,480

Source: Table 2-1(1)

According to Table 2-1(4), the percentage of the distribution volume of paddy rice is about 70% of the production volume in the grainery district of Terai, and the remaining 30% is consumed or used as seeds by farmers. However, the percentage differs substantially under geographical conditions.

Table 2-1(4) Percentage of Farmers' Rice Consumption Volume Against Primary Rice Distribution Volume

	Farmers' Consumption	Primary Distribution
Bhairahawa (Terai)	30%	70%
Nuwakot (Trishuli, Mid-Hills)	60	40
Panchkhal (Mid-Hills)	50	50
Lele (Hills)	80	20

Source: Rural Grain Save Programme, 1980/81

A typical chart of grain distribution channels in Nepal is shown by Figure 2-1(5). The percentage of grain distribution volume handled by the government had been about 10 to 20%, but it has tended to increase due to the recent adoption of a "floor price" (the producers' guarantee price) purchasing system. In principle the grain imported in a year of poor harvest is handled by the government.

There are a number of problems affecting foodgrain distribution in Nepal today; for example, the low level of producers' price, a large gap in the market price among regions, lack of purchasing power on the part of residents in food shortage regions, loss of foodgrain attributed to lack of infrastructures, and marketing facilities, and the flow of grain to India.

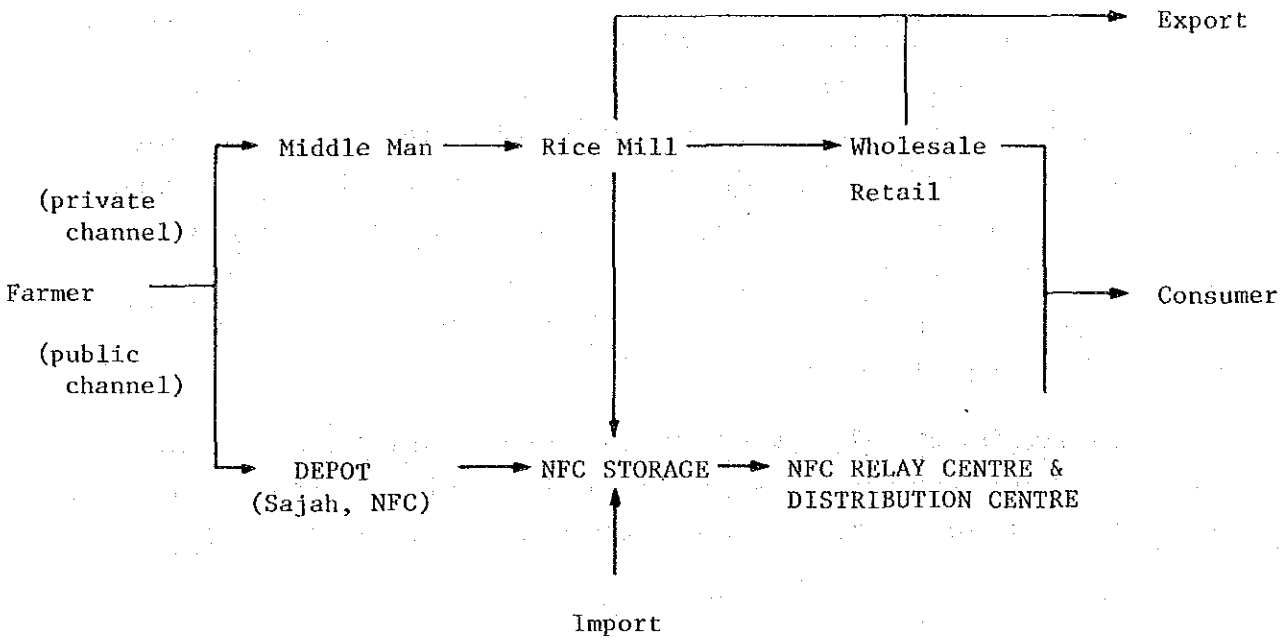
The major causes for the imbalance of food distribution among regions are as follows;

a) With Nepal's hilly and mountaneous regions, it is easier and more profitable to ship grain in India from the Terai Plain, the surplus producing grainery region.

b) The market mechanism is not fully built to ensure a rational distribution of foodgrain, with problems of transportation due to lack of infrastructure and information-related problems in the background. A regional market tends to be isolated because information concerning price and other factors cannot be conveyed in a timely manner. This poses a hindrance for proposed transactions.

c) Existing markets tend to be confused by inadequate storage facilities (loss of grain during storage), inadequate processing facilities (lack of rice-milling facilities and flour mill) and disparate weighing standards.

Table 2-1(5) Foodgrain Marketing Flow in Nepal



2-2 Food Production and Distribution in Proposed Districts

(1) Location

The proposed districts are located in the far and midwest development regions of the Terai Plain. Surplus foodgrain is produced, but roads and infrastructures are insufficient in the proposed districts. Adjacent to India, the "Open Border", the grain market is uniquely affected by the forces of the Indian market.

(2) Food Production

The production volume of foodgrain in the proposed districts is shown by Table 2-2(1). The major crops are paddy rice in the rainy season, wheat in the dry season and maize and mustard seed in the intermediate season. Recently, the production of wheat has risen considerably due to the introduction of high yielding varieties, but the production volume of other foodgrain has been stagnant. Harvesting seasons differ depending upon cropping patterns, as shown by Figure 2-2(2),

The quality of paddy rice to be collected is related to the post-harvest processing method adopted by farmers. In the proposed districts of the Terai Plain, paddy rice is processed as follows:

Reaping:

Reaped by a saw type hand-stickle, tied in a small bundle and dried on the paddy field.

Threshing:

Beaten manually on a hitting stand or on the ground, but is more often trodden by buffaloes on the ground.

Cleaning:

Threshed paddy is cleaned by wind in flat-type bamboo baskets.

Storage:

Threshed paddy is dried by exposure to the sun in the garden for 1 to 2 days, then stored in private granule containers (made of clay).

Table 2-2(1)

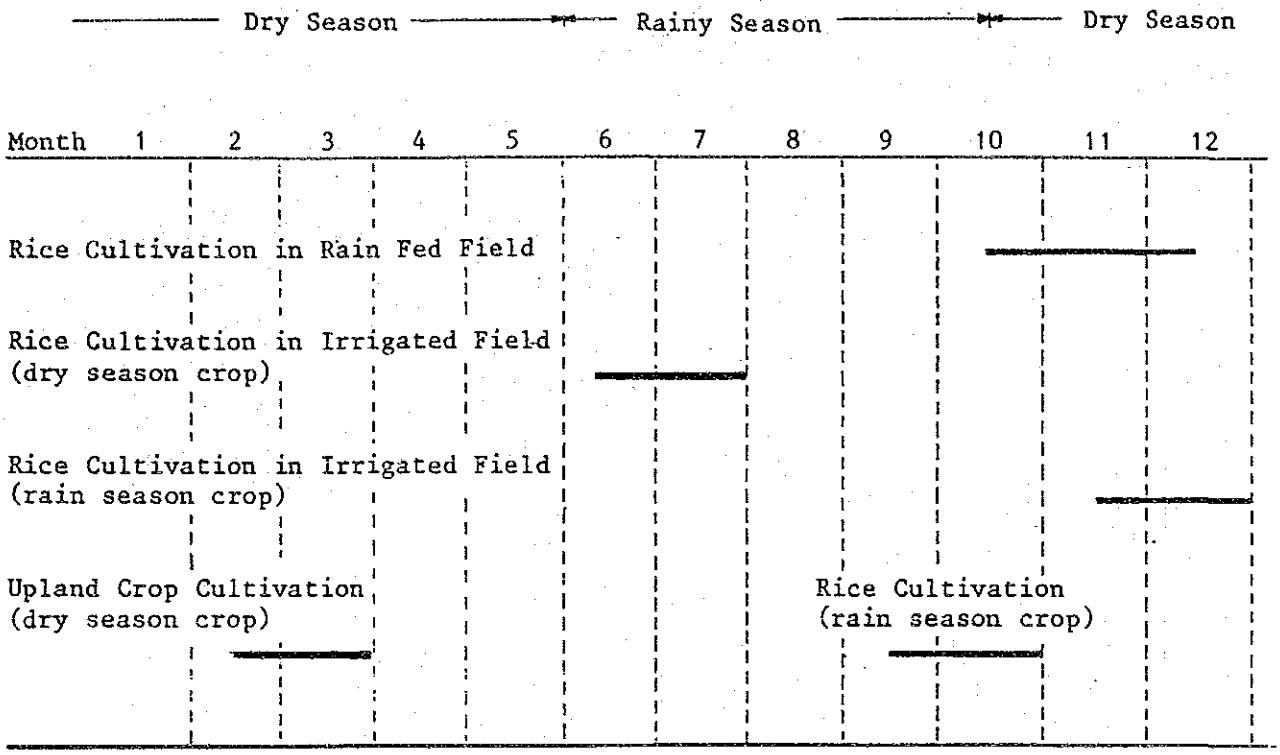
Foodgrain Production in Proposed Districts

(tonnes)

Fiscal Year	Bardiya District				Kailali District				Kanchanpur District			
	paddy	wheat	maize	total	paddy	wheat	maize	total	paddy	wheat	maize	total
1974/75	66,833	7,140	21,945	95,918	85,690	7,100	13,543	106,333	39,008	2,365	8,400	49,773
1975/76	77,230	3,986	15,360	96,576	94,650	10,465	8,130	113,245	42,760	6,900	7,560	57,220
1976/77	58,561	2,895	27,772	89,228	75,720	8,212	15,500	99,432	32,666	8,800	8,820	50,286
1977/78	63,200	2,050	16,570	81,820	81,680	10,590	15,890	108,160	37,230	7,920	8,260	53,410
1978/79	63,220	2,200	17,510	82,930	81,680	6,950	16,780	105,410	42,330	5,120	6,200	53,650
1979/80	37,930	3,000	10,500	51,430	32,670	8,210	16,730	57,610	16,930	6,000	5,890	28,820
1980/81	60,200	8.120	15,300	83,620	86,700	10,950	17,470	115,120	43,660	8,670	9,750	62,080
1981/82	60,130	10,750	12,510	83,390	73,790	18,670	14,320	106,780	55,000	8,850	6,440	70,290
1982/83	53,270	10,580	14,440	78,290	58,680	19,060	13,600	91,340	44,240	9,890	12,720	66,850
1983/84	60,260	12,010	12,660	84,930	75,600	12,010	12,660	100,270	77,150	9,620	6,560	93,330

Source: Agricultural Statistics of Nepal 1983
NFC Report 1983/84

Fig. 2-2 (2) Grain Harvesting Season in Terai Plain



Source: Agricultural Mechanization Plan in Developing Countries, p.86.

Transportation:

Threshed paddy in bulk (800 to 900 kg) is carried by two-bull carts.

Rice milling:

Stone or wooden tread-mills have long been used for milling, but have been recently replaced by huller-type under the payment of charges.

(3) Foodgrain Distribution

The routes for collecting surplus foodgrain in each of the planned districts of Bardia, Kailali and Kanchanpur are shown by Figure 2-2(3). Grain is distributed within each proposed district because it is a producing district, as shown by Figure 2-1(5).

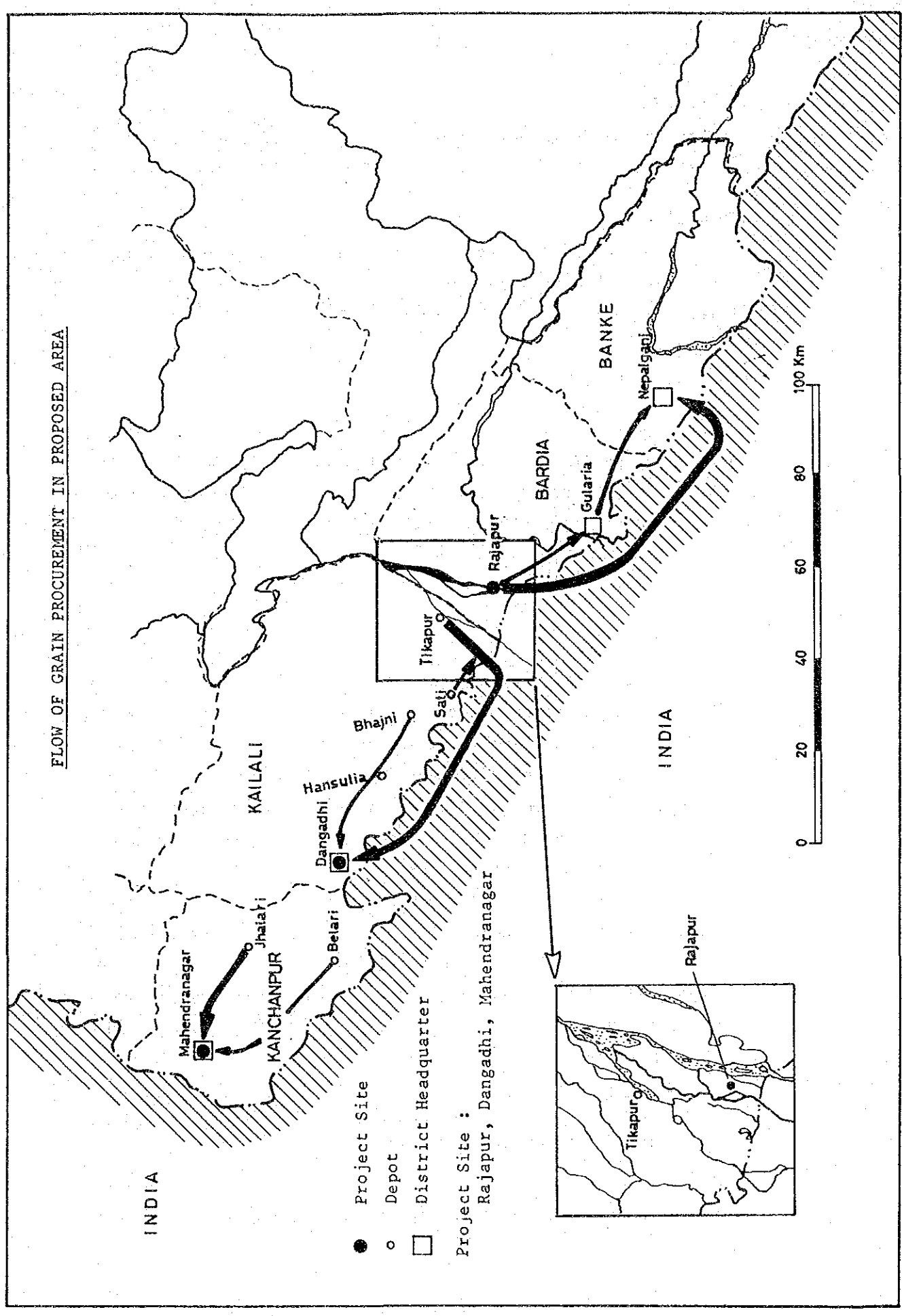
Distrubution in each proposed district is described as follows;

a) Rajapur

Rajapur is a grainery district developed in the fertile island in the Karnali river, where foodgrain in the Bardia District is collected. As the number of storages in Rajapur is limited and most of the rice mills are located in Nepalganj, the collected grain is sent to Nepalganji, the next destination for distribution, in the form of paddy rice. For transportation to Nepalganj there are the Nepalese route and the Indian route. Many roads in Nepal can only be travelled by bull carts. Therefore, the roads in India must be counted on for the vehicle transportation. The transportation expenses from Rajapur to Nepalganj and the days required for such transportation are as follows: An bull cart moves at a speed of approximately 30 to 40 km per day.

Transportation Routes	(Distance)	Transportation Means	Days Required	Transportation Cost
Nepalese route	(85 km)	Bull cart	Two	700 Rs/ton
Indian route	(100)	Truck	Halfday	300

Fig. 2-2(3)


FLOW OF GRAIN PROCUREMENT IN PROPOSED AREA
INDIA
KAILALI
KANCHANPUR
BARDIA
BANKE
INDIA
Mahendranagar
Jhalari
Belari
Dangadhi
Hansulia
Bhajni
Sati
Tikapur
Rajapur
Gularia
Nepalgani
0
20
40
60
80
100 Km
Project Site
Depot
District Headquarter
Project Site :
Rajapur, Dangadhi, Mahendranagar
Tikapur
Rajapur

It is evident that the India route is more attractive in terms of expense and time. As the bridge along the Karnali river near Rajapur was destroyed by flood last year, so bull carts and ferries had to be employed to cross the Karnali river from Rajapur, on both the Indian and the Nepalese route. The bridge will be repaired in the next dry season.

Food collected to Nepalganj from Rajapur is mainly supplied to Surkhet, Dailekh, Kalikot, Jumla, Mugu, Jajarkot, Dolpa regions with food shortages.

b) Dangadhi

Dangadhi is the administrative center of the Kailali District, as well as the foodgrain distribution center. Major foodgrain producing areas within the District are Takapur, Sati, Bhajni, Hansulia and Dangadhi. The transportation of grain to Dangadhi from Takapur and Sati depends on the Indian route and trucks. Bull carts are used via the Nepalese route from Bhajni and Hansulia to Dangadhi.

Grain collected in Dangdhi is mainly sent to Dadeldhula, Bajhang, Achhan, Bajura and Doti.

c) Mahendranagar

Mahendranagar is the Headquarter of the Kanchanpur District, to which the grain collected within the district is sent. Then, the grain is shipped via the Indian route to the Baitadi and Darchula Districts, which have low foodgrain supplies.

As previously mentioned, food is basically distributed from each of the proposed districts to the districts with food shortages, or from south to north. However, some lots are distributed between east and west to regulate the flow of products among the proposed districts, and others are sent to India in the south. The conditions are the same in the other districts of the Terai Plain.

(4) Distribution Volume

Although there is no statistical data immediately available on the distribution volume of grain in the proposed districts, NFC estimates that about 30% of the production volume is sent to the market. This percentage does not correspond with the percentage in the Terai Plain, as indicated by Table 2-1(4). According to the Food Balance Sheets as shown by Table 2-1(1), the percentage of surplus volume against production volume in the proposed districts is 13 to 37% or 21% on the average as shown by Table 2-2(4).

Table 2-2(4) Percentage of Surplus Volume against Production Volume in Proposed Districts

	1981/82			1982/83		
District	Production	Surplus	Percentage	Production	Surplus	Percentage
Bardia	50,904 t	9,645 t	19%	48,375 t	6,043 t	13%
Kailali	66,488	24,704	37	58,063	15,191	26
Kanchanpur	41,670	6,520	16	41,868	5,795	14

Source: Table 2-1(1), Food Balance Sheets

The surplus is expected to equal the distribution volume. However, according to informed local sources, the actual calorie intake of farmers is lower than the calorie intake on the Food Balance Sheets, and the balance should be added to the distribution volume. The percentage of about 30% mentioned before is estimated by taking this fact into consideration.

The volume of foodgrain procurement by NFC in proposed districts is shown by Table 2-2(5). The percentage of the volume of foodgrain handled by the government against the total distribution volume has been 10 to 20%, but is expected to increase with the adoption of the "floor price" purchasing system. The procurement plan in NFC's proposed districts indicates the distinct growing transaction volume, as shown by Table 2-2(6).

Table 2-2(5)

Procurement of Foodgrain by NFC Zonal Office and Branch in Proposed Districts

(tonnes)

Fiscal Year	Nepalganj (Rajapur)					Dangadhi					Mahendranagar				
	Rice	Wheat	Paddy	Maize	Total	Rice	Wheat	Paddy	Maize	Total	Rice	Wheat	Paddy	Maize	Total
1975/76	3,481	246	1,965		5,692		416	5,592		6,008	463	-	386		489
1976/77	3,880	73			3,953	3,692	536	2,575		6,803	534	-			534
1977/78	7,345	106	500	53	8.004	2,575	699	2,182	97	5,553	1,177	104	81		1,362
1978/79															
1979/80	3,348	38		504	3,890	1,672	144			1,816	397			241	638
1980/81	6,094				6,094	2,170		966		3,136	371		375		746
1981/82	6,509		595		7,104	3,667	24	912		4,603	960		18		978
1982/83	5,317	695	27	127	6,166	2,095	534	500		3,129	1,124	1,237		497	2,858
1983/84	3,203	769	547	412	4,931	2,064	114	687		2,865	1,620	500	277	321	2,718
1984/85 (till Mar.)			2,000 esti.								172		464		

Rajapur is main supply area for Nepalganj procurement

Source: NFC

Table 2-2(6)

Procurement Plan of Foodgrain by NFC in Proposed Districts

(tonnes)

Fiscal Year	District		
	Bardia	Keilali	Kanchanpur
1985/86	5,000	7,450	4,350
1986/87	6,950	11,925	7,775
1987/88	10,500	14,975	12,725

Source: NFC 1985

(5) Local Middlemen in Distribution Process

After inspecting the quality of foodgrain brought by farmers on bull carts, local middlemen quote and purchase the grain, exercising their expertise based on experience. While NFC purchases only the grain that meets its quality standards, middlemen may purchase poor quality grain at a lower price. The brokers may have the field for weighing, processing and drying the grain, but most of them do not have their own storage facilities. Therefore, they need to resell the grain soon to rice mills, also for financing.

(6) Rice Mill

NFC owns no rice mills in the proposed districts. Private rice mills are shown by Table 2-2(7).

There are two types of mills; the huller-type small rice mill, and the commercial-type rice mill mainly equipped with Indian machinery. A commercial-type rice mill is usually equipped with parboil facilities, mustard seed oil extracting facilities and pulses processing facilities. A number of warehouses are attached to a rice mill because a large number of raw paddy rice must be accommodated. As there exists no private warehousing industry in Nepal, the storages attached to rice mills actually play the role of buffer stock in food distribution.

According to the APROSC (Agricultural Projects Services Center) survey, the existing capacity of rice milling in all the Mid-Western Development Regions is 21 tons per hour, but this should be increased to 26 tons per hour. The current rate of sufficiency is 80%.

The capacity for rice milling is particularly insufficient in Rajapur, so paddy collected must be transported to Nepalgaji, 100 km away, in spite of poor transportation conditions. Paddy is approximately 20% heavier than milled rice, and occupies 40% more space than milled rice. It is difficult to mobilize a sufficient number of vehicles, partly due to hard road conditions, resulting in a substantial loss of rice.

Table 2-2 (7) Private Rice Mills in Proposed Area

Name	Location	Capacity
Durga Rice Mill	Narayanpur, Kailali	4 ton/hr
Mauraniyh Rice Mill	Narayanpur, Kailali	2
Loktej Rice Mill	Narayanpur, Kailali	2
Sakti Rice Mill	Narayanpur, Kailali	2
Nepal Food Products	Geta, Dangadhi, Kailali	2
K.C. Rice Mill	Geta, Dangadhi, Kailali	2
Prem Pushpa Rice Mill	Dangadhi, Kailali	2
Vijayh Rice Mill	Dangadhi, Kailali	1
Tika Rice Mill	Hashuliya, Kailali	1
Dushyanta Rice Mill	Munua, Kailali	1
Bajni Rice Mill	Bhajani, Kailali	1/2
Kudi Rice Mill	Bhajani, Kailali	1/2
Sharshoti Rice Mill	Geta, Atariyh, Kailali	1/2
Champa Rice Mill	Dangadhi, Kailali	1/2
Chandan Rice Mill	Dangadhi, Kailali	1/2
Baighanath Rice Mill	Mahendranagar, Kanchanpur	1
Mahendra Agro Industries	Mahendranagar, Kanchanpur	2
Kanchanpur Athanic Rice Mill	Mahendranagar, Kanchanpur	1
Siddhehath Rice Mill	Mahendranagar, Kanchanpur	1/2
Guputa Bros. Rice and Oil Mill	Mahendranagar, Kanchanpur	1/2

Source: NFC

(7) Depots and Storages Operated by NFC

The depots and storages operated by NFC within the proposed districts are shown by Table 2-2(8). A depot is a paddy-purchasing place to which farmers bring grain. It is operated either directly by NFC or by Sajah, an organization of Cooperatives. Sajah collects grain on behalf of NFC, which pays a 3% commission to Sajah for collected grain. A depot is equipped with a 500-ton storage, weighing equipment and inspection instruments.

NFC storages are designed to store the grain collected from depots and the milled rice delivered from rice mills. Such warehouses are either owned by NFC or leased from REC (Rice Export Company).

Table 2-2 (8) Capacity of NFC Foodgrain Storage in Proposed Area (ton)

	District		
	Bardia	Kailali	Kanchanpur
NFC Storage	--	2,200 (Dangadhi)	1,000 (Mahendranagar)
		500 (Tikapur)	
		500 (Seti)	
Rented Storage			
REC	--	3,000 (Dangadhi)	1,000 (Mahendranagar)
		1,000 (Bhajni)	
Sajha	200 (Rajapur)	--	--

Source: NFC, 1985

2-3 Undertakings and Facilities of NFC

2-3-1 On NFC

The aim of this project is to construct storage facilities which are required for the execution of NFC's task of distributing foodgrains. NFC was founded in 1974 as a public corporation regulated by the Corporations Act (1964), and is currently under the control of the Ministry of Supplies (MOS). MOS has a total staff of 49 persons, of which 15 are officers (Refer to Fig. 2-3-1(1) for the organization). MOS engages in administration of the stable supply of necessary commodities such as foodgrains, edible oil, salt, sugar and petroleum fuel. As is with NFC, Nepal Oil Corporation is under the control of MOS.

The principal undertakings of NFC consist of two functions. 1) is to guarantee NFC's floor price of foodgrains to farmers and 2) is to assure a stable supply of foodgrains to deficit hilly and mountain areas by consumer prices properly set and stabilized by HMG. Other than these, NFC is in charge of maintaining food stocks for emergency use.

The organization of NFC is shown in Fig. 2-3-1(2). NFC's staff totals approximately 1,150 persons. It has 11 zonal offices across the nation, under which are 8 branches, 48 sub-branches, 30 depot offices and 47 temporary depots. Private dealers are appointed as agents for NFC operates is decided by its Board of Directors. The board is composed of representatives from the organizations mentioned below.

- Ministry of Finance
- Ministry of home
- Ministry of Supplies (Chairman)
- National Planning Commission
- Nepal Restra Bank
- Food and Agriculture Marketing Services Department

Fig. 2-3-1 (1) Organizational Structure of the Ministry of Supplies

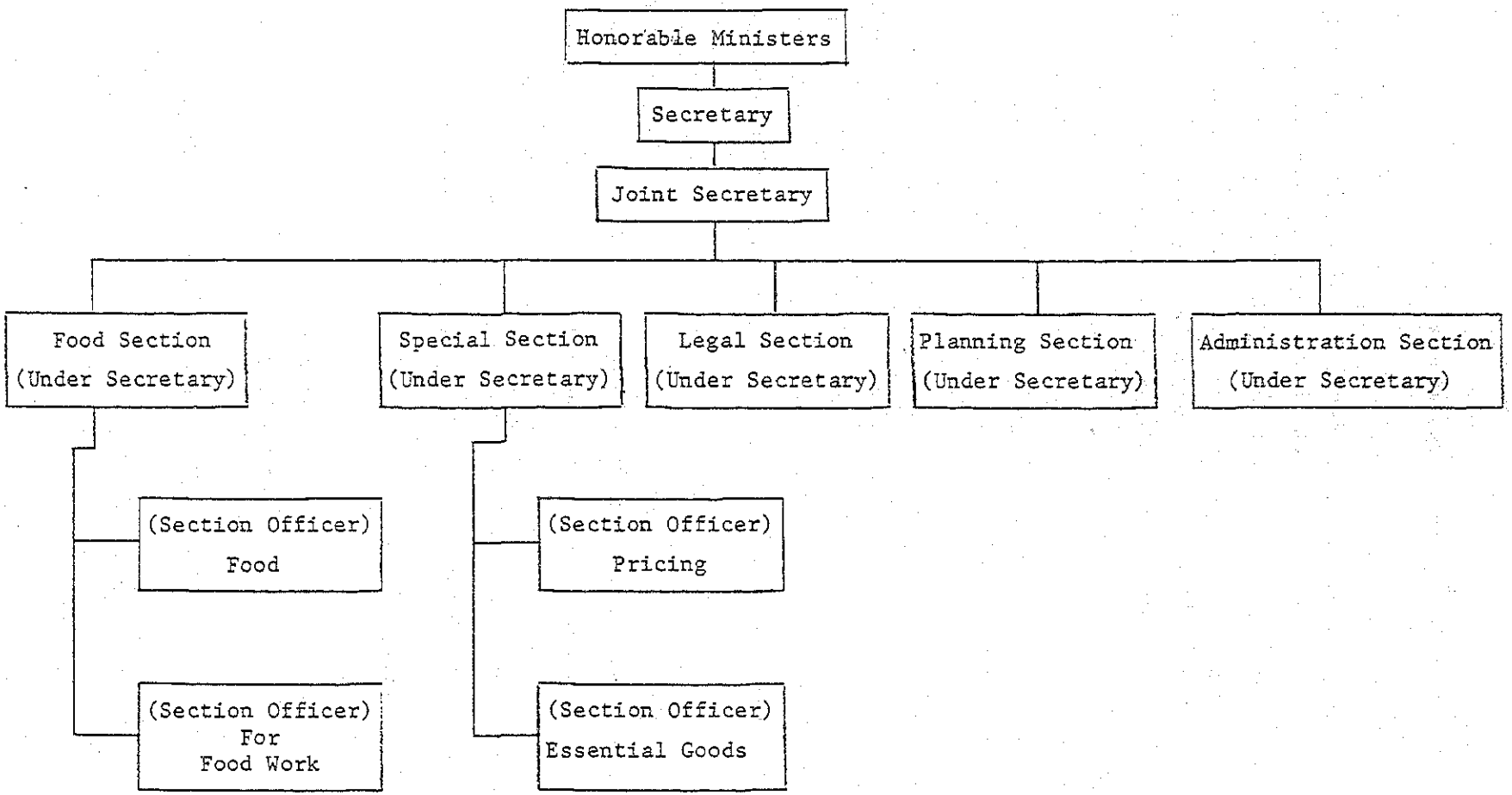
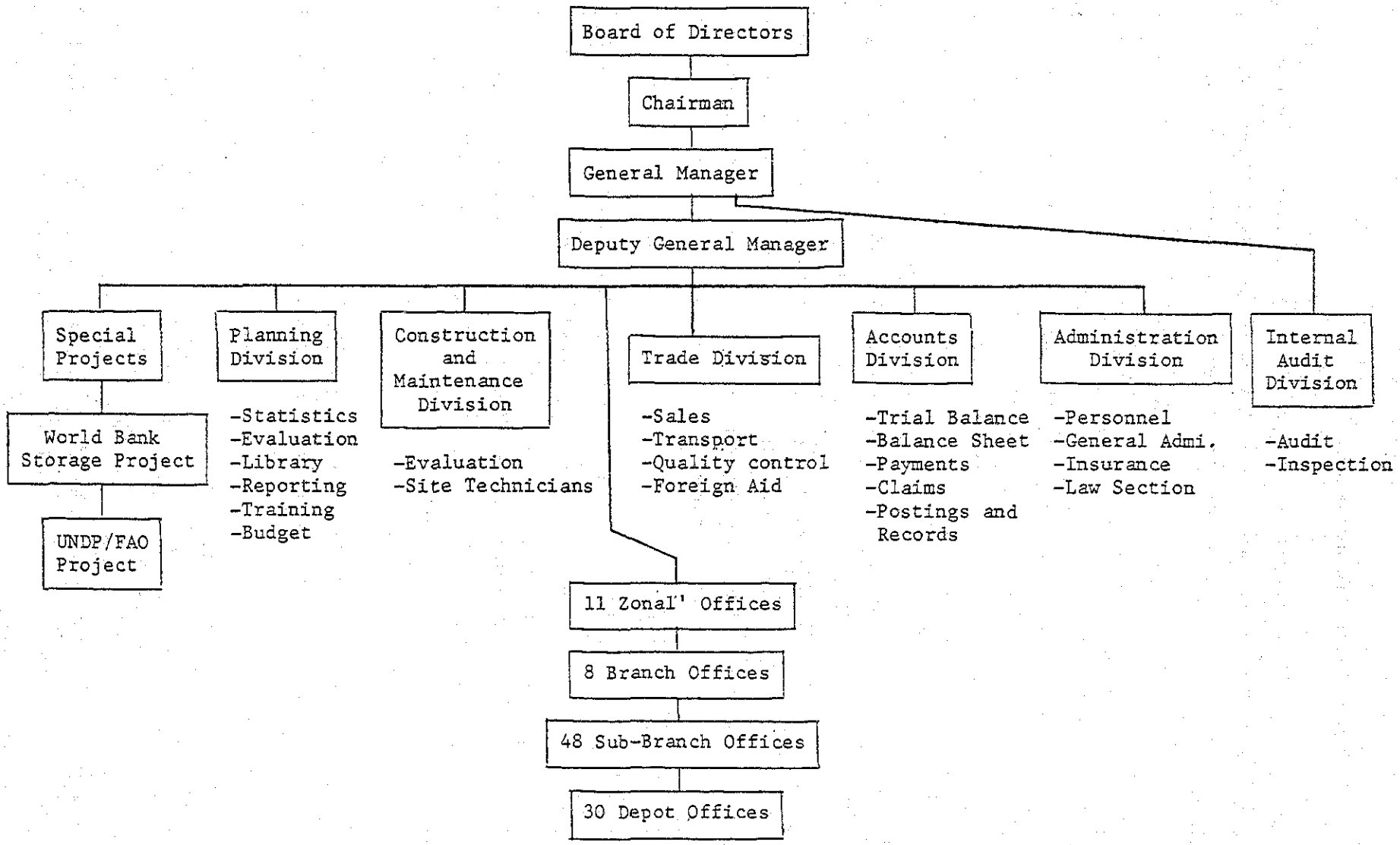


Fig. 2-3-1(2) Organizational Structure of NFC



2-3-2 NFC's Business Lines

NFC is responsible for procuring the necessary amount of grain and providing a constant supply of food to the hilly and mountianous regions where food is in chronic short supply. NFC's business lines are as follows;

(1) Purchase

As previously mentioned, NFC purchases grain as part of its business. The historical amount of purchase is shown by Table 2-3-2(1). Raw grain such as paddy rice and wheat is purchased directly from farmers at producing district depots. The purchase of paddy and wheat is based on the floor price, the minimum price to producers set to promote the government policy for increasing foodgrain production. The purchase plan was put into full action from fiscal 1984/85. The government determines the floor price prior to seeding, to provide farmers with an incentive for increasing foodgrain production. The floor price in India must be taken into consideration for the purpose of determining the floor price in the Terai grainery.

The floor price in the hilly and mountianous regions is higher than in the Terai Plain, as shown by Table 2-3-2(2). This is probably because the government intends to reduce national expenditures by purchasing as much grain as possible in food shortage regions. Freight from the Terai Plain to the hilly and mountianous regions is in part included in the floor price for the hilly and mountianous regions.

NFC applies the following quality standards set by the Central Food Research laboratory to the grain purchased from farmers.

Moisture content	:	15 - 24%
Foreign material	:	less than 2%
Broken rice	:	less than 12%
Damaged or colored rice	:	less than 14%

The standards are said to be stricter than those of middlemen. Therefore, it is important for NFC to apply the quality standards

Table 2-3-2(1)

PROCUREMENT OF GRAIN BY NFC (tonnes)

Region	1975/76			1976/77		1977/78				1978/79		
	Rice	Wheat	Paddy	Rice	Wheat	Rice	Wheat	Paddy	Maize	Rice	Wheat	Maize
EASTERN TERAI												
Bhadrapur	8911			8000	-	6779	-					
Biratnagar	7818			8898	76	3204	3			9809	-	-
CENTRAL TERAI												
Rajbirag	4637			2674	-	855	-		2200			1656
Janakpur	2455			1202	284	713	524		-	8828	2245	
Birgunj	938			3727	83	2813	9		371			1356
WESTERN TERAI												
Bhairahawa	4847			1369	184	2698	191		1546	1207	-	2125
MID WESTERN TERAI												
Nepalganj	3481	246	1965	3880	73	7345	106	500	53			
Dang	-	15		-	28	-	208	-	-			
										4577	90	-
FAR WESTERN TERAI												
Dangadhi	-	416	5592	3692	536	2575	699	2182	97			
Mahendranagar	463	-	386	534	-	1177	104	81				
OTHERS												
Surkhet		29										
Kathmandu				8	518	1755	2					
Hetauda				34	-	122						
Jumla				2	-	-						
Sindhuli				1	-							
Trishuli				-	12							
Darchula				-	-		49					
Syangja												
Pokhara												
Arghakhachi												
Palpa												
Chitawan												
Sankhuwasabha												
TOTAL	33549	706	7942	34022	1792	30035	1895	2763	4266	24421	2335	5137
Total		42199			35814			38961			31893	

Source: NFC

PROCUREMENT OF GRAIN BY NFC (tonnes)

Region	1979/80			1980/81			1981/82			1982/83			
	Rice	Wheat	Maize	Rice	Wheat	Paddy	Rice	Wheat	Paddy	Rice	Wheat	Maize	Paddy
EASTERN TERAI													
Bhadrapur	13200			9319			8894			17384		124	
Biratnagar	13911			10812			6086			10032			
CENTRAL TERAI													
Rajbirag	8983			9025			3680			5492			
Janakpur	4103			842			871			1479	461		
Birgunj	2511	136		1363			1776			92			
WESTERN TERAI													
Bhairahawa	1362	290		1831	330		599		214	768	2798		
MID WESTERN TERAI													
Nepalganj	3348	38	504	6094			6509		595	5317	695	127	27
Dang								-	221			300	
							-	221			300		
FAR WESTERN TERAI													
Dangadhi	1672	144		2170		966	3667	24	912	2095	534		500
Mahendranagar	397		241	371		375	960		18	1124	1237	497	
OTHERS													
Surkhet													
Kathmandu	354			183			311						
Hetauda	307			842									
Jumla													
Sindhuli							4				50		
Trishuli													
Darchula													
Syangja					23								
Pokhara					56								
Arghakhachi					11								
Palpa					124								
Chitawan											192		
Sankhuwasabha							20						
TOTAL	50148	608	744	42851	544	1341	33378	245	1739	43783	6267	748	527
Total		51500			4737			35362			51324		

Source: NFC

PROCUREMENT OF GRAIN BY NFC (tonnes)

Region	1983/84			
	Rice	Wheat	Maize	Paddy
	t	t	t	t
MID WESTERN TERAI				
Nepalganj	3203	769	412	547
Dang	-	170	-	-
FAR WESTERN TERAI				
Bangadhi	2064	114	-	687
Mahendranagar	1620	500	321	277

Table 2-3-2(2)

Paddy Rice Gate Price (Floor Price) by District

	District	Price
1	Jumla	450 RP/Quintal (100 kg)
2	Ackhan	400
3	Rukum	310
4	Sankhuwasaba	275
5	Doti	300
6	Bhojpur	300
7	Baitadi	250
8	Nuwakot	215
9	Surkhet	215
10	Sindhuli	215
11	Khotang	210
12	Terai Area	197 (coarse variety)
		207 (fine variety)

Source N F C

in good faith and instruct farmers on measures for improving quality, if it wishes to win the confidence of farmers.

Payment is made in cash up to 1,000 Rs, and in bank checks for higher amounts for safety reasons.

Middled rice had been procured as a levy stamp to REC's export rice before REC was dissolved up in July 1980, but it is now purchased on the open market. Parboiled rice is the major portion of milled rice purchased by NFC, which represents about 75% of the total. The quality standards of milled rice purchased by NFC are shown by Table 2-3-2(3).

Funds for purchasing foodgrain represent the largest share of NFC's budget. The total amount for the purchase of foodgrain in 1984/85 is estimated to be 152,740,000 Rs. NFC could not continue to purchase grain without government support. Therefore, its activities are subject to some form of government support every year.

(2) Contract Rice Milling on Consignment

NFC should process paddy rice collected in producing districts into milled rice for the purpose of supplying it to consuming districts. In this connection, the milling of paddy is consigned to private rice mills on a contract basis. The contract outline is as follows:

- Yield

  The yield of parboiled rice is 63%, and that of raw rice is 58%. There is no difference between coarse variety and fine variety.

- Transportation Charge

  Transportation charge of paddy and milled rice between NFC and the rice mill is usually paid for by NFC.

- The consignment of milled rice is determined by auction or through negotiation.

- Fees for the consignment of milled rice in 1984/85 are 250 Rs per ton.

Table 2-3-2(3)

QUALITY STANDARDS

A. Paddy:-

Grading factor	Maximum acceptable limit
a) Moisture	14%
b) Foreign matter	2%
c) Damaged paddy	5%

B. Parboiled Rice:-

Grading factor	Tolerance Limit %	Projection Limit %	Price Reduction
a) Moisture	14.5	14.5	
b) Foreign matter	0.5	0.5	
c) Brokens	16.0	20.0	1/2 the value
d) Damaged	3.0	5.0	Full value
e) Discoloured	4.0	8.0	1/2 the value
f) Red and ungelatinised	5.0	7.0	1/2 the value

C. Raw Rice:-

a) Moisture	14.0	14.0	
b) Foreign matter	0.5	0.5	
c) Brokens	25.0	33.0	1/2 the value
d) Damaged	3.0	3.0	
e) Discoloured	3.0	4.0	1/2 the value
f) Red and chalky	7.0	8.0	1/2 the value

In fine rice the mixture of coarse rice should not be more than 10%.

(3) Supply

Grain stored in NFC storage is sent to a relay center (as called by NFC), to a distribution center and then to consumers.

According to Table 2-3-2(4), the grain is transported mainly by trucks, and to a lesser extent, by manpower, airplane and cattle wagon. Railway via the Indian route is also used for transportation between east and west in the Terai Plain.

Table 2-3-2(4) Food Grain Movement by Ecological Belts, 1980/81

Means of Transportation	Terai	Hills	Mountains	Whole Country	%
Truck	7,502 ton	56,470 ton	754 ton	66,726 ton	80.5
Human Power	- -	9,071	1,670	10,741	13.0
Train	2,749	-	-	2,749	3.3
Airplane	-	1,129	665	1,794	2.2
Animals	-	554	260	814	1.0
Total	10,251	67,224	3,349	82,824	100.0

Source: NFC

NFC sets the standard retail price of milled rice, wheat and maize as shown by Table 2-3-2(5). Retail prices differ from region to region due to differences in transportation costs.

Table 2-3-2(5)

NEPAL FOOD CORPORATION

Central Office, Kathmandu

Exists selling price of coarse Rice, Wheat and Maize.

S. No.	District	Coarse Rice	Wheat	Maize
1.	Mugu	680	455	338
2.	Jumla	680	455	338
3.	Humla	680	455	338
4.	Mustang	680	455	338
5.	Dolpa	680	455	338
6.	Solukhumbu	680	455	338
7.	Manang	680	455	338
8.	Kalikot	680	455	338
9.	Lamjung	570	325	280
10.	Baitadi	570	325	280
11.	Darchula	570	325	280
12.	Arghakhanchi	570	325	280
13.	Dolkha	570	325	280
14.	Pyuthan	570	325	280
15.	Salyan	570	325	280
16.	Baglung	570	325	280
17.	Parbat	570	325	280
18.	Myagdi	570	325	280
19.	Ramechap	570	325	280
20.	Tehrathum	570	325	280
21.	Rolpa	570	325	280
22.	Diktel	570	325	280
23.	Okhaldhunga	570	325	280
24.	Bhojpur	570	325	280

- continued -

S. No.	District	Coarse Rice	Wheat	Maize
25.	Doti	620	390	300
26.	Rasuwa	620	390	300
27.	Panchthar	620	390	300
28.	Sankhuwasawa	620	390	300
29.	Dailekh	620	390	300
30.	Jajarkot	620	390	300
31.	Rukum	620	390	300
32.	Taplejung	620	390	300
33.	Bajura	620	390	300
34.	Acham	620	390	300
35.	Bajhang	620	390	300
36.	Sindhupalchok	525	290	260
37.	Trisuli	525	290	260
38.	Ilam	525	290	260
39.	Dhanakuta	525	290	260
40.	Udayapur	525	290	260
41.	Kabhre	555	290	260
42.	Kathmandu	420	225	200
43.	Dhading	525	290	260
44.	Pokhara	525	290	260
45.	Sindhuli	525	290	260
46.	Syangja	525	290	260
47.	Damauli	525	290	260
48.	Gorkha	525	290	260
49.	Palpa	525	290	260
50.	Dang	525	290	260
51.	Surkhet	525	290	260
52.	Dadeldhura	525	325	280
53.	Gulmi	525	325	280

2-3-3 Facility Conditions

The total capacity of warehouses which NFC own is 55,300 tons. An additional capacity of 27,000 tons will be available in the future with warehouses presently under construction and capacity of 5,000 tons with warehouses in the planning stage. The details of existing and future capacities of NFC warehouses in each Development Region are as follow.

Table 2-3-3 Storage capacities of NFC (Unit: ton)

Development Region	Existing	Under Construction	Planned	Total
East	10,200	21,000	0	31,200
Middle	27,000	6,000	0	33,000
West	7,950	0	0	7,950
Mid-west	4,450	0	5,000	9,450
Far-west	5,700	0	0	5,700
Total	55,300	27,000	5,000	87,300

Some of the existing new warehouses were constructed with the aid of the UNDP. Also included in the figures on existing capacity are the warehouses which were recently completed with a grant aid from the UK. Those under planning or construction fall under the IDA projects. In addition to the above-mentioned warehouses, NFC rents warehouses from ex-REC, Sajha (agricultural co-operatives) and private enterprises. There were 8 semi-governmental Rice Export Companies (RECs) in the past, which have been liquidated and are now in legal process. The facilities of RECs including warehouses and rice mills will be transferred to NFC when the legal process has been completed.

The study team surveyed existing warehouses at various locations in Nepal and found substantial damages to grade A houses which were completed within the past 10 years. Because no statistic data is availalbe on the actual losses of foodgrains during storage period, it's impossible to analyse the figures. However the specialists concerned all agree that it is a considerable amount. Among the warehouses investigated, there were none which were free from defects such as infilt-

Table 2-3-2 Grade Requirements of warehouses of NFC

Grade	A	B	C
Wall	RC	RC + bricks or stones	Plasters wall
Floor	RC	RC	RC and stone
Truss	Steel	Wooden	Wooden
Roof	CGI	CGI	CGI or aluminum

ration of rain water and humidity, in adequate ventilation leading to a rise in humidity and temperature, or intrusion of birds and rodents through damaged structures. These defects can be attributed to the following causes.

1) Problems in design:
   inadequate ventilation, waterproofing, damage to shutters
2) Problems in construction:
   damage to floor surface, damage to mortar finish, rusted metal
3) Problems in operation and superintendence:
   damage to floors, grass, shutters and gratings
4) Problems in maintenance:
   metal rust

Concerning other facilities, NFC owns one rice mill and 10 trucks with maximum capacity of 10 tons.

Recently two NFC storage sites were completed with a grant aid from The United Kingdom, one in Kathmandu and the other in Lalipur, a suburb of Kathmandu. The former having a capacity of 2,500 tons and the latter, 9,750 tons. From a technical point of view, these warehouses are of good assistance in designing warehouses for foodgrains in Nepal. The meteological conditions of Kathmandu area are different from those of the present project and therefore the differences should be taken into consideration. It can be said that these warehouses suggest a way that the design for foodgrain warehouses in Nepal should be.

The study mission investigated the warehouses in Lalipur, and the outline of the facilities are described as follow:

1) Storage buildings

The total storage capacity of the nine warehouses is 9,000 tons, each having a capacity of 1,000 tons. Each warehouse has a dimension of 33.4 meters in width, 16.0 meters in depth, 5.0 meters in height at the eave girder and 8.0 meters at roof ridge. The floor is raised, and the floor concrete is finished with steel trowel and equipped with expansion joints. It is made of stiff-consistency type concrete. H-steel is used for columns, beams and girders (200 x 250). The column and beam make up a rigid frame structure. The roof is thick aluminum sheet with no gutters. The walls are made of one-layer brick, finished with mortar and washable paint. Two intakes are provided with manual heavy shutters installed. Other than those two doorways are provided with a single swing door each. The warehouse has no lower windows, but has fixed glass upper windows with openings in installed with grills that can be closed. There is no ventilator at the ridge of the roof, and no window on the gable end. All steel components are plated with zinc. Although there are no "rat-defense" devices at the intake floor, the platform for receiving cargo is a cantilever structure which is in effect, a "rat-defense". In order to avoid damage by the impact of collision by trucks, an H-steel bar is installed in front of the cantilever platform. Special devices are also installed at stairways in order to prevent rats from intruding into the warehouses via the doorways.

The normal capacity of a warehouse is 1,000 tons. However, with expectation of improvements in stacking skill in the future and at the possible event where storage capacity falls short, the warehouses are designed to hold more tonnage through piling the grain higher.

2) Other facilities

In addition to the storage buildings, a 750-ton pretreatment building was built, which can be also used as a warehouse. Control of receipt and shipment and quality control are conducted in the administration building, which provides a storage room for fumigation chemicals. Also provided is a guard house, a weighbridge, etc. The premises are surrounded with a brick fence. The roads on the

premises are paved with asphalt pitch. The drainage ditches are well arranged in order to drain rainwater rapidly. Plants are provided on the premises to protect the walls of the warehouses from direct solar radiation and to reduce the inside temperature. Thus, all possible means are taken to ensure storage efficiency.

2-3-4 Present Conditions for Foodgrain Storage

(1) Kind of Foodgrain

The foodgrain handled by NFC includes milled rice, wheat (including imported wheat), maize and mustard seed, etc. The major item is milled rice, 75% of which is parboiled rice. NFC also began to purchase paddy rice this year on a full-scale. Therefore, the volume of paddy in storage in producing districts is expected to rise.

Note: Parboiled rice is produced in India and its neighboring countries as a method of rice processing. A substantial portion of the rice production volume in the world is processed into parboiled rice. The purpose of this method is to harden rice granules by applying heat, and to reduce the loss of rice after harvest by (1) ameliorating the tendency to break and (2) achieveing own storage ability and adding nutritious elements. The process consists of soaking, steaming and drying of paddy.

(2) Form of Foodgrain Storage

All foodgrain stored by NFC is packed in bags. The specifications for the jute bags described earlier indicate that there is no difference in specifications among the kinds of foodgrain. The net weight of a bag is 100 kg for milled rice, 75 kg for paddy, 100 kg for wheat, 80 kg for maize and 85 kg for mustard seed vegetable.

As there are no basic formation of stacking provided in the foodgrain storages of Nepal, stacking many high level layers could

lead to a total collapse. The number of stacking layers is normally 10, and at the most, 15. If a basic formation of stacking is provided in the storages, a collapse of the stacking may be prevented and the capacity of the warehouse may be increased. The improvement of stacking technology including the provision for a basic formation is a subject which should be studied further.

Note: Stacking means to pile bags of foodgrain in accordance with a predetermined arrangement. Basic formation is the constituting unit, and the group stacking is the mass of basic formation.

(3) Pest Control

Fumigation is extensively used to control insects. As there are no closed-type "fumigation warehouses" in Nepal, a sheet is covered on every stacking, with 3 tables (9 g) of aluminum phosphide PH3 per ton applied.

The chemicals used are:

Phosfume (Aluminum Phosphide), The Swadeshi Chemicals (P) Ltd.
7 Rs/10 tablets (3 g each)
Quick Phos (Aluminum Phosphide 57%)
7.8 Rs/10 tablets (3 g each)

A large number of insects can be found in the proposed districts of the Terai Plain. "Grain Weevil" and "Kokokuzo" are major species of harmful insects.

Most grain warehouses are subject to damage by rats. Heavy damages are caused particularly in the Plain, where rat holes may be found in the walls and floors. Insecticides and poisonous bait are used to control the damage from rats.

(4) Mat

Wooden pallets (not for palletization) are usually used as mats. Bamboo mats are also used in some storages. According to the

actual measurement of the pallets (L5' x W34" x H5", L6' x W34" x H5", L150 cm x W90 cm x H15 cm), they vary in size. Standardization is required for the improvement of stacking technology. Existing pallet materials are too heavy to carry.

(5) Storage Loss

The loss of post-harvest rice by farmers is reported to be as high as 15 to 20% (Paddy Loss Assessment, Rural Save Grain Project 1980/81). Rice is likely to be lost particularly during storage, and this loss percentage in Bhairahawa of the Terai Plain is as high as 8.05%.

According to another survey of APROSC (Agricultural Projects Service Center), the percentage of lost grain in NFC storage is reported to be 0.5 to 1.6% (Reports by Storage Managers). Specific loss percentages of lost parboiled rice during storage are 0.35% for rats, 0.55% for insects and 0.13% for birds.

2-4 Policies Relevant to Foodgrain Supply

The 6th five-year plan started in fiscal year 1980/81 and ends 1984/85. The outline of the 7th five-year plan was announced last March titled with "The basic principles of the 7th Plan". The foodgrain shortage in 1982/83 was the most serious setback in the five year period, making close-up of the structural foodgrain deficit in the country. Responding to this changing situation, modifications of the policies and strategies of the 6th plan are found in the 7th Plan. At present, being a transitional period between the two plans, the policies are executed, some being based on the 6th Plan, others based on the 7th. Therefore, it is important that both plans be described to clarify relevant policies.

As mentioned before, as the actual implementer of the MHG's foodgrain supply policies, the main undertakings of the NFC are the following three items.

1) to supply food deficit districts with foodgrains at prices subsidized by HMG
2) to act as the executing agency for the National Food Security Plan
3) to procure foodgrains at the support prices set as an incentive to farmers and guaranteed by HMG.

Regarding foodgrain supply to deficit districts:

The following objectives are stipulated in the 6th five-year plan *in conjunction with the NFC's undertakings.*

- To Meet the Minimum Needs of the People: An objective of the Sixth Plan is to provide the people with such basic minimum requirements like foodgrains.

- Food consumption standard in Nepal is computed at 2,181 calories and 56.6 grams of protein per day, which is below the requirement of 2,256 calories and 60 grams of protein. The Sixth Plan aims to raise the consumption level to 2,266 calories and 59.8 grams of protein, taking the growth of population during the plan period into account.

- With such factors as geographical situation, population distribution and purchasing power in view, foodgrains will be purchased in excess areas of Terai and highland for transport, storage and sale in scarce, remote and mid-mountain regions, which are handicapped still more by lack of transport facilities. At the same time, foodgrains will be provided at a subsidized rate in the remote areas as a matter of policy.

Basic principles of the 7th Plan includes no positive description concerning the matters above. Rather, in conjunction with financial resources, it is described as follows: Steps must be taken to remove or lessen the mounting pressure on the subsides with government budget. These subsidies make good a part of the distribution costs. However, there exists a reality that political problems may arise if the government abandons the responsibility of providing foodgrains to the deficit areas. In consequence, there will be no appreciable changes in the task of NFC in the foreseeable future.

Regarding national food security plan:

In line with the FAO's recommendation in 1978 concerning a "Food Security Policy", the 6th five-year plan aims at maintaining a Minimum Operational Stock (MOS) of 10,000 tons and an Emergency Reserve Stock (ERS) of 5,000 tons, amounting to 15,000 tons in total.

In the Basic Principles of the 7th Plan, there is no description corresponding to these stocks of foodgrains. However, in the text of the project request, it is described that HMG is working on a plan to maintain a stock of 40,000 tons.

Regarding government-guaranteed floor prices:

During the period of the 5th plan (1975/76 - 79/80), the food supply problems focused upon the deficiency in years of poor harvest and the severe shortage in mountaneous areas. Consequently, it became the top priority of the 6th plan to increase agricultural productivity. One of the measures introduced for attaining this goal was a system of government-guaranteed minimum purchase prices (hereinafter referred to as floor prices), with a view to encouraging, and providing incentives to farmers.

However, HMG's attitude was not so positive as to give satisfactory results in early stage of 6th plan period. The poor harvest of 1982/83 brought attention to self-sufficiency of the country in foodgrains as a serious matter. Therefore, increased stress is put on productivity increase of foodgrains in the Basic Principles of 7th plan.

Contrary to the abstract and unclear description in the 6th plan, the 7th plan describes much more practical and positive measures concerning the floor prices.

They are as follwos:

- An advisory committee consisting of specialists will be formed, and it will be charged with continuously studying production costs and sales prices of farm products and give advice to His Majesty's Government on the appropriate support prices every year.
- Farmers will be informed about the support prices of the prescribed crops well before the onset of the sowing season.
- A central agency will be appointed to buy agricultural products at the support prices and it will arrange to buy from fairs, markets and other trading areas at a time when most of the farmers usually sell. An arrangement will be made under which purchases can be made through Sajha cooperatives, and through private agents in cases where the former is not available.
- If the proposed agency does not have enough funds to buy agricultural products, the policy will be to enable it to borrow from commercial banks under the guarantee of His Majesty's Government.

Regarding construction of storage facilities:

NFC's existing storage facilities were described in the 6th plan as having a total capacity of 58,050 tons as of the closing of the 5th plan, and it was stated that new storage facilities with a total capacity of 47,500 tons would be built within the period of the 6th plan, i.e. from 1980/81 to 1984/85, bringing total capacity to 105,550 tons.

At the closing of the 6th plan period, storage facilities of 39,250 tons have been constructed, and existing storage capacities

have been reduced from original 58,050 tons to 43,050 tons. NFC will have a total capacity of 82,300 tons by the end of 6th plan. In addition to this capacity, NFC has a structure with a 5,000 ton capacity now under construction as the 3rd phase of the IDA financed project, and there are REC's storage buildings which are scheduled to be transferred to NFC in the near future.

As to the storage construction, the Basic Principles of 7th plan state that additional storage facilities will be created as and when required, in coordination with the Agricultural Input Corporation, Food Cooporation, and Sajha cooperatives.

2-5 Circumstances and Contents of the Request

(1) Circumstances of the Request

The IDA funding project is directly related to the background of this project. The text of the request states that this project will be complementary to the IDA project. NFC is curently constructing warehouses (shown in Table 2-5(1)) which are financed by IDA and located in the East Development Region (EDR), Central D.R. (CDR), and Mid-west D.R. (MWDR). Phases 1 and 2 of the project were simultaneously initiated at the beginning of last year (1984) and are scheduled to be completed in June this year. Phase 3 will be started soon.

Table 2-5(1) IDA Funding Foodgrain Storage Project (Unit: M.ton)

Region/District/Place	Capacity x No. of Buildings	Total Tonnage
Phase 1.		
EDR/Morang/Biratnagar	2,000 x 3 1,000 x 1	7,000
EDR/Jhapa/Birtamod	2,000 x 4 1,000 x 1	9,000
	Phase 1 total	16,000
Phase 2.		
EDR/Seraha/Lahan	1,500 x 2 2,000 x 1	5,000
CDR/Dhawesha/Janakapur	1,500 x 2	3,000
CDR/Hetauda/Makwaupur	1,500 x 2	3,000
	Phase 2 total	11,000
Phase 3.		
MWDR/Bank/Nepalganj	2,000 x 2 1,000 x 1	5,000
	Phase 3 total	5,000
Grand total		32,000

The IDA project was originally to total 40,000 tons including Phase 1 through 3. However, while Phases 1 and 2 are being implemented as originally planned, Phase 3 which was originally to

total 13,000 tons, as shown in Table 2-5(2) was reduced at the final stage of decision to 5,000 tons due to inflation and cost-ups incurred through the quality grade-up. It is to be built at Nepalganj only.

Table 2-5(2) Original Phase 3 plan by IDA funding (Unit: M.ton)

MWDR	Nepalganj	4,000
	Rajapur	3,000
FWDR	Dangdhi	4,000
	Mahendranagar	2,000
		13,000

This project has an aspect to revive storage construction in Rajapur, Dangadhi, and Mahendranagar which have been excluded from Phase 3 of the IDA project. The Government of Japan was thus requested by HMG of Nepal for grant aid cooperation.

A rice mill facility was not included in the initial request, but was requested to the study mission when staying in Kathmandu by the Ministry of Supplies as a rice mill plant and parboiled rice plant to be constructed in Rajapur.

(2) Content of the Request

The responsible agency for this project is NFC, a public corporation under the control of the Ministry of Supplies.

The purpose of this project lies in construction of storage facilities necessary for carrying out NFC's task of foodgrain distribution. Another purpose of this project lies in construction of rice milling facilities, with a view to reducing the transportation cost. The outline of the facilities and equipment requested by HMG of Nepal are as follows:

a) Construction of foodgrain storages in Rajapur, Dangadhi and Mahendranagar; 4 warehouses with a 1,000 tons capacity at each site and additional facilities such as garages, management

offices, external facilities, etc., and supply of necessary equipment.

b) Construction of a rice milling plant and a parboiled rice plant in Rajapur, and auxiliary facilities for the plants, and the supply of necessary equipment.

Chapter 3. CONTENTS OF PROJECT

3-1 Objectives

In order to solve the shortage of storage, and rice mills, and reduce the loss of foodgrains in the grainery region of Western Nepal, where foodgrain distribution is ineffectively conducted due to the shortage of the facilities and the inadequacy of traffic and a large volume of foodgrains is lost during the various stages of distribution, the objective of this project is to build foodgrain storages and rice mills required, thus improving the foodgrain distribution system.

3-2 Study on the Contents of the Request

As explained in the former chapter, as a part of the IDA project, it was planned to construct storage facilities with a capacity of 3,000 tons in Rajapur, 4,000 tons in Dangadhi, and 2,000 tons in Mahendranagar. The current request, however, calls for capacity of 4,000 tons at all 3 sites. Being the IDA plan was formed before 1980, it can be assumed that reconsideration and modifications would be made to update it.

In this circumstance, it is necessary during the study to work out required capacities of storage facilities to be built, taking into consideration the various conditions such as an increased role of NFC and increased productivity in the area, during the past few years, and the transfer of ex-REC storage facilities to NFC.

Although not clearly specified in the request, additional facilities for management and equipment for quality control, quantity control and storing are also indispensable. These elements must also be clarified in this study.

The rice mill in Rajapur is deemed to be effective for the reduction of transportation cost, in view of the current dispersion of rice mills in this area. A rice milling plant and a parboiled rice plant are required, so the necessary capacities and other requirements of the plants, auxiliary facilities and equipment have to be clarified.

3-3 Proposed Foodgrain Storages

3-3-1 Preconditions in Proposed Districts

The proposed districts are located in Rajapur (Bardia District), Dangadhi (Kailali District) and Mahendranagar (Kanchanpur District), all of which belong to the grainery region producing mainly rice. Storages in a producing district are designed to accommodate locally harvested grain immediately after harvest, store it in a safe environment and ship it to a relay center or to consuming districts. As the length of storage period may be prolonged depending upon the season, a storage should have the functions of minimizing the quantitative and qualitative loss of grain during storage. The storages to be constructed should be complete with the necessary and proper equipment required for efficient cargo handling and quality control.

In addition, a rice mill should be built in Rajapur where the rice milling capacity is low, in order to save expenses for transporting paddy rice to distant location of rice mills.

The present aspects of grain distribution in the proposed districts described above are not likely to change drastically under the current government policy on foodgrain. If infrastructures such as roads and bridges are extensively built in the future, the aspects of foodgrain distribution may undergo substantial changes, but they will remain unchanged at least for several years to come. Foodgrain is currently collected within each district of Bardia, Kailali and Kanchanpur, and only a slight volume of foodgrain is transported among the districts.

Specifically, the Rajapur storage should have the function of collecting foodgrain because Rajapur is located in the producing center of the district. In addition, a rice mill should be built in Rajapur to make up for the inadequacy of the rice milling facilities and means of transportation. Milled rice is basically transported from Rajapur to Nepalgani via the Indian route. A distribution storage should also be built in each of Dangadhi and Mahendranagar because these are the centers of grain distribution within their respective districts.

3-3-2 Stored Foodrain

Threshed paddy in a bag, milled rice, wheat, maize and mustard seed are kept in storage. The net weight of foodgrain in a jute bag with common specifications is 75 kg for paddy, 100 kg for milled rice, 100 kg for wheat, 80 kg for maize and 85 kg for mustard seed. The standard specifications of a jute bag are 29" (74 cm) 44" (112 cm) with the tare of 1.0 kg. The capacity of a storage under this project is based on milled rice.

3-3-3 Storage Capacity for this Project

NEC had requested a 4,000 ton storage in each of the proposed districts. The study team recognized the need for building storages, but could not get the justification of scope of the requested capacity. The study of the team of the necessary capacity produced the following concept and method.

The capacity of storages to be built should suit the inventory management of NFC, and be designed to operate economically. Basically, this capacity should be determined by taking into consideration several factors such as the amount of foodgrain collected, the turnover of storage space based on storage period and the capacity of existing storages which may affect the collection, storage and shipment of grain by NFC.

Under this project, storages for storing grain and additional facilities attached to a storage would be built in the grainery districts producing surplus agricultural products. For the purpose of calculating the scope of the project, the ground-rules on the building of storage in a relay center or a consuming district should not be taken for granted.

The capacity of a storage in each proposed district under this project may be calculated by the following formula.

$$At = (m + d)\ pi - c$$

at: Capacity of a new storage to be constructed in the proposed district

m: Distribution volume

Distribution is obtained by subtracting the consumption volume of farmers from the production volume, which is the maximum figure in a common harvest year (from 1974/75 to 1982/83) as shown by Table 2-2(1). All of the harvested foodgrain should be stored safely during a bumper year. The consumption volume is based on the Table 3-3-3(1) extracted, on each proposed district form the Food Balance Sheet, as per Table 2-1(1), prepared by FAMSD (Food and Agricultural Marketing Services Dept., Ministry of Agriculture, HMG). 95% of the estimated population of farmers (Nepal District Profile 1982) and 61.8% of the edible yield are considered for the purpose of calculation. Table 3-3-3(3) shows the results of the calculation.

d: Increase distribution volume by the irrigation agricultural development project currently under way

The irrigation project in the proposed districts shown by Table 3-3-3(2) is expected to increase the production volume per field unit, the cultivated area and finally the distribution volume. The average production volume of each proposed district (1977/78 - 1982/83) is expected to rise by 70% by estimating the effective harvestable area to be 80% of the command area under the irrigation project, and the achievement of double cropping as a result of the irrigation project.

p: Percentage of grain collected by NFC

The percentage of grain collected by NFC is obtained by comparing NFC's performance with the aforementioned distribution volume (m). The volume of grain collected by NFC in each proposed region is shown by Table 2-2(5). The proposed volume of grain collection has been rising every year, as shown by Table 2-2(6), but it is less accurate than the performance data. The calculation results is 18.6% as shown by Table 3-3-3(3).

i: Coefficient of storage capacity

Coefficients for replacing the annual volume of grain transactions for the storage capacity required are obtained by the formula "peak inventory/annual transaction volume". They are the reverse

Table 3-3-3(1)

Food Balance in Proposed District

(tonnes)

Fiscal Year	Bardia District			Kailali District			Kanchanpur District			Whole Country		
	Production	Requirement	Balance	Production	Requirement	Balance	Production	Requirement	Balance	Production	Requirement	Surplus
1981/82	50,904 83,390	41,259	+9,645	66,488 106,780	41,784	+24,704	41,670 70,290	35,158	+6.520	2,508,593	2,247,624	+260,969
1982/83	48,375 78,290	42,332	+6,043	58,063 91,340	42,872	+15,191	41,868 66,850	36,073	+5,795	2,196,526	2,307,468	-110,942
1983/84												

Production shows edible form as numerator and coarse grain form as denominator.

$\frac{\text{edible form}}{\text{coarse grain}}$ = 61.8% (conversion rate from coarse grain to edible form)

Source: NFC 1985, and
Food and Agricultural Marketing Services Department (FAMSD)
Ministry of Agriculture

Table 3-3-3(2)

IRRIGATION PROJECTS UNDER IMPLEMENTATION
IN
BARDIA, KAILALI AND KANCHANPUR DISTRICTS

AS OF MARCH 1985.

PROJECT NAME	DISTRICTS COVERED	YEAR OF START	YEAR OF COMPLETION	COMMAND AREA IN HA.	AVERAGE FOOD GRAIN YIELD	ESTIMATED INCREMENTAL FOODGRAIN PRODUCTION AT FULL DEVELOPMENT
Kailali Tube Well Irrigation Project	Kailali and Kanchanpur	2032/033	041/042 (84/85)	8,000	1.5 ton/ha	6,900 ton
Khutia Irrigation Project	Kailali	2035/036	040/041 (83/84)	5,000	1.5	4,500
Mohana Irrigation Project	Kailali	2036/037	040/041 (83/84)	3,500	1.5	2,900
Mahakali Irrigation Project	Kanchanpur	2037/038	042/043 (85/86)	6,600	1.5	5,600
Babai Irrigation Project	Bardia	2037/038	046/047 (89/90)	13,500	1.8	13,800

Source: Department of Irrigation, Hydrology and Meterology (Panipokhari), H.M.G. Nepal.

Agricultural Statistics of Nepal, 1983 for Average food grain yield by district in 1977/78 - 1982/83.

Table 3-3-3 (3) NFC Procurement Percent for Marketing in Proposed Area

District	Year	Grain Production ton	Consumption by farmers ton	Grain Marketing ton	Procurement by NFC ton	Procurement Percent for Marketing
Bardia	1981/82	83,390	63,424	19,966	4,973	24.9%
	1982/83	78,290	65,073	13,217	4,316	32.7
Kailali	1981/82	106,780	64,231	42,549	4,603	10.8
	1982/83	91,340	65,903	25,437	3,129	12.3
Kanchanpur	1981/82	70,290	54,045	16,245	978	6.0
	1982/83	66,850	55,452	11,398	2,858	25.1
					Mean	18.6

Note: 1) Estimated percent of farming population 95%

2) Recovery percent of edible form from coarse grain 61.8% (Ref. Table 3-3-3 (1))

3) Estimated percent of procurement from Bardia Dist. for NFC Nepalganj Branch.

Source: Agricultural Statistics of Nepal 1983
Nepal District Profile 1982
Food Balance Sheet, FAMSD
NFC

Table 3-3-3(4-1)

Stock Inventory Record of NFC Mahendranagar Branch 1982/83

(tonnes)

Period	Opening Stock	Stock In						Stock Out						Closing Stock
		rice	wheat	paddy	maize	total	%	rice	wheat	paddy	maize	total	%	
Jul. 1982	221	-	-	-	-	-	-	30	-	-	-	30	2	191
Aug. 1982	191	-	-	-	-	-	-	37	-	-	-	37	2	154
Sep. 1982	154	-	-	-	-	-	-	130	-	-	-	130	8	24
Oct. 1982	24	66	-	-	263	329	12	35	-	-	70	105	6	248
Nov. 1982	248	-	-	-	223	223	8	50	-	-	150	200	12	271
Dec. 1982	271	100	-	-	-	100	4	101	-	-	75	176	10	195
Jan. 1983	195	60	-	-	-	60	2	60	-	-	50	110	6	145
Feb. 1983	145	100	-	-	-	100	4	80	-	-	141	221	13	24
Mar. 1983	24	290	-	-	-	290	11	50	-	-	-	50	3	264
Apr. 1983	264	225	108	-	-	333	13	155	-	-	-	155	9	442
May 1983	442	105	563	-	-	668	25	47	-	-	-	47	3	1,063
Jun. 1983	1,063	-	570	-	-	570	21	-	451	-	-	451	26	1,182
Total		946	1,241	-	486	2,673	100	775	451	-	486	1,712	100	

500 tonnes of wheat received under the special food aid programme.

Inventory coefficient: $\frac{1,182}{1,712} \fallingdotseq 0.7$

Table 3-3-3(4-2)

Stock Inventory Record of NFC Mahendranagar Branch 1983-84

(tonnes)

Period	Opening Stock	Stock In						Stock Out						Closing Stock
		rice	wheat	paddy	maize	total	%	rice	wheat	paddy	maize	total	%	
Jul. 1983	1,181	-	-	-	-	-	-	51	153	-	-	204	9	977
Aug. 1983	977	-	102	-	-	102	5	29	85	-	-	114	5	965
Sep. 1983	965	-	-	-	-	-	-	20	39	-	-	59	3	906
Oct. 1983	906	-	-	-	1	1	-	100	141	-	-	241	11	666
Nov. 1983	666	117	-	-	123	240	11	201	110	-	-	311	14	595
Dec. 1983	595	165	-	18	98	281	13	-	80	-	-	80	3	796
Jan. 1984	796	211	-	2	29	242	11	20	265	-	230	515	23	523
Feb. 1984	523	268	-	-	3	271	13	-	19	14	24	57	2	737
Mar. 1984	737	45	67	-	68	180	9	40	-	6	-	46	2	871
Apr. 1984	871	50	484	-	-	534	25	114	67	-	68	249	11	1,156
May 1984	1,156	135	16	-	-	151	7	325	18	-	-	343	15	964
Jun. 1984	964	130	-	-	-	130	6	51	-	-	-	51	2	1,043
Total		1,121	669	20	322	2,132	100	951	977	20	322	2,270	100	

Inventory coefficient: $\frac{1,043}{2,132} \fallingdotseq 0.5$

Source: NFC Mahendranagar Branch

Table 3-3-3(4-3)

Stock Inventory Record of NFC Dangadhi Zonal Office 1983-84

(tonnes)

Period	Opening Stock	Stock In				Stock Out				Closing Stock
		Milled Rice	Wheat - -	Total	%	Milled Rice	Wheat - -	Total	%	
Aug. '83	3,494	-	2,289	2,289	30	264	364	628	8	5,155
Sep. '83	5,155	453	-	453	6	163	79	242	3	5,366
Oct. '83	5,366	23	7	30	0.5	281	80	361	5	5,035
Nov. '83	5,035	23	7	30	0.5	288	23	311	4	4,754
Dec. '83	4,754	249	500	749	10	525	881	1,406	18	4,097
Jan. '84	4,097	183	-	183	2	666	387	1,053	13	3,227
Feb. '84	3,227	206	12	218	3	614	127	741	9	2,704
Mar. '84	2,704	660	801	1,461	19	354	281	635	8	3,530
Apr. '84	3,530	270	300	570	7	556	697	1,253	16	2,847
May '84	2,847	680	219	899	12	244	315	559	7	3,187
Jun. '84	3,187	313	-	313	4	390	134	524	7	2,976
Jul. '84	2,976	141	311	452	6	124	23	147	2	3,281
Total		3,201	4,446	7,647	100	4,469	3,391	7,860	100	

Inventory coefficient: $\frac{5,366}{7,860} \fallingdotseq 0.7$

of the volume of storage turnover. The standard value of 0.7 was obtained by looking at several instances within the proposed districts, as shown by Table 3-3-3(4-1) - (4-3). Generally, the coefficients of storages in a producing region are vulnerable to the schedule of cultivating crops.

c: Existing and proposed storage capacity

The storage capacity of existing storages owned and leased by NFC as well as proposed storages are shown by Table 2-2(8). The following factors were taken into consideration for the purpose of calculating the storage capacity.

The storages of grade B and C are omitted because they are not suitable for storing foodgrain over a long period of time.

Even grade A storages are omitted if they are more than 20 years old. Most likely they are heavily damaged and cannot be easily repaired.

The storages owned by NFC in Ticapur and Subaranch (each with 500-ton capacities) are omitted because they are used only for collecting foodgrain.

As the storages leased from REC are scheduled to be transferred to NFC, those used as NFC storages are deemed existing storages owned by NFC as follows;

the storage capacity of 1,000 tons out of 3,000 tons of the storage attached to a rice mill of Seti Mahakali Paddy & Rice Export Co., Dangadhi. The remaining 2,000 tons are not used for storage; namely 500 tons as a provisional storage for equalizing the disparity of quality caused by the process of drying parboiled paddy, 1,000 tons as a workshop for packing milled rice in bags and a depot, and 500 tons as a workshop for taking out raw threshed paddy for rice mills.

The storage capacity of 1,000 tons of REC's storage annexed to NFC's storage in Mahandranagar.

Table 3-3-3(5)

Required Storage Capacity Under Project

Calculation Processes for Storage Capacity	Rajapur Bardia Dist.	Dangadhi Kailali Dist.	Mahendranagar Kanchanpur Dist.
	ton	ton	ton
1. Production Volume (Maximum Figure in normal harvest years among 1974/75 - 83/84)	96,576	115,120	70,290
2. Consumption Volume of farmers	65,073	65,903	55,452
3. Marketing Volume	31,503	49,217	14,838
4. Increase of Marketing Volume by Irrigation Agricultural Development Project	9,526	7,350	6,233
5. Total Marketing Volume	41,029	56,567	21,071
6. Procurement by NFC (total marketing volume x average rate of procurement 18.6%)	7,631	10,521	3,919
7. Coefficient of Storage Capacity (0.7)	5,342	7,365	2,743
8. Available Existing Storage Capacity	0	3,200	2,000
9. Required Storage Capacity	5,342	4,165	743
10. Result after Adjustment (marketing route and building module)	5,500	4,000	1,000

However, the storage leased in Bhajini is omitted because it is used only for collecting grain.

The construction of any other storages except those under this project is not considered in the proposed districts.

The required storage capacity obtained by the above-mentioned method of calculation is adjusted by taking into consideration the local characteristics of each proposed district (related to grain distribution and construction) and construction modules (most of the existing storages have a capacity of 500 tons each).

As shown by Table 3-3-3(5), the storage capacity of existing storages in proposed districts in insufficient. The required storage capacity under this project is 5,500 tons in Rajapur, 4,000 tons in Dangadhi and 1,000 tons in Mahendranagar.

3-3-4 Method of Grain Storage

(1) Stacking Plan

Stacking depends largely upon the skill of workers. Improvement of this skill is very important as it is related to the basics of storage technology. Under this project, a stacking consists of a combination of 5 bags each as Figure 3-3-4(1) shows, in accordance with the concept of "Tsugaru Gohyo Bai". It is effective for stabilizing stacking, preventing collapse and carrying out easily. Training workers for this purpose is very important.

The size of a group stacking is normally a basic formation 4x4x15. The basic group stacking weighs 128 tons in the case of milled rice. The height of stacking is currently up to 10 to 16 decks. For the sake of safety it should be restricted to less than 16 decks. Upper space for setting stacking should be sufficiently provided for giving room for operation and preventing radiant heat under the roof. The width of the main passage, sub-passages, and the side wall passage are designed to be 1.8 m, 0.9 m and 0.9 m respectively, so as to achieve better working efficiency and air-conditioning. The occupancy rate of the stacking portion against the floor space should be 70%, which is the rating capacity.

(2) Mats

Wooden pallets are mostly used in Nepal, with bamboo mats used to a lesser extent. The specifications for a pallet are affected by the type of basic formation and the plating of the pallet. The project is based on the most popular size in Nepal (160x100x15 cm).

(3) Handling Work

Vehicles were unable enter the storages to be constructed under this project, as describe later. Loading and unloading from a vehicle is carried out on the platform in front of a storage. The carry-over and piling of lots within the storage relies wholly on manual labor.

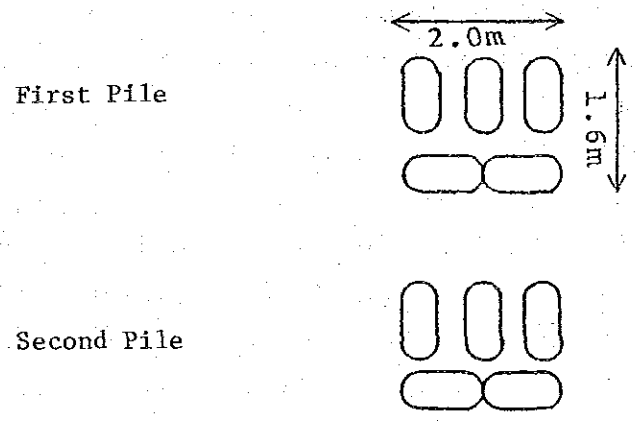
(4) Damage by Insects and Rates

Aluminium Phosphide pH3 is used for fumigation. It is a popular chemical in Nepal. Although it may be inferior to methyl bromide, it is less likely to create a residue. The equipment required for fumigation is included in this project.

Traps and other devices are considered for the control of rats, as well as the application of repellants, insecticides and poisonous bait.

Fig. 3-3-4(1)

BASIC FORMATION OF STACKING "TSUGARU GOHYO BAI"



3-4 Construction of Rice Mill

A rice mill with a substantial scope should be built in Rajapur along with a storage, in order to solve the problem of transportation and the loss of rice. The reasonable scope of the rice mill is the capacity of 2 tons per hour, in view of the fact that NFC may collect the paddy of 2,000 to 2,500 tons per year (1984/85). A remodelled parboiled rice plant should also be added in order to take advantage of the fact that people in the proposed districts have traditionally eaten parboiled rice.

Electricity or alternative energy is required for providing power and water to the rice mill. As no electricity is available in Rajapur, the site for building the rice mill under this project, a generator powered by an internal combustion engine is planned to be installed. Expenses for operating the rice mill may be well covered from the present consignment fees for milled rice paid by NFC to private rice mills. With yield improvements, the operation of rice mills will bring profits to the NFC.

3-5 Operation and Employment Plan

The proposed storage in Rajapur will be managed by the NFC Zonal office in Nepalganj, and the proposed storages in Dangadhi and Mahendranagar will be by the NFC Zonal Office and Branch Office which exist in each respective town.

The employment plan for the operation of storages is shown by Table 3-5-1. As each proposed storage is built adjacent to an existing storage, only a limited workforce is required.

A workforce for the proposed rice mill in Rajapur should be recruited. Though the officials of NFC say that it is possible to recruit skillful people, complete training should be provided. The employment plan for rice mills is shown by Table 3-5-(2).

NFC sent its officials to JICA's group training in post-harvest rice course processing as shown by Table 3-5(3). Those who study the course will certainly by useful for the proposed rice mill. However, as they have their own job, it is impossible to make them work full time in Rajapur. Nepal side emphasises the importance of training and that the training should be provided to workers in the skills of rice milling, rice mill management and the actual operation of rice mills.

Table 3-5(1) Plan of Personnel for Each Storage

Occupation	Grade	Nos. Required	Nos. Already Assigned Rajapur	Dangadhi	Mahendranagar
Storage Chief	5	1	(1)	1	1
Store Keeper	3	1	3	1	1
Accountant	3	1	(1)	1	1
Purchase Assistant	3	1	1	1	1
Technician	5	1	1	1	1
Guard	1	2	(2)	2	2
Peon	1	1	(1)	1	1

( ) serves concurrently for Rice Mill

Table 3-5(2) Plan of Personnel for Rice Mill

Occupation or Section	Grade	Nos. Required	Remarks
Rice Mill Chief		(1)	Rice processing Engineer
Technician		1	Assistant Chief
Accountant		(1)	
Guard		(2)	
Peon		(1)	
Operators & Labourers			
Parboiling		8	Receiving - 2 Parboiling - 3 Boiler - 2 Other - 1
Drying		8	Sun drying - 8
Milling		7	Receiving - 3 Milled rice- 3 Bran - 1
Generator		1	

Table-3-5(3)

Group Training Course in
Post-Harvest Rice Processing

JICA

Country	Name	Office	Home	Year
18.Nepal	Puran Chaudhary	*Section Chief Agricultural Development Bank, Nepal Agricultural Development Bank, Head Office, Panchayat Plaza, Kathmandu, Nepal	Coberdiha, Deckhuri Distt. Dang-Deokhuri, Rapti Zone, Nepal	'74
	Bhim Bahadur Kshetry	Nepal Food Corporation Central Office, Ramshah Path, Kathmandu, Nepal	Jhamshikhel Lalitpur Kathmandu, Nepal	'75
	Ganga Prasad Manandhar	Food Research Section Ministry of Food & Agriculture Babar Mahal, Kathmandu, Nepal	5/20, Layakusal, Kathmandu, Nepal	'76
	Devendra Bahadur Pradhan	Nepal Food Corporation Head Office Battis Putli, Kathmandu, Nepal Tel: 15200	7/883 Maru Tole Kathmandu, Nepal	'77
	Bhabani Raj Panday	*Division Chief Nepal Food Corporation Adwait Marg, Kathmandu, Nepal	211724 Maitedevi Dillibazar, Kathmandu, Nepal	'78
	Rahajeet Manandhar	Nepal Food Corporation, Central Office Kathmandu, Nepal	Baansbaarl, Sallaghari, Kathmandu, Nepal	'79
	Lokendra Bahadur Shahi	Nepal Food Corporation Battishputaly Kathmandu, Nepal	Munegaun, Doti, Setizone, West Nepal	'80
	Chandreshwar Prasad Shah	*Technical Assistant Ministry of Agriculture, Central Food Research Hetauda Industrial District, Hetauda, Nepal	Brahmpuri Village Panchayat Ward No.6, Sariahi District Janakpur Zone, Nepal	'81
	Singh Lall Deab Pradhan	Assistant Food Research Officer Rural Save Grain Programme Srimahal Rambangala, Lalitpur, Nepal(P.B.No.107) Tel: 21-151	9/572-Yatkha Tole, Kathmandu, Nepal	'83
	Gautam Buddha	Assistant Agricultural Engineer, Ministry of Agriculture, Dept. of Agriculture, Eng. Division, Khumaltar, Lalitpur, Kathmandu, Nepal	5/827, Maru Dachhesal, Kathmandu, Nepal	'84

3-6 Site Selection

The storage and the rice mill should be designed to meet their respective functions. The conditions of a site are a major factor in design. Basic items for consideration in site selection are as follows:

Convenience to traffic
Good for drainage and dry land, not humid nor low land area
Solid ground base
Low chance of fire
Low chance of flooding
Regular land profile, reasonably flat. Preferably long from east to west
Not close to residences
Easy access to electricity, power source, water mains and telephone

Several possible sites selected by NFC's preliminary survey were studied for each of the aforementioned items. Lack of electricity and telephone lines was overlooked as long as alternative means were available. As a result, an appropriate site was selected for each of the three proposed districts.

3-7 Facilities and Equipment Required

As a result of the foregoing study, factors such as functions, capacities and capabilities which decide the actual scale and content of facilities and equipment have been clarified.

Taking sites conditions into consideration, the facilities and equipment are drawn and summarized as follows:

(1) Rajapur

1) Buildings and Contents

Buildings	Room, function, capacity, capability, etc.	Utilities, etc.
Foodgrain warehouses	1,000 tons x 4	Electric lighting, Lightning rods
Foodgrain warehouses	1,500 tons x 1	"
Office building	Chief's office/ 1 person	Electric lighting
	Office/5 persons	"
	2 Laboratories	"
	Technician's office 2 persons	"
	Toilet & small	Electric lighting Water supply & drainage system Sanitary arrangements
Storehouse	For equipment and materials	Electric lighting
Guard-house	For 2 persons	Electric lighting
Rice mill plant	Receiving & cleaning room	Electric power, Electric lighting Lightning rods
	Husking, whitening & packing room	
	Rice bran room	"
	Fan room	"
	Admixture room	"
	Workshop	"
Parboiled rice plant	Receiving & cleaning room	"
	Control tank & parboiling room	"
Warehouse	For in process parboiled paddy	Electric power, Electric lighting

Buildings	Room, function, capacity, capability, etc.	Utilities, etc.
Boiler room	For in process par-boiled paddy	Electric power, Electric lighting
Generator room		"
Storehouse	For husk	"

2) External works

* A wall surrounding the premises
* Pavement of the road on the premises
* Drainage for rainwater and its disposal device
* Sewage disposal
* Drying yard for in-process parboiled paddy

3) Equipment

Equipment for foodgrain storage of the capacity:
5,500 tons

Equipment for rice milling plant of the capacity:
paddy 2 tons/hour

Equipment for parboiled rice plant of the capacity:
paddy 2,000 tons/year, max. 20 tons/day

(2) Dangadhi

1) Buildings and Contents

Buildings	Room, function, capacity, capability, etc.	Utilities, etc.
Foodgrain warehouses	1,000 tons x 4	Electric lighting
Office building	Office/4 persons	Electric lighting
	2 laboratories/ 1 person	"
	Toilet & small kitchen	Electric lighting Water supply & drainage system Sanitary arrangements
Storehouse	For equipment and materials	Electric lighting

2) External Works

* Pavement of the road on the premises
* Drainage for rainwater
* Sewage disposal

3) Equipment

Equipment for foodgrain storage of the capacity:
4,000 tons

(3) Mahendranagar

1) Buildings and Contents

Buildings	Room, function, capacity, capability, etc.	Utilities, etc.
Foodgrain warehouses	1,000 ton x 1	Electric lighting
Office building	Office/4 persons	Electric lighting
	2 laboratories/ 1 person	"
	Toilet & small kitchen	Electric lighting Water supply & drainage system Sanitary arrangements
Storehouse	For equipment and materials	Electric lightings
Guard-house	for 2 persons	Electric lighting

2) External Works

* Wall surrounding the premises
* Pavement of the road on the premises
* Drainage for rainwater
* Sewage disposal

3) Equipment

Equipment for foodgrain storage of the capacity:

1,000 tons

Chapter 4. OUTLINE OF THE SITE CONDITIONS

4-1 Rajapur

The site faces the main road of the village. The road, which is a little over 6 meters wide, consists merely of a soil embankment 10 - 20 cm higher than the surrounding land. The soil for the filling comes from digging the ground along both sides of the road, which leaves pits approx. 3 meters in width.

The land for the site is now owned by two local land owners, and is scheduled to be procured by NFC. The possibility of the procurement is affirmed.

At present the land is used as farm land for dry field rice. It has a total area of approx. 2.3 hectares with a width of approx. 134 meters and a depth approx. 174 meters.

The land is flat, but the level of the plot is 10 - 20 cm lower than that of the road, as is the same as that of the all adjacent land. The village people say that there is no risk of flood, but it would be desirable to fill the lands approx. 30 cm higher in order to protect the storage facilities from moisture.

The surface layer of the soil is silt so when it absorbs water, it turns muddy and the bearing capacity becomes nil. However, there is a pebble layer at a depth of 2.0 meters and an underground water table of approx. 1.5 meters, which is assumed to elevate during the rainy season.

There is no electric power, city water supply or telephone in this area, and it is necessary to dig a well. Villagers say that drinking water is available at a depth of 12 meters. Topographically, this district is flat, and there is no drainage so the rainwater runs into the pits along the road, or is disposed of by infiltration into the earth or by evaporation

The surroundings are agricultural farms. Only the northeast corner of the site is in contact with a villager's house lot. The opposite side of the frontal road is also occupied by villagers' houses.

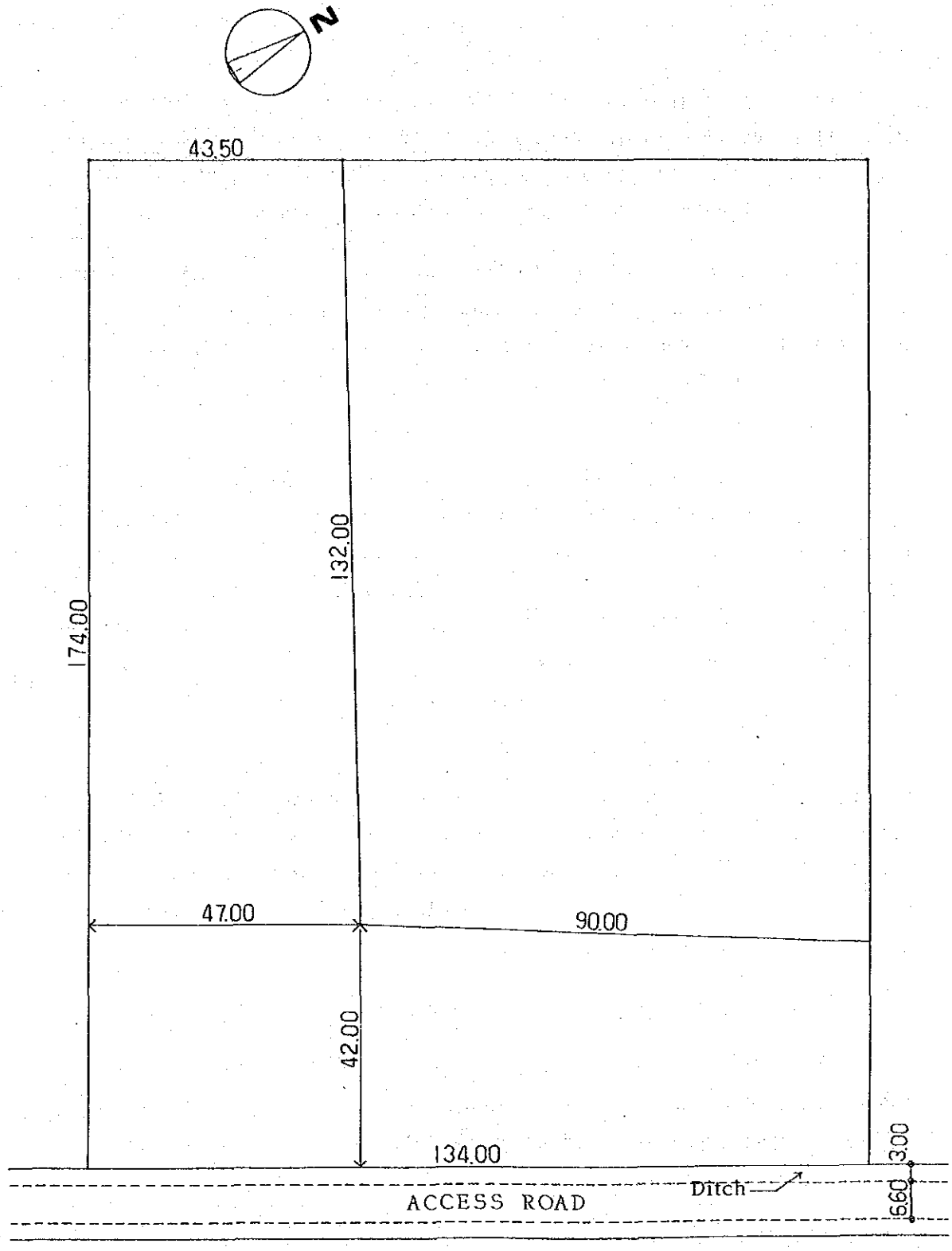


Fig. 4-1 RAJAPUR PROPOSED SITE scale 1 : 1000

4-2. Dangadhi

The project site is located at rice mill premises of former Seti Mahakali Paddy Rice Export Co., Ltd.* which is situated approx. 8 km from the center of the town of Dangadhi. The mill faces the asphalt pitched road leading from Dangadhi to Mahendra Highway.

The premises are enclosed with a brick-wall fence, and the inner facilities are relatively new and appear to be in good order. The proposed plot for the project is shown on Fig. 4-2 by dotted lines. The wooden temporary warehouse (No.7) shall be demolished. The area of the plot is approx. 0.7 hectare.

The plot is flat and there is no need for filling. The soil is in good condition. The surface is silt. However, below a depth of approx. 70 cm, the silt soil contains fine sand and marginal moisture. Local people claim that the soil has a pebble layer at a depth of 1.2 - 1.5 m, but a trial digging down to a depth of 1.8 m did not confirm any existence of this layer. The soil was, however, judged to have a enough bearing capacity, because it contains sand.

Electric power is available, but is currently blocked at the connection point with the main supply line on the road in front of the site. Telephone is not available. City water supply is also unavailable to the site, necessitating the digging of a well. Although there exists one well on the premises, it would probably be less costly to dig a new well than to install a pipeline from the existing one.

Drinking water is available at a depth of 12 - 15 meters.

Water drainage is presently treated by natural infiltration into the ground and by natural evaporation. When the area around the warehouses is paved, treatment of rainwater will become an issue. The

* This Rice Export Co. was a semi-governmental enterprises as is in the cases of the other RECs. However, all the RECs liquidated, and are now under legal process. Both the land and facilities are to be transferred to NFC after legal matters have been settled. The capacity of the rice mill plant was 2 tons/hour. The facilities can be referred to in Fig. 4-2.

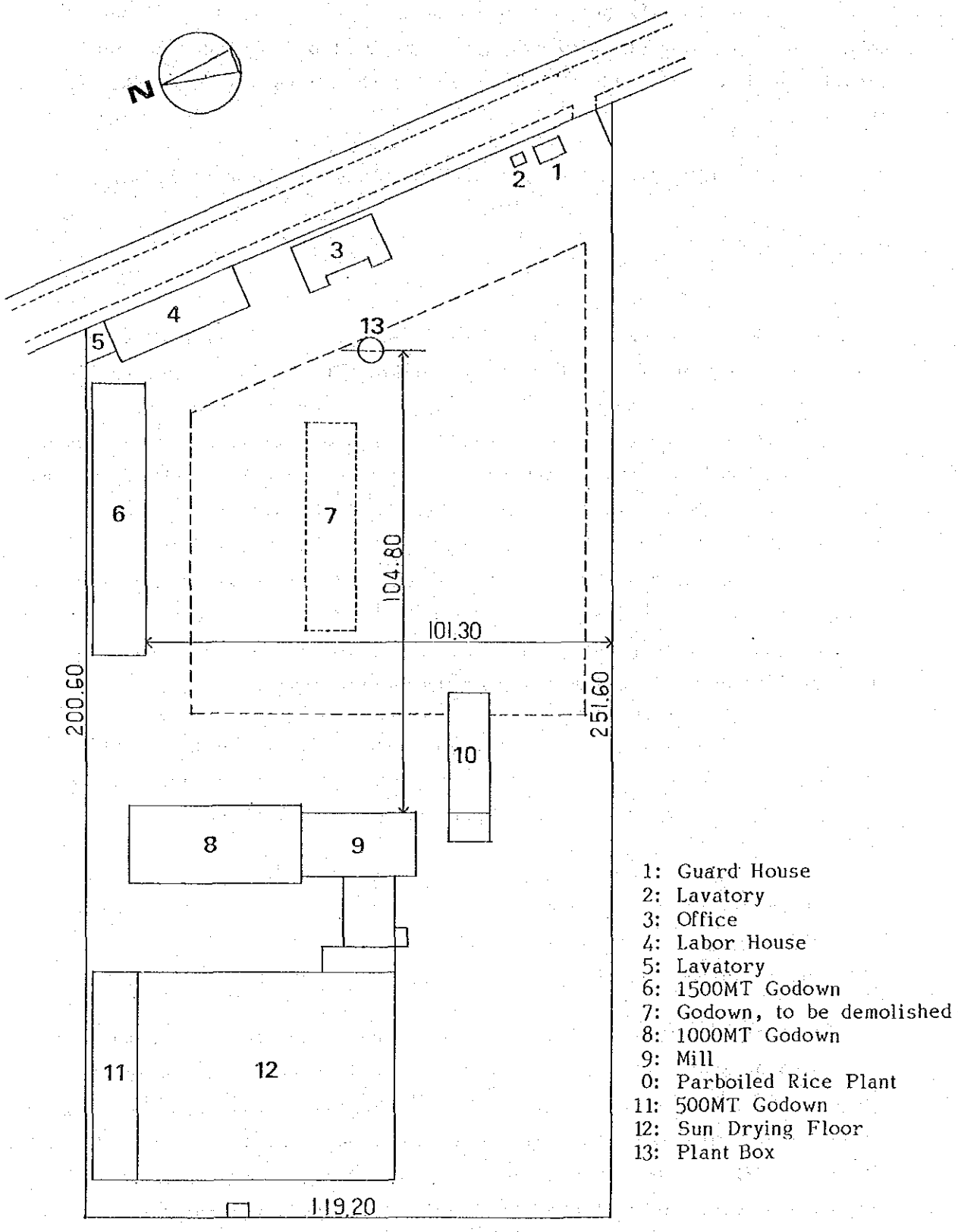


Fig. 4 -2 DANGADHI PROPOSED SITE IN SETI MAHAKALI RICE MILLS

scale 1 : 1.250

like pits along the road are not designed for drainage, but are only holes excavated for the purpose of collecting soil to fill the road embankment. The way of rainwater treatment will be concluded at the detail design stage surveying how effective the holes will work for the drainage.

The bordering properties surrounding the mill are farm lands.

4-3 Mahendranagar

Two sites were proposed. One is a plot of NFC adjacent to another NFC's plot where two existing NFC warehouses (500 tons x 2) now stand. The other is a plot of ex-REC storages behind NFC's. The former shall be called No. 1 and the latter No. 2. Both are located on outskirts northeast of the town center of Mahendranajar, and are within a developed area by the town authority which is at a distance of only 1.2 km from the NFC's branch office. Priority will be given to the plot No. 1, but its area is limited and land shape is poor. If the plot No. 1 cannot accommodate the planned storages, the plot No. 2 will have to be taken into consideration. This is the agreement shown in the minutes of discussion. The road passing in front of the No. 1 plot is paved with asphalt-pitch and is the final leg of Mahendra Highway.

The areas of the plot No. 1 is 1 Bigaah (= 0.6772 hectare). If NFC wishes, another area of approx. 0.3 hectare west of the pole can be procured. The No. 1 has a large amount of soil which will have to be moved.

It is concluded in the plan to construct a storage of 1,000 tons in Mahendranagar, and it is decided that the area of the plot No. 1 is sufficient. So the description on the plot No. 2 shall be omitted here.

The soil of the plot No. 1 is silt. The underground water table is located at 1.2 meters below the ground level at the lowest point of the plot. The bearing capacity of the soil is almost nil, but there is a pebble layer at 2.0 meters below the said ground level. It was confirmed that the subsoil of the plot No. 2 is of a similar condition. The points where electric power, telephone and city water supplies are available are illustrated on Fig. 4-3.

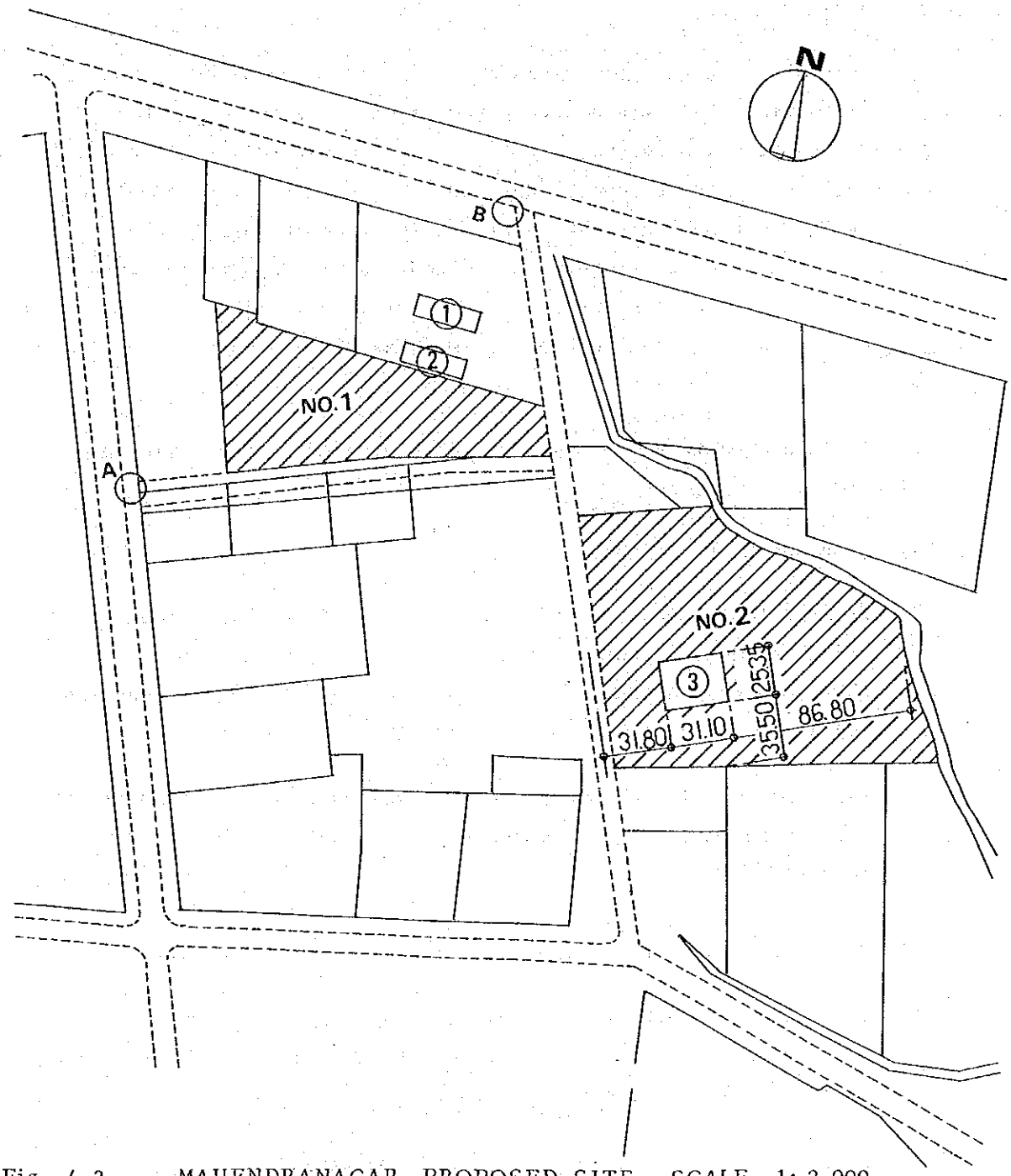


Fig. 4-3 MAHENDRANAGAR PROPOSED SITE SCALE 1: 3,000

No.1 Site has priority over No.2 Site
1 2 : 500 MT godown of NFC
3 : 1000 MT godown of REC

A point: Power and telephone line and city water supply are available.

B point: Power and telephone line available.

Chapter 5. BASIC DESIGN

5-1 Basic Concepts

In order that the most satisfactory results can be extracted from the cooperation the basic design concepts shall be to design the facilities which are the most suitable for the natural, socio-economic, technical, financial circumstances and other conditions of Nepal as well as Mid-west and Far-west Terai, taking requirements of the Japanese grant aid system such as limited construction period into account. Meanwhile, the grade of the facilities shall be determined in reference to NFC's grade standard as well as NFC's recent storage projects.

The aforementioned concepts will be embodied in the following points:

(1) To adapt to the climatic conditions

Located in the monsoon zone, the climate of the Terai shows both tropical and subtropical features. It is also situated between the South East Asian humid zone and the West Asian dry zone and exhibits continental climatic features.

Therefore, design of the foodgrain warehouses and other auxiliary facilities shall be that which will most suit to the climatic conditions.

(2) Consideration on the operational skill and technical level

In designing of the facilities and equipment selection, the operational skill and technical level of the workers and technicians shall be taken into consideration.

(3) Consideration on Maintenance costs

Designing shall be done so as to minimize the financial burden for maintenance, nad so that all maintenance works required can be carried out by locally available materials and manpower.

(4) Consideration on Operational costs

Designing of the facilities and selection of equipment shall be conducted so as to minimize operational costs such as energy cost and expenses required for spare parts.

(5) Consideration on Security

Due to the nature of the storage facilities, special consideration shall be given to preventative measures against theft, vandalism, fire, etc.

(6) Local procurement of technical know-how and materials

Technical manpower and materials locally available shall be utilized in the construction works as much as possible, thereby making the most of the financial cooperation from Japan.

(7) The Grade of the storage facilities

The grade of the storage facilities shall be in compliance with the "A" rank of NFC's storage standard, with further reference to the technical level of the storage facilities built recently with British cooperation.

5-2 Basic Plan

5-2-1 Plot Plan

(1) Warehouse Layout

The axis of the ridge of the warehouses shall be directed along the west-east axis so that the amount of solar heat to be received by the external wall of the warehouses can be minimized.

The distance between the warehouses shall be spaced so that a 10-ton truck can be parked with its back up against the receiving platform. The space between the gable ends shall remain as a passageway.

(2) Office Building and Guard House

The guard house and office building shall be located close to the entrance of the premises. Space for a cargo truck to park in front of the office for quality and quantity checks shall be incorporated.

(3) Layout of Rajapur Facilities

Flow relationships between the warehouses, the rice mill and other auxiliary facilities are shown on Fig. 5-2-1. Each facility shall be laid out so that they can function as efficiently as possible.

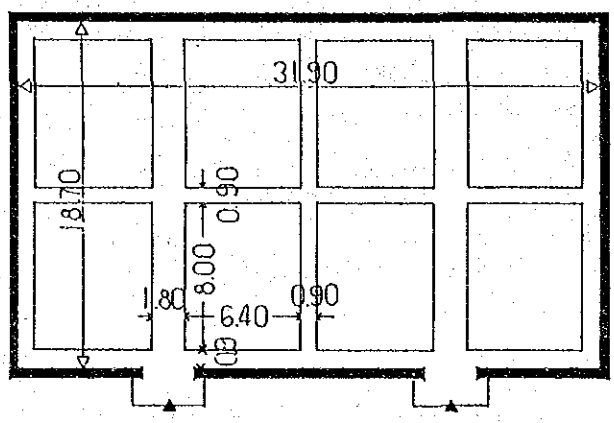
5-2-2 Building Plan

(1) Floor Plan

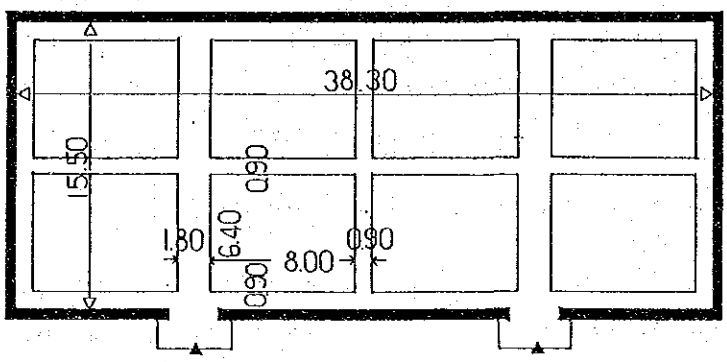
a) Warehouses

In Chapter 3, "Contents of Project", a basic formation of stacking has been determined. According to this stacking method, the floor plan of the most efficient warehouse is studied as follows. Plan "A" and Plan "B" are two possible alternatives of the warehouse plan introduced from the basic stacking method. As to the formation of multiple stacking groups selected among those now popular in Nepal.

Concept Alternative (A)



Concept Alternative (B)



If a stacking is made into a flatter shape, the floor plan of the warehouse would be more like a square and the other, more like a rectangle. In the case of a more rectangular shape as in Alternative "B", the areas of external wall and floor increases. In the case of a more square-like shape as in Alternative "A", the beam span becomes larger as well as floor area. Therefore, neither case is economically desirable. The selection should be made from a shape like "A" or "B". The following table is a comparison.

Table 5-2-2 Comparison of Alternative "A" and "B"

	Alternate A		Alternate B	
Floor area	596.5 m^2	disadvantageous	593.6 m^2	advantageous
External length	101.2 m	advantageous	107.6 m	disadvantageous
Occupation ratio	0.587	slightly disadvantageous	0.690	slightly advantageous
Beam span	larger	slightly disadvantageous	smaller	slightly advantageous
Outdoor area	smaller	advantageous	large	disadvantageous

From the above comparison, it can be said that there is no large economical difference between the two alternatives. However, when external works are taken into consideration, "A" appears more advantageous.

Furthermore, "B" is not desirable in the Rajapur and Dangadhi sites, as they lack sufficient width in the west-east direction. These are the reasons why "A" is selected as the basic floor plan for the 1,000-ton warehouses.

b) Office Building, Storehouse and Guardhouse

Storehouse for the equipment and materials for fumigation is built separately near the office building, because of the possibility of the chemicals reakage and the convenience of control. The size and areas of each room are determined by taking the layout of the furniture, equipment and working space into consideration. A pilotis provided in the office building front is to be used as a corridor. This design suits the climatic conditions of the area which is situated between the tropical zone and the subtropical zone, and also makes the most of the pilotis as a space where laborers and administration staff can hold mutual communication.

c) Rice Mill Facilities

The floor plans of the rice mill plant, parboiled rice and other related buildings are decided in accordance with the

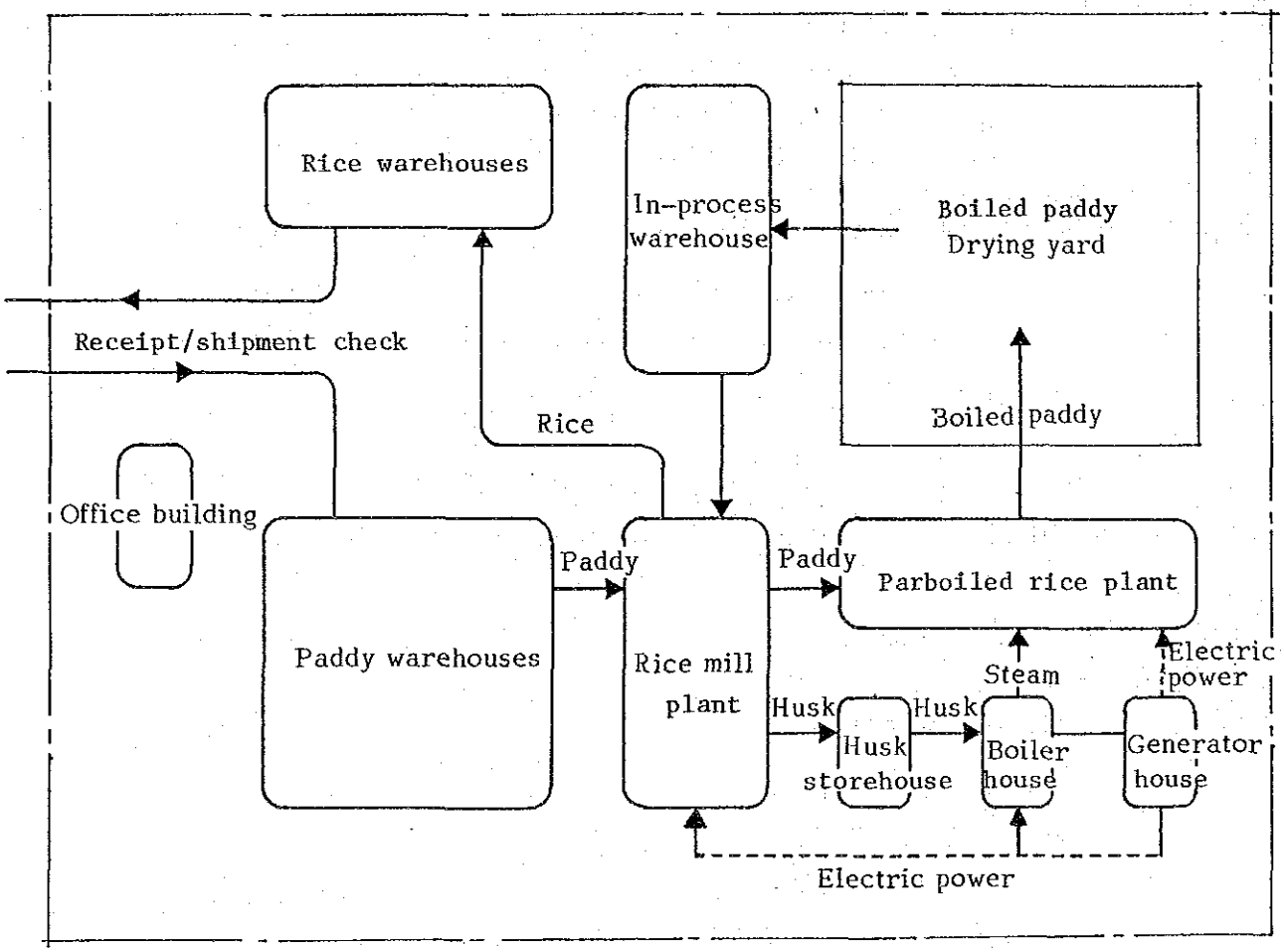


Fig. 5-2-1 Flow Between Storage and Plants

layout of the function and equipment, and flow of materials.

Therefore, floor plans of the plants are studied in the "Rice Mill Plan" (see 5-2-6 Plan for Equipment). As a result of the study, necessary buildings, rooms and their respective floor areas have been clarified as follows:

1)	Rice mill plant	600 m^2
	* Receiving and cleaning room	130
	* Husking, whitening and packing room	165
	* Bran room	20
	* Fan room	20
	* Dust collecting room	20
	* Workshop and spare aprts room	20
	* Working room	225
2)	Parboiled rice plant	250 m^2
	* Receiving and cleaning room	100
	* Control task and parboiling room	150
3)	In-process parboiled paddy storage	450 m^2
	* Temperature area	
	* Temporary yard	
	* Dryer area	
4)	Husk storehouse	105 m^2
5)	Husk storehouse	75 m^2
6)	Generator house	90 m^2
	Total	1,570 m^2

(2) Sectional Plan

1) Basic Concept for the Sectional Plan of the Warehouses

In studying the sectional plan of the warehouses, the following basic concepts according considered:

a) To avoid structures which require internal columns which would be an obstruction in the fumigation operation.

b) To adopt a reasonable, practical ventilation system.

c) To raise the roofs of the warehouses to a higher elevation, higher than typical, so that the space inside can be enlarged and ventilated more effectively for protection against the strong solar heat.

Regarding item a) above, it is a natural consequence when using fumigation sheets. A study is to be made on item b) below, "2) Ventilation of Warehouse". As to item c), the study results are as follows.

Several ways are known to reduce or eliminate solar radiant heat.

- Dual ceiling structures using material hard enough to repel rodents.
- Use of heat insulation materials
- Sunshade roofing over the conventional roof

From a technical standpoint, each of the above can be considered better than the planned roof structure, and would be even better if combined. However, when the level of local resources for maintenance and oepration are taken into consideration, these solutions are not practical. Therefore, a more simplified structure is desirable to avoid problems both in constuction work and in maintenance.

On the other hand, expecting that when storage amounts are increased in the future, improvements will be made in stacking skills. The higher space over the ordinary stacking level could temporarily accommodate more foodgrains, thus increasing the total storage capacity. Because of this, the roof plan described in item c) is considered the most practical and efficient.

2) Ventilation of Warehouses

While the ventilation system should reasonably match the local climatic conditions, it should be practical and efficient as well. Some warehouses have a ventilation system which requires windows to be opened and closed manually in accordance with the temperature and humidity conditions. However a manual opening and closing routine can hardly be considered efficient. In this plan, openings in relation to the ventilation system should mean an opening always left open. A window in relation to the intake of sunlight, however, means a fixed glass window always closed.

As mechanical ventilation systems do not suit with the local conditions, a natural ventilation system is under consideration.

Local climatic features are basically as follow:

a) The continental climate exhibits a highly differentiated temperature range over a single day and night.

b) The summers are tropical and dry, where temperatures frequently exceed 40°C, and rise up very rapidly under direct sunshine.

c) In the monsoon season, it is hot and humid with rain often accompanied by strong wind.

d) In the remaining seasons other than the monsoon, it is relatively dry.

The selection of a suitable ventilation system is one of the most important tasks in designing warehouses.

Although the study team made a trip through the Terai investigating native foodgrain storage facilities developed to suit the climatic features of the Nepalese Terai, not a single one was found.

Most of the design and ideas of the large warehouses have British origin and imported via India. The various types of

of warehouses that have been investigated can therefore be considered "varieties" in the process of adjusting to the natural and climatic features of Nepal.

Those can be classified into the three types. In the Nepal Terai, the ideal indoor circumstances for foodgrain warehouses are those which are kept at the lowest possible temperature and humidity.

Temperatures should also be kept constant. Attention should be paid to the possibility of dew condensation. The ventilation system for this project can be selected from among the three methods given below, and it's concluded that the "high window and opening at the ridge", or system 3), is the most appropriate.

1) High and low window system (Fig. (A))

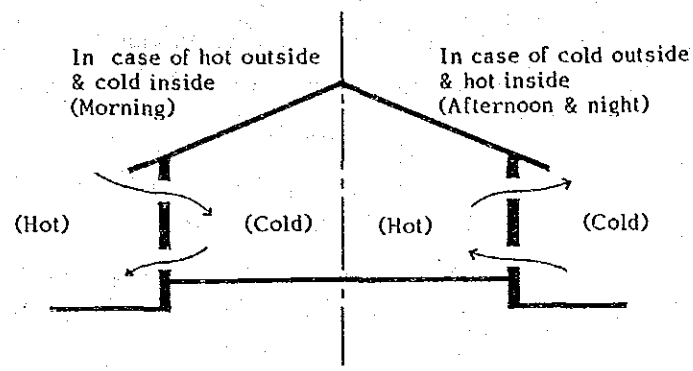


Fig. (A)

Though this system may be seen often in the Terai districts, it is illogical. The right half of the figure shows a phenomenon where the high and low windows act as a chimney when the inside temperature is higher than that of the outside, (i.e., in the afternoon and at night.)

Here the cold air outside is introduced into the room, which is the original purpose of this system. On the other hand, the left half of the figure shows an undesirable phenomenon. The cold air introduced into the room overnight is then pushed outside from the low window, due to the chimney effect, when outside temperature rise in the morning.

Concerning the low window, it has other disadvantages that

the highly humid air near the ground may be pushed inside during rain and may not prevent rain water from getting inside when accompanied with strong winds.

2) High window system (Fig. (B))

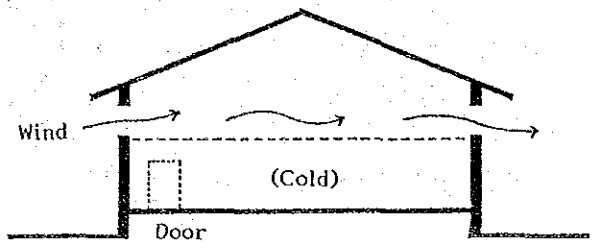


Fig. (B)

The high window system is created by eliminating the lower windows thus avoiding the aforementioned disadvantages. The UK project is using this system and it is often seen in private warehouses in the Terai. Its drawback, however, lies in the insufficient exchange of cool outside air and the exhausted hot inside air, as the intake of the outside air is supplied solely by the wind. On the other hand, its advantage is in its keeping the cool air from escaping to the outside once introduced into the room.

Furthermore, the chimney effect is created by opening the entrance door to exhaust hot air when needed. This is far earsier than the opening and closing of the lower windows.

Practically speaking, however, the entrance door cannot be left open all day and night.

3) High window and opening at the ridge (Fig.(C))

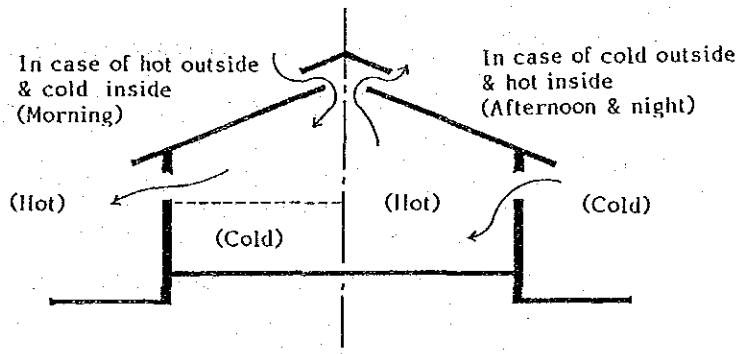


Fig. (C)

This system is recommended by a FAO expert in NFC. We witnessed an example of

this system in the Terai, but it is still not prevalent. This system eliminates the disadvantages of having low windows, without sacrificing the desirable chimney effect. It is effective in keeping the low portions of the warehouse space for grain stacking at a lower temperature.

As stated before, this system is the most rational of the three systems, and is thus adopted for this project.

(3) Construction Method

1) Construction of each building element is planned as follows:

Table 5-4 Construction Method

Element	Warehouses & main plants	Administration office & auxiliary buildings
Footings	* brick foundation	* brick foundation
Foundation beams	* reinforced concrete (RC), finished with mortar	* reinforced concrete (RC), finished with mortar
Floors	* earth fill * ballast fill * hard-mixed concrete * finish surface of concrete by steel trowel * expansion joint	* earth fill * ballast fill * concrete * mortar finish
Walls	* bricks reinforced with RC * both sides finished with mortar * paint coating	* bricks reinforced with RC * both sides finished with mortar * paint coating
Columns	* SRC with H-section steel * mortar finish * paint coating	* RC mortar finish * paint coating
Beams	* H-section steel * partially rigid frame * partial truss	same as above

Table 5-4 Continued

Element	Warehouses & main plants	Administration office & auxiliary buildings
Roof	* galvanized corrugated steel sheet	* RC * water-proofing mortar
Ceiling	(roof structure -- steel frame)	* as cast concrete place roof slabs) * paint coating
Opening for shipping/ receiving	* Sliding steel door w/overhead horizontal track	
Entrance	* steel door	* wood door * paint finish
Window	* fixed glass window * steel frame * wire glass	* horizontal sliding window * wood frame * wire glass * paint finish
Ventilation openings	* steel casement * stainless steel net	* made of brick

Note: All the steel materials are galvanized.

As earthquakes do occur in the area, the brick masonry must be strengthened with reinforced concrete to give a horizontal resistance equivalent to 40% of Japan's design standards. The construction methods listed in Table 5-4, use conventional, local systems, with the exception of the following:

- Column and beam structure of warehouse building
- Sliding doors at the openings of shipping/receiving area
- Galvanization of the steel materials

a) Beam and column structure of the warehouses

Long span roofs shall be supported with trusses made of steel pipe. With this system, columns shall be reinforced concrete, on which the trusses will be placed.

The column is constructed with an H-section steel encased in reinforced concrete.

The beams are composed of a structural system made up of a rigid frame and an H-section steel truss.

It is understood that conventional methods in Nepal are more economical than this method but the reasons for proceeding with this system is set forth below.

- Due to the low level of labour skill, it is very difficult to execute accurately, steel works such as steel-trusses and steel sheets which do not permit dimensional inaccuracy. This is a factor which affects the durability of the building after completion.

- More specifically, it is very difficult to accurately install the truss on top of the columns, so placement of steel sheet roofing cannot be worked out well. Consequently the deterioration of the steel materials is accelerated.

- Since the concrete column contains H-section steel, anchor bolts can be set prior to erection, allowing steel frame to be fabricated on the floor, and thereby increasing the accuracy of the work.

- Although the merit set forth above is the primary reason for the use of H-steel in concrete columns, by doing so, also increases rigidity at the joint of the beam and column. As a result, the lower member of the truss can be moved up to a higher level, thereby increasing the effective height of the interior space.

b) Sliding doors at the openings of shipping/receiving

For large openings such as those to the shipping/receiving yard, it is common to use manual type roll-up steel shutters imported from India. In India the manual shutters are usually used at the front opening of shops and are so popular that they are widely available and easily obtained.

However, for this purpose, the sliding door is preferable, as its supporting structure is much simpler and maintenance is easier.

c) Galvanization of the steel material

All the steel materials used in the UK project were galvanized with no paint coating.

Compared with the conventional paint finish with anti-rust undercoating, this galvanization has the following advantages.

a) The paint work on steel material is very difficult, and may be beyond the level of the workers skill.

b) Damage to the galvanized material during transportation is much less significant than of steel with rust-proof undercoating.

c) Maintenance is not necessary for galvanized steel.

Although the cost is increased, the use of galvanized steel materials can be justified for the works in the Terai because good maintenance service cannot be depended on.

2) Construction Materials Required

1) Materials locally available

sand, rock, wood, wood concrete forms, logs

2) Materials to be locally procured (Procurement in India is considered as local.)

cement, wire glass, paint, hardware, galvanized corrugated steel sheet

3) Materials to be imported from Japan

re-bar, steel frames, steel door, steel window frames, steel ventilation frames, stainless wire-mesh