No. 3

BASIC DESIGN SURVEY REPORT

ON

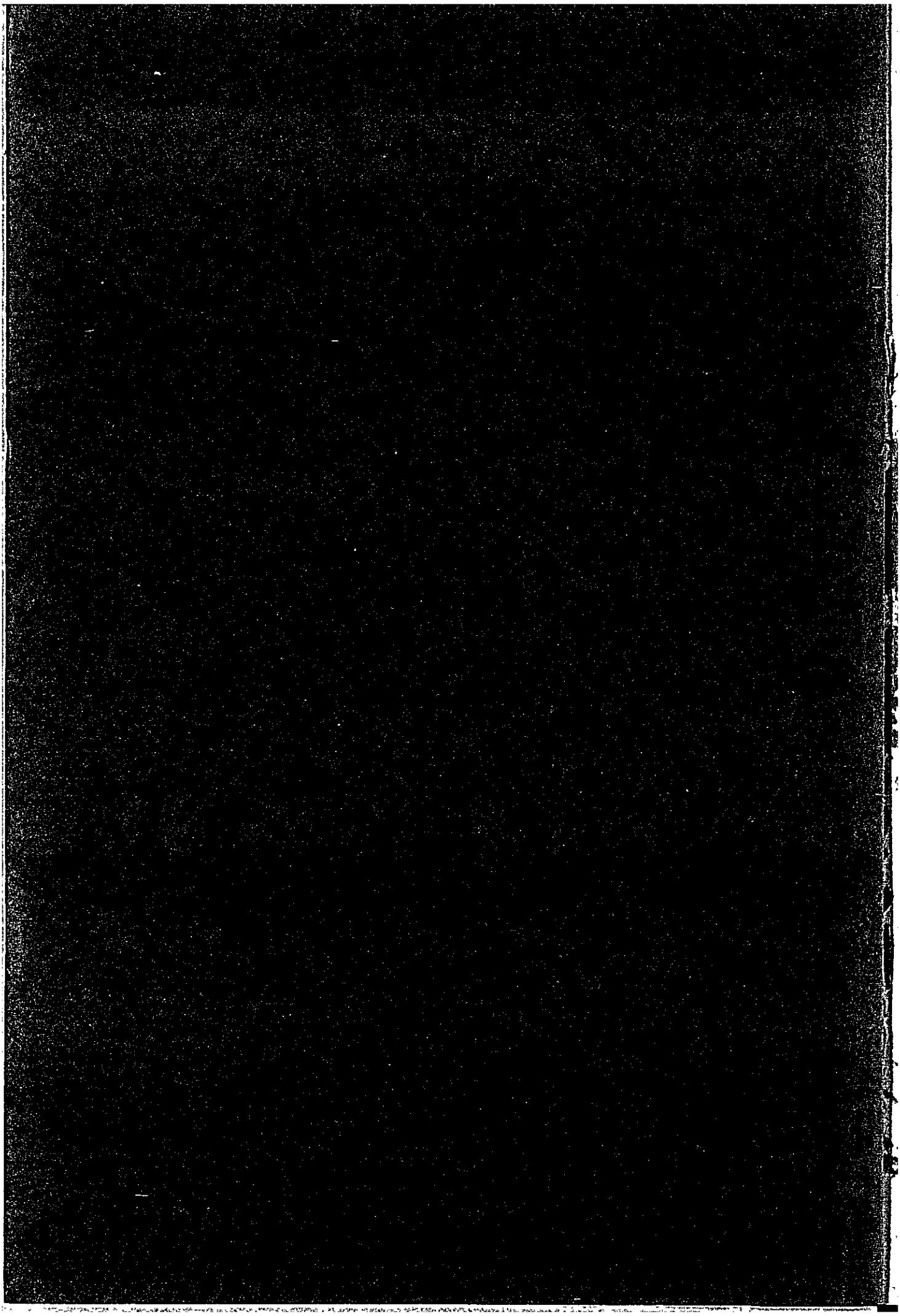
FOOD GRAIN STOREHOUSES CONSTRUCTION PROJECT

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

March 1979

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN



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P R E F A C E

The Government of the People's Republic of Bangladesh requested the Government of Japan for a grant aid for the construction of foods storehouses with a total capacity of 30,000 tons to improve the foods storage capacity of the country.

Following the above request, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Survey Team on Foods Storehouses, headed by Mr. Kyoichi Hanado and comprising 5 others from 13th November to 9th December 1979 to conduct a necessary survey for construction of the storehouses and exchange views with the Bangladesh Authorities concerned.

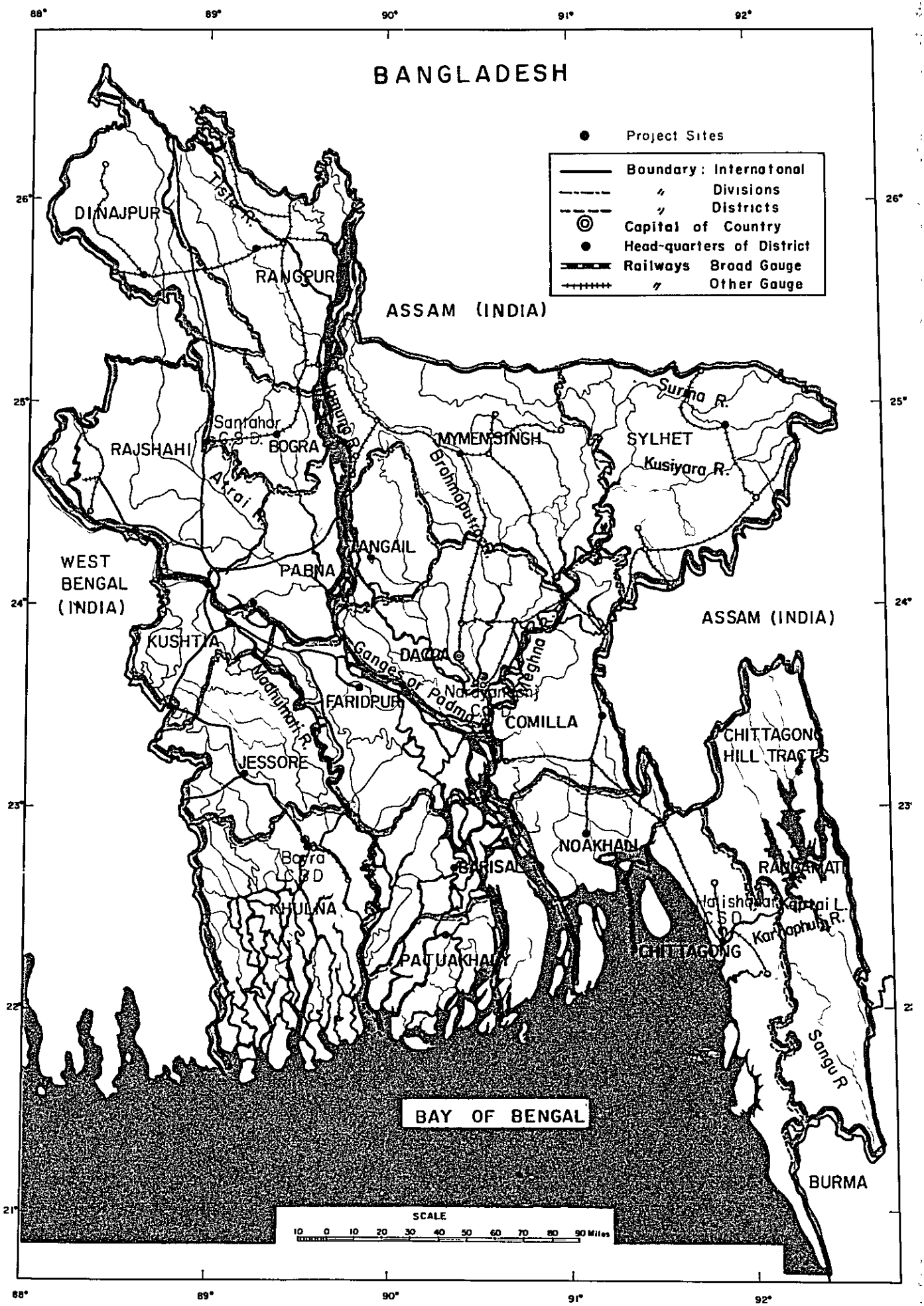
After further studies based on the above survey and discussions, this design report has been completed.

I hope this report will be found useful for the construction of the foods storehouses.

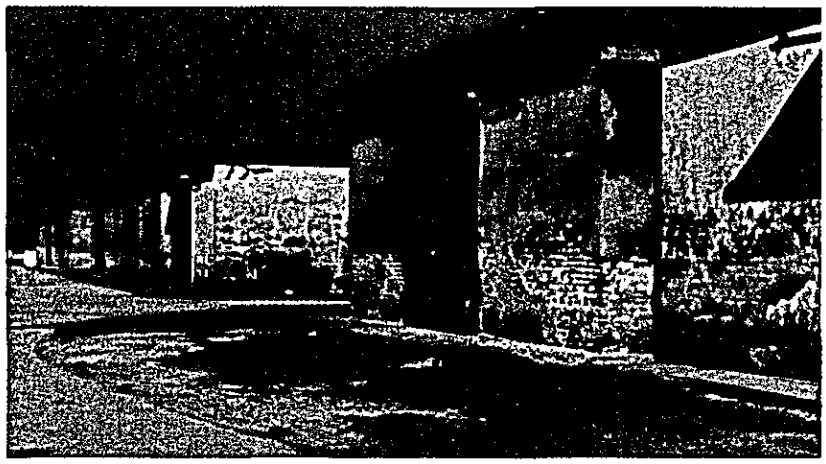
I wish to express my heartfelt gratitude to the Bangladesh Authorities and officials concerned for their cooperation extended to the Team.

March, 1979

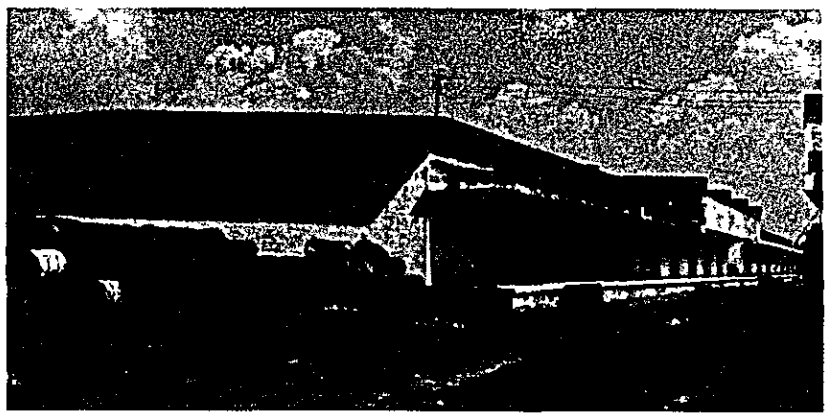
Sinsaku Hogen
President,
Japan International Cooperation Agency


BANGLADESH
Project Sites
Boundary : International
Divisions
Districts
Capital of Country
Head-quarters of District
Railways Broad Gauge
Other Gauge
DINAJPUR
RANGPUR
ASSAM (INDIA)
Tista R.
Jamuna R.
Surma R.
Santahar C. S. D.
BOGRA
RAJSHAHI
Atrai R.
MYMENSINGH
Brahmaputra R.
SYLHET
Kusiyara R.
TANGAIL
PABNA
WEST BENGAL (INDIA)
ASSAM (INDIA)
KUSHTIA
Ganges or Padma R.
DACCA
Meghna
Narayanganj
Madhumati R.
FARIDPUR
COMILLA
CHITTAGONG HILL TRACTS
JESSORE
Bagra C. S. D.
KHULNA
BARISAL
NOAKHALI
RANGAMATI
Halishahar C. S. D.
Kaptai L.
Karnaphuli R.
CHITTAGONG
PATUAKHALI
Sangu R.
BAY OF BENGAL
BURMA
SCALE
10 0 10 20 30 40 50 60 70 80 90 Miles
88°
89°
90°
91°
92°
26°
25°
24°
23°
22°
21°

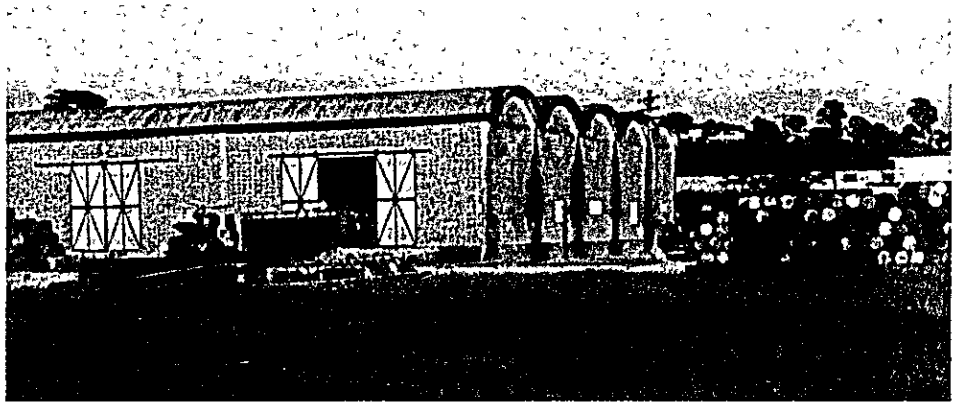
New Storehouses by the Japanese Grant of 1977
Capacity: 1,000 tons
Maheswarpasha CSD, Khulna



Dacca Type
Capacity: 500 tons
Santahar CSD, Bogra

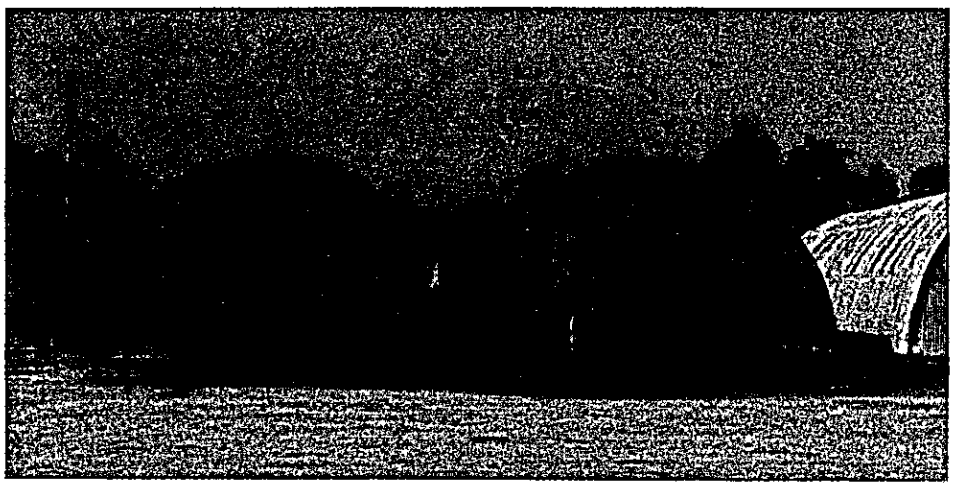


Dacca Continuous Type
Capacity: 500 tons
Halishahar CSD, Chittagong



Shell Type
Capacity: 1,750 tons
Dewanhat CSD, Chittagong

Shell Type
Capacity: 2,000 tons
Maheswarpasha CSD, Khulna



Twin Nissen Type
Capacity: 700 tons
Boyra CSD, Khulna

SUMMARY AND CONCLUSION

1. Introduction

The Government of the People's Republic of Bangladesh requested the Government of Japan to provide the Japanese Grant necessary for food grain storehouses construction project (total storage capacity: 30,000 tons). The Government of Japan dispatched a basic design survey team to Bangladesh for food grain storehouses construction project through Japan International Cooperation Agency in order to appraise the project to the grant. The Survey Team which comprises 5 experts and a coordinator has undertaken field surveys for 27 days from November 13 to December 9, 1978 in Bangladesh.

After the survey in Bangladesh, the Survey Team prepared in Japan a draft report on the survey. The Draft Report was sent to the Government of Bangladesh on February 5, 1979. Received comments on the Draft Report from the Government of Bangladesh, the Survey Team made some adjustments to finalize the report.

2. Storage Capacity

The total capacity of food storage of the Bangladesh Government is 1,309 thousand tons including CSDs, LSDs and Silos. However, it seems that the total capacity of 1,309 thousand tons contains about 300 thousand tons of dilapidated storehouses which are not utilized for food grain storage.

The distribution of storage capacity biased among supply area and consumption area. Rice supply areas in northern and northwestern zones have less storage capacity than food consuming area in comparison with necessities of procurement and consumption respectively. The shortage in rice supply area causes the limitation of procurement and large amount of loss by stacking grain outdoor or in substandard storehouses.

Moreover, Aman rice shares about 60 % of total annual production and 80 % of procurement. This makes the storage capacity gap between supply area and consumption area wider.

3. Justification and Expected Impacts of the Project

Bangladesh has been taking various measures for the purpose of accomplishing self-sufficiency of staple-food. However, the volume of imported food in the recent years has been as much as ten to twenty percent of total consumption, and the ratio of donation has been increasing in the imported food. But because continuous donation cannot be expected permanently, accomplishment of self-sufficiency of a staple food is urged for improving the balance of international accounts.

Improvement of the infrastructures of production, marketing and institution is necessary for increasing domestic production of food, and guarantee of prices of farm products is particularly effective motivation to farmers for production. Although the main purpose of staple-food control system of this country was to secure staple-food for consumers in the past, its emphasis has been recently directed to price-support for producers.

However, the volume of government procurement rice for rations is restricted, and sufficient effect of price-support policy has not yet been obtained because of constraints of the marketing infrastructure represented by (a) shortage of number and capacity of storehouses in the supply districts, (b) unconsolidated means of transportation, (c) unsuitable time and inefficiency of procurement, and (d) insufficient processing facilities.

Consolidation of the marketing infrastructure of staple-food in Bangladesh is not what can be solved simply through physical repletion, but it should be made based on a series of systematic development view. For increasing the volume of procurement, however, promotion of the purchase of Boro and Aus rice by introduction of dryers, increase of storehouses in production districts, improvement of efficiency of procurement and improvement of home storage methods are considered to be effective.

The Project is to contribute to improvement of food marketing by the Government and stabilization of market prices of staple-food in Bangladesh through the increase of food grain storehouses with the consolidation of key procurement center in the production areas, consolidation of reserve storehouses in the large consumption areas and consolidation of imported grain storage at international ports as the major objectives.

The effects of construction of storehouses will be improved if technical trainings and extension of equipments and materials related to cereal inspection and storage management are coordinated along with the project.

4. Selection of the Project Areas

With respect to the survey, a field survey was carried out in six CSDs in four districts requested by the Government of Bangladesh, and collection of necessary information was made from two aspects, that is, conditions of demand and supply of staple-food such as cereal production, consumption, transportation capacity, storage capacity and situation of storage management as well as conditions of construction such as the situation of construction sites, and availability of construction materials and of the labor force.

As for the selection of construction sites, the criteria for judgement from the standpoint of marketing of staple-food were placed on 1) the key areas in rice producing and supply zones, 2) the increases of food reserve capacity in large consumption areas, and 3) the consolidation of imported grain storage at international ports. With respect to the conditions of construction, judgement was made with criteria placed on 1) the number of storehouses which can be constructed in same area, 2) the situation of the sites, 3) the availability and unit prices of construction materials and of labor force, and 4) the availability of means of transportation.

Judgement of Proposed Sites

Construction Sites	Condition of Staple-food Marketing	Condition of Construction	Number* to be constructed
Santahar CSD (Bogra)	Supply area, base of transportation	Large space available, good site	10
Narayanganj CSD (Dacca)	Large consumption area	Small space, with obstacles	2
Boyra CSD (Khulna)	Import storage and consumption area	Small space, inferior site	13**
Maheswarpasha CSD (Khulna)	Import storage and consumption area	Large space available, good site	0
Halishahar CSD (Chittagong)	Consumption and import storage area	Large space available, with obstacles	5
Dewanhat CSD (Chittagong)	Consumption and import storage area	Large space available, with obstacles	0
		Total	30

* Capacity of a storehouse is assumed as 1,000 tons.
** By the request of the Bangladesh Government on the condition of withdrawal of dilapidated storage.

5. The Plan

Layout plan: For the convenience of preparation of the plans, floor space of 40 ft x 100 ft (capacity: 500 t) is used as the basic unit, but the actual floor space is determined as 80 ft x 100 ft (capacity: 1,000 t) for increasing the storage efficiency. Two types of entrances are prepared, that is gable-side entry type and ridge-side entry type. (Refer to Figs. 5-1, 5-2.)

Structure plan: The body will be made of reinforced concrete structure with brick walls. The design standard strength of concrete was determined as Fc = 180 kg/cm^2, and live load was set as 2 t/m^2.

Facility plan: As for the draft and ventilation, the use of mechanical equipment is avoided as practicable and the use of effective natural ventilation was taken into consideration. Lighting is natural lighting through top windows in the day time and lighting by electric lamps at night time. For drainage of rain water, open conduits will be provided around the buildings, and water will be led to the tank in the site.

Construction plan: As for the construction equipment and materials, locally produced materials will be used as a rule and labor intensive construction methods will be used as much as possible. The materials to be domestically procured will include bricks, sand, gravel, crushed stones and materials for temporary structures, and it was decided to use imported goods; reinforcing bars, steel, cement and wood for the purpose of shortening the term of construction works. The term of construction work will be fifteen months which shall include two dry seasons, because work is delayed in rainy seasons. The labor cost and material costs were calculated based on the field survey with the Schedule of Rates, 1977 prepared by the Ministry of Works used as references.

Approximate construction costs: Rough estimate of total construction costs is 2.5 billion yen based on the assumption that the number of storehouses to be constructed is thirty, the sites of construction will be six CSDs in four districts and the term of work is fifteen months in accordance with the conditions stated in 5-4, "Scope of Work".

6. Conclusion

The Survey Team determined the economic role of project storehouses and technical feasibility of the construction on the assamption of the request of Japanese Grant by the Bangladesh Government, and prepared the basic design of the Project as the results of survey.

As has been described in the previous section, the construction of food grain storehouses plays an important role in the storengthening the food control system of Bangladesh Government through improvement of their marketing infrastructure. That is, not only does the construction of storehouses simply increase the storage capacity, but also the food control system at present stimulates food grain production in agriculture sector through the function of the price support policy by the Government's procurement and stabilizes market prices as well through operation of food stock by the Government's ration. This system contributes to the extent of welfare stability as well as food self-sufficiency which is the most urgent goal of Bangladesh.

The Government storage capacity is lacking particularly in 1) procurement storage, 2) buffer stock and reserve storage, and 3) imported grain storage at the port. The expansion of storage capacity in these areas shall be placed on the highest priority and then, implemented immediately.

Therefore, since the Survey Team confirmed that the Project plays an indispensable role to the improvement of food management, and that the construction of project storehouses is technically feasible, it is hereby expected that the Project shall be promoted to the implementation stage in earliest possible occasion as specified in the Chapter V., "The Plan" of this report. In the Boyra CSD, however, certain number of dilapidated storage will be withdrawn for the new construction of 13 storehouses. The withdrawal will offset the expansion effect of the Project to the total storage capacity and reduce the investment efficiency because of its cost from the view of national economy.

For the implementation of the Project, it is necessary that the Government of Bangladesh execute the site clearance such as removal of obstacles on the construction sites, the supply of power and water for the construction, the budgetary action for custom duties on imported construction materials and domestic transportation cost of the materials from the port to the sites, and other preparations for smooth promotion of the Project, prior to its commencement.

Needless to say, the Project is not in the position solely to solve the problem in food management simply by expanding the food storage capacity. Along with the project, it is necessary to improve other related marketing infrastructure, such as technical training and introduction of facilities in post-harvest processing, procurement operation, transportation, quality control and storage management. In order to utilize the Project storehouses effectively, the Team sincerely hopes that the technical training of the staff and the commitment of materials for quality control and storage management are coordinated together with the Project. ("Recommendations on Quality Control and Storage Management of Food Grains" is inserted in Appendix-II)

Finally, the Survey Team could not find a systematic master plan for improvement of the national food marketing infrastructure. Hence, it is strongly recommended to establish it for effective development of the national food operation as soon as practicable.

CURRENCY EQUIVALENTS

US$ 1.00 = TK 15.0

US$ 1.00 = ¥ 200.0

WEIGHTS AND MEASURES

1 foot (ft) ≒ 30.48 centimeters (cm)

1 pound(lb) ≒ 373.24 grams (g)

1 maund(md) ≒ 37.3 kilograms (kg)

Weights of rice are expressed as milled rice except specified otherwise.

ABBREVIATIONS

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
CSD	Central Storage Depot
CERDI	Central Extension Resource Development Institute
GDP	Gross Domestic Production
HYV	High Yielding Variety
JICA	Japan International Cooperation Agency
LSD	Local Storage Depot
PWD	Public Works Department
TK	Taka
UNDP	United Nations Development Program
¥	Yen

TABLE OF CONTENTS

CHAPTER I : INTRODUCTION

1-1 Purpose of Survey

The Government of the People's Republic of Bangladesh requested to the Government of Japan that the Japanese Grant Aid be provided for the construction of food grain storehouses of 30,000 tons in total storage capacity. In response to the request, the Government of Japan has dispatched a basic design survey team (hereinafter called "the Survey Team") through Japan International Cooperation Agency for the construction of food grain storehouses (hereinafter called "the Project") in order to appraise the eligibility of the Project to the Grant Aid.

Therefore, the survey aims to prepare basic information for the purpose of the project appraisal by the Government of Japan to the Japanese Grant. The Survey is excuted to determine the economic role of the Project by studying present food grain marketing in Bangladesh and to examine the technical feasibility of project construction through researching present conditions of construction works in proposed project areas. Thereby, the Survey Team is to provide a general plan including selection of construction sites, number of storehouses at each project site and to prepare a basic design for the project storehouses including rough estimate of construction cost.

1-2 Formation of the Survey Team

Team Leader	Mr. Kyoichi HANADO	Senior Officer Storage Management Operation Department Food Agency, Ministry of Agriculture, Forestry and Fisheries
Storage and Quality Control	Mr. Sadao YOKOI	Section Chief Operation Planning Section Operation Planning Division Operation Department Food Agency, Ministry of Agriculture, Forestry and Fisheries

Facilities Planning	Mr. Kiichi KOBAYASHI	Architect, Acting Manager Architecture Division Japan Engineering Consultants Co., Ltd.
Structural Engineering	Mr. Keisuke TAKAMURA	Senior Engineer Acting Manager Geological Division Japan Engineering Consultants Co., Ltd.
Architectural Design	Mr. Keiji KOBAYASHI	Architect, Assinstant Manager Architecture Division Japan Engineering Consultants Co., Ltd.
Coordination	Mr. Tadanori SUZUKI	Officer Technical Affairs Division Agricultural and Forestry Planning and Survey Department Japan International Cooperation Agency

1-3 Course of the Survey

The survey in principle consists of interviews and discussions with the concerned personnel, field investigations and discussions on the survey results with the Government officials. Each member of the Survey Team conducted interviews, information collection, field surveys and studies according to their respective speciality.

After the survey in Bangladesh, the Survey Team prepared a general plan and basic design for the Project, upon studying the data and information collected in the field survey. These results are made into a draft report on the basic design survey. While the Draft Report was submitted to the Government of Japan, it was also sent to the Government of Bangladesh on February 5, 1979. On March 9, the Survey Team received comments on the Draft Report from the Government of Bangladesh, then revised the Draft Report after determination of the comments in order to finalize the report.

1-4 Preparation of the Plan

The basic design is prepared by Japan Engineering Consultants Co., Ltd. based on the survey results as per the Contract Agreement between Japan International Cooperation Agency and Japan Engineering Consultants Co., Ltd.

CHAPTER II : REVIEW OF FOOD GRAIN SECTOR OF BANGLADESH

2-1 General Conditions of Food Grain Marketing

Rice cultivation in Bangladesh is divided into three catagories according to the cultivation season, namely Boro, Aus and Aman, and the production of Aman accounts for about 60 % of the total rice production. The annual average yield of rice is approximately 1.2 t/ha, and there has been no substantial change in recent years. But the annual production shows a slight increasing tendency and the production for 1977/78 was over 12,500 thousand tons because of the bumper crop due to favorable climatic conditions.

On the other hand, the quantity of rice procured by the Government has greatly increased in recent years reaching about 540 thousand tons for 1977/78. The procurement for 1978/79 is estimated at nearly 600 thousand tons. However, the rate of procurement to total production is extremely small. The great majority of rice procured by the Government is Aman rice and the procured guantities of Boro and Aus are very small due to insufficient drying.

The rice supply in recent years is 10.5-11.5 million tons after deducting losses and seed reserve, and 1.5-2 million tons of rice and wheat are imported annually to meet the demand for the population of 80 million. The consumption of rice and wheat per capita is 141-162 kg which is below the level of the pre-independence period of the country.

The major cities which are big consuming districts in Bangladesh are Dacca (population: about 2 million), Chittagong (about 890 thousand) and Khulna (about 440 thousand). Rice is cultivated throughout the country, but most of the rice produced by farmers is consumed by themselves. The main producing and supply districts are concentrated in the north and west of the country, and rice cultivated in these areas is shipped to big consumption districts.

This country, which is suffered from a chronic food shortage, is carrying out the following policies to increase production and stabilize supply in order to achieve self-sufficiency in food. The Government's procurement of rice and wheat for rationing is executed in relation to

the policies such as (a) price support for producing farmers, (b) even food rationing among the districts, (c) stabilization of food market prices, and (d) the prevention of smugging.

Food grain for rationing is inspected at the time of procurement by inspectors who are assigned to each storehouse, and the inspection is conducted emphasizing moisture content, foreign matter and damaged kernals, and then the grade of food grain is determined. Regarding procurement prices, the price of paddy is uniform whereas the price of milled rice is decided according to the grade of grain and the transportation charge of 4 Taka/maund is added thereto. The sellers can get cash by submitting the W.Q.S.C. to designated banks.

There are two systems for rationing, the Statutory Rationing System and the Modified Rationing System. The purpose of the former is to achieve uniform rationing to inhabitants of designated consuming districts, and the latter is carried out for aiding poor people in rural areas. The ration of staple food, which is rationed on the basis of units per person per week, can be received from licenced retailers in accordance with the ration cards. The price of rationed rice is about 1/2 of the free market price, which is about 75 % of procurement price.

Some aid projects in the construction of food storehouses are now being made and implemented by foreign countries, etc., such as the World Bank, the Asian Development Bank, West Germany, the Netherlands, Canada, and the U.K., etc. emphasizing the construction of 500 ton of Thana storehouses in the producing districts.

2-2 Storage Capacity

2-2-1 Nominal Capacity

(1) The nominal capacity as of November 1978 was 1,309 thousand tons.

CSD	12 locations	403 thousand tons	
LSD	322 "	679*	"
Silo	4 "	227	"
Total		1,309	"

* including 160 thousand tons of leased storehouses.

Table 2-1 Storage Capacities by District (As of November, 1978)

(Unit: 1,000 tons)

Division	District	No. of LSD	Capa-cities	No. of LSD	Capa-cities	Total	No. of Silo	Capa-cities
Dacca	Dacca	3	69.3	21	35.7	105.0	1	50.5
	Mymensingh	1	22.0	27	71.3	93.3	-	-
	Tangail	-	-	6	12.7	12.7	-	-
	Faridpur	-	-	20	30.0	30.0	-	-
	Total	4	91.3	74	149.7	241.0	1	50.5
Chittagong	Chittagong	2	104.2	15	25.2	129.4	1	100.5
	Chittagong H. T.	-	-	12	8.8	8.8	-	-
	Noakhali	-	-	17	32.1	32.1	-	-
	Comilla	1	12.3	18	34.7	47.0	1	50.5
	Shylhet	-	-	25	64.9	64.9	-	-
	Total	3	116.5	87	165.7	282.2	2	151.0
Rajshahi	Rajshahi	-	-	23	49.2	49.2	-	-
	Dinajpur	-	-	20	59.7	59.7	-	-
	Rangpur	-	-	22	63.2	63.2	-	-
	Bogra	1	20.0	12	35.2	55.2	1	25.0
	Pabna	1	30.5	7	20.7	51.2	-	-
	Total	2	50.5	84	228.0	278.5	1	25.0
Khulna	Khulna	2	122.6	17	28.7	151.3		
	Barisal	1	22.5	18	32.4	54.9		
	Patuakhali	-	-	17	29.5	29.5		
	Jassore	-	-	16	24.4	24.4		
	Kushtia	-	-	9	20.8	20.8		
	Total	3	145.1	77	135.8	280.9		
Grand Total		12	403.4	322	679.2	1,082.6	4	226.5
Total Storage Capacity						1,309.1		

Figures are based on data from the Ministry of Food, Bangladesh. (LSD figures include leased storehouses.)

The capacity of each CSD is from 20 to 60 thousand tons, 33 thousand tons on the average and about 2 thousand tons in case of LSD. Also the capacity per storehouse is 500 tons in the Dacca type that is said to be the standard type. (15 storehouses of 1,000 tons each have been constructed by the Japanese Grant Aid with a total of 15,000 tons capacity.)

2-2-2 Capacities of Available for Use

The total capacity is officially said to be 1,309 thousand tons, but CSD and LSD (zinc roof storehouses were extremely deteriorated in appearance) about 300 thousand tons of this capacity seem to be deteriorated, and these are not used for the storage of food.

Therefore, the capacity of storehouses available for the storage of food is approximately estimated as follows:

1,300 - 300 = 1,000 (Unit: 1,000 tons)

$$1{,}000 = \begin{cases} \text{CSDs, LSDs} & \text{----------} \quad 770 \\ \text{Silos} & \text{----------} \quad 230 \end{cases}$$

(Remarks: As a result of the survey in the Khulna and Bogra areas, it has been learned that the actual capacities were about 70 percent of the officially announced capacities because of bad floor conditions, leaking and so on.)

2-3 Consideration on Capacity Distribution

The following three problems are introduced from the survey regarding the relationship between the storage capacity of existing storehouses and the estimated necessary storage capacity in Bangladesh.

i) There is a sharp distinction between supply districts and consumption districts of food and there is a disparity in their respective storage capacities.

ii) There is a seasonal imbalance in the supply of indigenous food.

iii) Rice mills are mostly concentrated into one particular area of the country in an unbalanced manner.

The results of the consideration of the relationship between the storage capacity of existing storehouses and the estimated necessary storage capacity are as follows:

(1) The food grain supply districts are concentrated in the north, while the consumption districts are concentrated in the south (Patuakhali in the south is an exception, being a food supply district). The existing storage capacity in 6 consumption districts (Dacca, Chittagong, Comilla, Pabna, Khulna and Barisal) accounts for 50 %

of the entire existing capacity, while that of 7 supply districts (Mymensingh, Sylhet, Rajshahi, Dinajpur, Rangphur, Bogra and Patuakhali) accounts for 38 % of the said capacity. However, as for the rate of estimated necessary capacity of food storage in each district of the country, the six consumption districts and the seven supply districts account for 37 % and 52 % respectively, showing that the necessary capacities and the existing capacities are in reverse. As mentioned above, there is a sharp distinction between supply districts and consumption districts, and the shortage of storage capacity in northern supply districts causes problems. (Refer to Table 2-2)

The ratio of existing capacity to necessary capacity in Rajshahi is 0.6, where the rate of food purchase quantity to production is high (8.3 % for 1977/78), 0.5 for Dinajpur (14.4 %), and 0.7 for Patuakhali (14.5 %), showing a remarkable shortage in storage capacity. Moreover, the storehouses in the supply districts are apt to be gathered in or near the central districts of rural areas, and this tendency is considerable in the Boro paddy and wheat producing districts where the possibility of increase in production is great in the future.

The shortage of storage capacity in the supply districts causes the following results:

(i) At times, it is impossible for the Government to carry out food purchases even when sufficient quantities exist.

(ii) Substandard storehouse facilities or the storage of food out in the open give rise to abnormal losses.

(2) Seasonal imbalance of supply accelerates the imbalance of storage capacity in the above mentioned supply districts and consumption districts. Because imported food and food from production areas gradually are sifted to and stowed in the storehouses in consumption areas, there is a balanced year round inflow and outflow of food from the storehouses. (Refer to Fig. 2-1.)

On the contrary, the procurement in the supply districts consists mainly of "Aman rice" and about 80 % of the purchase quantity is concentrated in the dry season, thereby causing the efficiency of storage capacity to decline and widen the disparity gap of capacity between consumption districts and supply districts.

(3) Rice mills in Bangladesh are located mostly in supply areas (about 40 % are located in Dinajpur alone), and therefore it is natural that the paddy be stored in producing areas until it is hulled, which aggravates the shortage situation in the supply areas. Further, the inefficiency of having to transport the paddy from supply areas to consuming areas temporarily for storage due to the storehouse shortage in the supply areas, and then back again to the supply areas for milling is placing a burden on the scanty rail transport capacity.

Thus, the state of storage capacity in Bangladesh is as such, as the main objectives of the Bangladesh Government policies regarding the construction and manegement of food grain storehouses have been aimed at distribution rather than the procurement.

This can be seen as one of the causes for the above mentioned imbalance in storehouse location, however, in recent years there has been a shift in policy toward increasing domestic production by placing greater importance on the procurement, and attention will be focused on this matter in the future.

Table 2-2 An Estimation of Necessary Capacity for Rationing by Districts

(Unit: 1,000 tons)

Division	District	Purchase of rice (Aman)	Ration 1977/78			Necessary capacities only wheat and rice		Existing capacities	Ratio of sufficiency
			Rice	Wheat	Total				
		A	B	C	D		E	F	F/E
Dacca	Dacca	1	226	320	546	D/4	137	105	0.8
	Mymensingh	69	29	58	87	A+C/4	84	93	1.1
	Tangail	1	8	26	34	D/4	9	13	1.4
	Faridpur	1	14	58	72	"	18	30	1.7
	Total	73	277	462	739			241	
Chitta-gong	Chittagong	25	72	138	210	A+C/4	53	129	2.4
	Chittagon H.T.	4	8	5	13	"	5	9	1.8
	Noakhali	23	9	45	54	"	34	32	0.9
	Comilla	18	21	85	106	"	39	47	1.2
	Sylhet	24	16	78	94	"	44	65	1.5
	Total	94	126	351	477			282	
Rajshahi	Rajshahi	63	32	48	70	A+C/4	75	49	0.7
	Dinajpur	88	15	19	34	"	93	60	0.6
	Rangpur	51	24	51	75	"	64	63	1.0
	Bogra	25	14	21	35	"	30	55	1.8
	Pabna	3	12	38	50	"	13	51	3.9
	Total	230	97	177	274			278	
Khulna	Khulna	15	59	76	135	A+C/4	34	151	4.4
	Barisal	29	13	51	64	"	42	55	1.3
	Patuakhali	56	5	19	24	"	61	30	0.5
	Jassore	4	12	47	59	D/4	15	24	1.6
	Kushtia	1	8	38	46	"	12	21	1.8
	Total	105	97	231	328			281	
Grand Total		501	597	1,221*	1,818*			1,082	

Remarks:
1. This estimation is done only for the capacity of rationing, volume of transit is not considered.
2. Purchase figures in this table are used as base for calculating the necessary capacities for Aman rice which is purchased in the greatest quantities.
3. The calculations for the necessary capacity are made based on 3 months reserve (C and D).
4. * Figures do not include wheat flour.

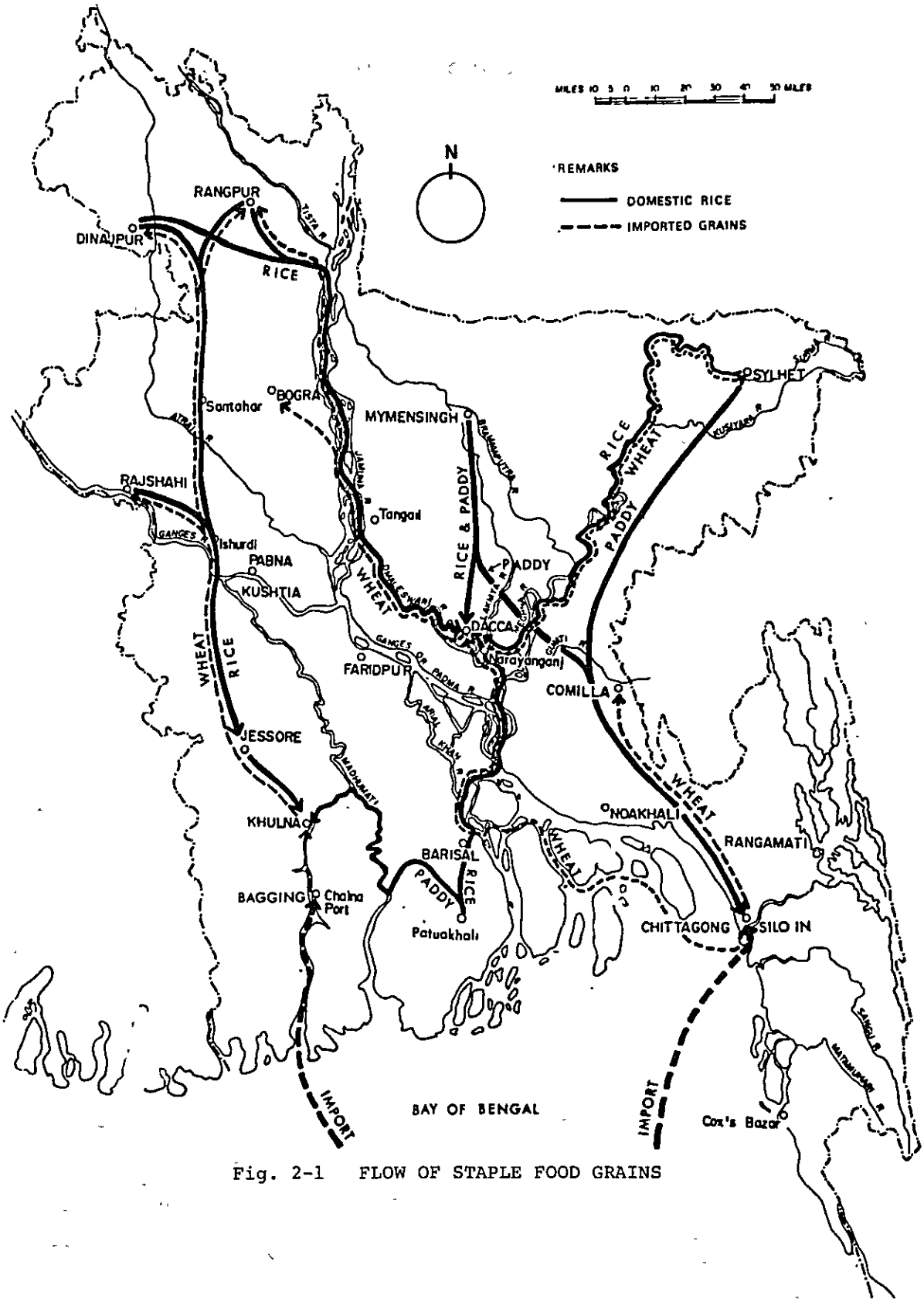


Fig. 2-1 FLOW OF STAPLE FOOD GRAINS

CHAPTER III : JUSTIFICATION AND THE EXPECTED IMPACT OF GRAIN STORAGE PROJECT IN BANGLADESH

3-1 Urgency of Attaining Self-sufficiency of Food

Much emphasis is placed on attaining the self-sufficiency in food grain supply in Bangladesh during the course of the First Five Year Plan, 1973-1978. As observed in the discription of demand-supply of major food grain in Bangladesh, the quantity of imported grain reaches to as much as ten to twenty percent of national consumption. Several years ago the monetary value of imported food grain amounted nearly half of the total import of the nation (1973/74), but thanks to the increased weight of donation in the imported grain, recently the proportion reduced considerably (Table 3-1). However, as the quantitative proportion of the importation remains over 10 percent (Table 3-2), the situation is still grave and the urgent rectification is required because it is impossible to expect such donation permanently.

Table 3-1 Monetary Proportion of the Imported Food Grain to the Total Import

Year	Total Import (A)	Imported Food Grain (B)	B/A
1973/74	7,320 million Taka	3,379 million Taka	0.46
1974/75	10,842	4,781	0.44
1975/76	14,703	4,281	0.29
1976/77	13,993	1,683	0.12

(Source: The Ministry of Planning)

Table 3-2 The Proportion of Imported Food Grain to the Total Food Grain Supply

Year	Import (A)	Domestic Supply (B)	Total Supply (A+B)	$\frac{A}{(A+B)}$
1974/75	2,468 thousand ton	10,101 thousand ton	12,569 thousand ton	0.24
1975/76	1,436	11,498	12,934	0.11
1976/77	795	10,503	11,298	0.07
1977/78	1,625	11,541	13,166	0.14

(Source: The Ministry of Planning)

3-2 Price Support for the Production Increase of Food Grain

In order to increase the domestic production of food grain, either the increase of planted area or increased yield per unit areas is required. To increase the planted area in Bangladesh, it is most effective to widen the irrigated area so as to enable multi-cropping. For the increased yield per unit area, such measures would be useful as supplementary irrigation, supply of HYV seeds, fertilizer, chemicals, etc., extension activities of farming technology, and so forth. Each and all of these measures have already been practiced by the Government of Bangladesh.

However, in order to make these measures most functional, farmers must be well off economically and mentally up to the extent that they can adopt them and must be able to enjoy those benefits derived from them, by using the proper assistance such as financing institution, cooperative activities, farm products price support system, rationalized marketing mechanism, etc. among which price support system plays most important role. This has been proved through the experiences in various countries. Where there is an effective price support system, farmers can be active to put their efforts to the increase of production and be eager to adopt various effective measures for the purpose.

The Government of Bangladesh has been practicing the purchase of rice and wheat as mentioned. The main objectives were to ration food to consuming areas initially, but it has gradually changed into price support to the farmers. In order to make procurement, about 230 temporary purchase centres (TPC) have been set up other than 300 CSDs and LSDs.

However, it seems the function and impact of the government procurement are very limited on account of the following factors:

(i) Shortage of number and capacity of storages in major growing areas where the purchase takes place chiefly,

(ii) Inordinate inconvenience of traffic and transportation for carrying in and out paddy to and from the purchasing points,

(iii) Very low efficiency of inspection and purchase procedures,

(iv) Delay of timing of purchase (Many of farmers have sold their paddy to the free market by that time),

(v) Unsuitable location of storages and personnel due to the

previous operation method of storages aimed at rationing, and

(vi) Limited purchase of Aus and Boro rice on account of absence of mechanical dryers.

3-3 Improvement of Food Grain Marketing

The food grain storage project by World Bank which is currently underway, covers major rice growing areas (six districts, i.e. Sylhet, Mymensingh, Rajshahi, Dinajpur, Rangpur and Bogra) and is expected to contribute to ease these problems.

Concerning improvement of food marketing, not only additional construction and repairment of storages, but also various other proposals shall be included, such as to improve the present subjective and inefficient inspection procedure on purchase so as to shorten the waiting time of sellers, to quicken the payment, to organize a training program of officials concerned, to increase the number of the authorized grain dealers (AGD) so that the supported price can better be reflected at the farmgate price, etc. Indeed, it is commonly seen that mere materialistic input does not improve the situation as in many cases, the most basic problem to be solved is a consolidation of organizational behavior of human.

It is also worthwhile to note that the introduction of paddy dryer is conceived to facilitate purchase of Boro rice. It is very discouraging for farmers that Boro rice is not extensively purchased by the Government in spite that recent increase of rice production much owes to the increased production of Boro crop whose yield is almost double of Aus and Aman (Table 3-3). This also negates efficient purchasing operation and better utilization of storage.

Table 3-3 Production and Yield of Various Rice Crops

Year	Production (milled rice, million ton)				Yield (Maund per acre)			
	Aus	Aman	Boro	Total	Aus	Aman	Boro	Average
1965/66	2.92	6.80	0.62	10.33	10.8	12.6	14.8	12.1
1966/67	2.67	5.92	0.83	9.42	10.4	11.5	16.2	11.4
1967/68	3.07	6.81	1.11	10.99	10.2	12.6	19.7	12.2
1968/69	2.68	6.87	1.61	11.16	9.5	13.0	21.8	12.6
1969/70	2.96	6.95	1.90	11.81	9.5	12.7	23.7	12.6
1970/71	2.86	5.91	2.19	10.96	9.9	11.3	24.6	12.2
1971/72	2.34	5.70	1.74	9.78	8.6	11.9	22.6	11.6
1972/73	2.27	5.59	2.07	9.93	8.5	10.8	23.2	11.4
1973/74	2.80	6.70	2.20	11.70	9.9	12.9	23.3	13.1
1974/75	2.86	6.00	2.25	11.11	9.9	12.1	21.3	12.5
1975/76	3.23	7.05	2.29	12.56	10.4	13.5	21.9	13.5

(Source: the Ministry of Agriculture)

Supply of food grain can be increased through the increased production on one hand, as referred above, and through the reduced post-production loss and optimized marketing process on the other hand.

In the field of the latter, there are two subjects. One being on food grain to be consumed by farmers, the other on that which flows into marketing channels. As seventy to eithty percent of food grain produced in Bangladesh is consumed by farmers, it is of great importance to improve the post-harvest processing and storage of farm-consumed grain. Storage and processing condition of farm-consumed grain is not known in detail. However, farm storage facilities and the storage technology are regarded to be very low. Parboiling and rice milling process are also regarded to be very primitive and wasteful in both cases of custom processing and home processing.

Reduction of storage loss and processing loss of farm-consumed foodgrain will increase the marketable surplus and will contribute to improve the farm economy. It will, of course, result in the increased flow of grain to the marketing channels in nation-wide scale.

United Nations Development Programme (UNDP) is currently undertaking a project to improve farm grain storage. When it is properly combined with farm financing institutions, it is expected to contribute

to the improvement of farm economy to a great extent as it will reduce the famers' such need as to sell paddy right after or even before the harvest and to buy back required grain afterwards again at a much higher price.

In order to attain such target, however, much technical cooperation on the spot would be required rather than any input of commodities. Such work may not look very bright and spectacular but will culture the most fundamental conditions of rural development ultimately since it requires alteration of behavioral pattern of many farmers.

3-4 Storages for Marketed Grain and the Stabilization of the Price

It goes without saying that marketed grain also needs to reduce its losses by the use of improved storages and processing technology. However, under poor traffic and transportation conditions prevailing in Bangladesh, the necessity to have sufficient stock of food grain for the purposes of emergency and price stabilization, located near by large consuming areas, is more accute from the point of view of assuring effective and righteous distribution.

Agriculture in the country is prone to flood damage, and non-urban areas are also liable to be consuming areas in such emergencies when the traffic is almost sure to be completely jeopardized. It follows that those emergency stocks need to be extensively located in sufficient number.

Famine on disasterous situations more often appears as unavailability of food grain to low income people on account of the famine price caused by localized distribution of food grain which is the result of the failure of transportation, rather than overall shortage of total quantity of food grain in the country. Even if the total quantity is short, if it is evenly distributed, no starved people will exist in almost all the cases. In this sence, famine is mostly a kind of social phenomenon rather than innevitable consequences of natural disaster.

Under such situation, it is not rare cases that a huge quantity of food grain is spoiled and wasted as a consequence of unordinary handling and piling with the intention of speculation, boarding and even with the emergency measures by the government. The only possible ways to avoid these are to make sure of reliable emergency transportation media or to

have emergency stock in sufficient number and quantity.

When it is foreseen that short supply will last, increased supply from outside sometimes does not increase the supply at the end of the retailer shops, but it is liable to be absorbed on each stage of private marketing routes. This phenomenon will worsen the tragic situation. When the supply-demand condition is slackened, all of the boardings will be discharged all at once thus lowering the price extravagantly to the extent of killing all the incentives for the production.

Even under normal condition, always there exists price fluctuation seasonally and regionally. It provokes speculation on a minor scale all the time. When this is limited to the minimum, not only the social welfare is realized but reduction of grain loss attained. Presently, about 80 % of marketed grain supplied domestically is in the hands of private sector, the rest being by the government. Counting imported grain, about half of the marketed grain is under the government. But almost all of the imported grain is wheat and it does not contribute to increase the proportion of the government-controlled rice. However, 20 % is the sufficient proportion to make it functional to stabilize the price, if it is employed effectively. Grain storages this time contributed from Japan are expected to be utilized for such purposes.

3-5 Role of the Project

The Project which aims to expand the food storage capacity in the course of function; food self-sufficiency - increasing agricultural production - price stability - efficiency in food management - improvement of food marketing infrastructure; could contribute to modelate the constrains of the Government procurement volume in the supply area and food reserve in the consuming area. In other words, not only does the project expand the storage capacity, but also the project contributes to the extent of welfare stability and agricultural development by realizing the stability of prices in the consumption goods through the Government rationing and increase of agricultural production through price support of farm products by increased procurement.

For more effective use of the Project storehouses, related operations in food management such as the preparation of national food

marketing infrastructure improvement plan, improvement of food grain inspection and quality control techniques, introduction of necessary facilities for technical improvement, development and extension of food grain transportation means, processing and storage machinery are hopefully implemented along with the Project.

CHAPTER IV : SELECTION OF THE PROJECT AREAS

4-1 General

One of the major objectives of the subject survey is to select the districts in which storehouses are to be constructed. The basic approach of selection is such that construction districts are determined through field survey out of the districts proposed by the Government of Bangladesh with demand and supply conditions of staple-food and conditions of construction taken into consideration, and also to determine the capacity of storehouses in each selected district.

On acceptance of the request with respect to the proposed sites of construction, (1) construction site should have been already secured, (2) construction districts should not be scattered to a large number of areas, and (3) total capacity of the project storehouses should be 30,000 tons at maximum were established as the conditions.

The proposed sites for construction of storehouses requested by the Government of Bangladesh are as follows:

1)	Bogra District	Santahar CSD
2)	Dacca District	Narayanganj CSD
3)	Khulna District	Boyra CSD
4)	Khulna District	Maheswarpasha CSD
5)	Chittagong District	Halishahar CSD
6)	Chittagong District	Dewanhat CSD
7)	Comilla District	Chandpur CSD

As for investigating the situation of each one of the proposed sites, the survey team carried out field surveys and collection of relevant data. First of all, the areas to be investigated were classified into four areas, that is, (1) Bogra area, (2) Dacca area, (3) Khulna area, and (4) Chittagong area. Although the Khulna area and the Chittagong area include two CSDs respectively, it was considered as two CSDs belonging to the same area respectively. The Chandpur CSD in the Comilla District was excluded from the objects of investigation of this time because of the limited construction space in said CSD even though the effect of additional construction would be considerable.

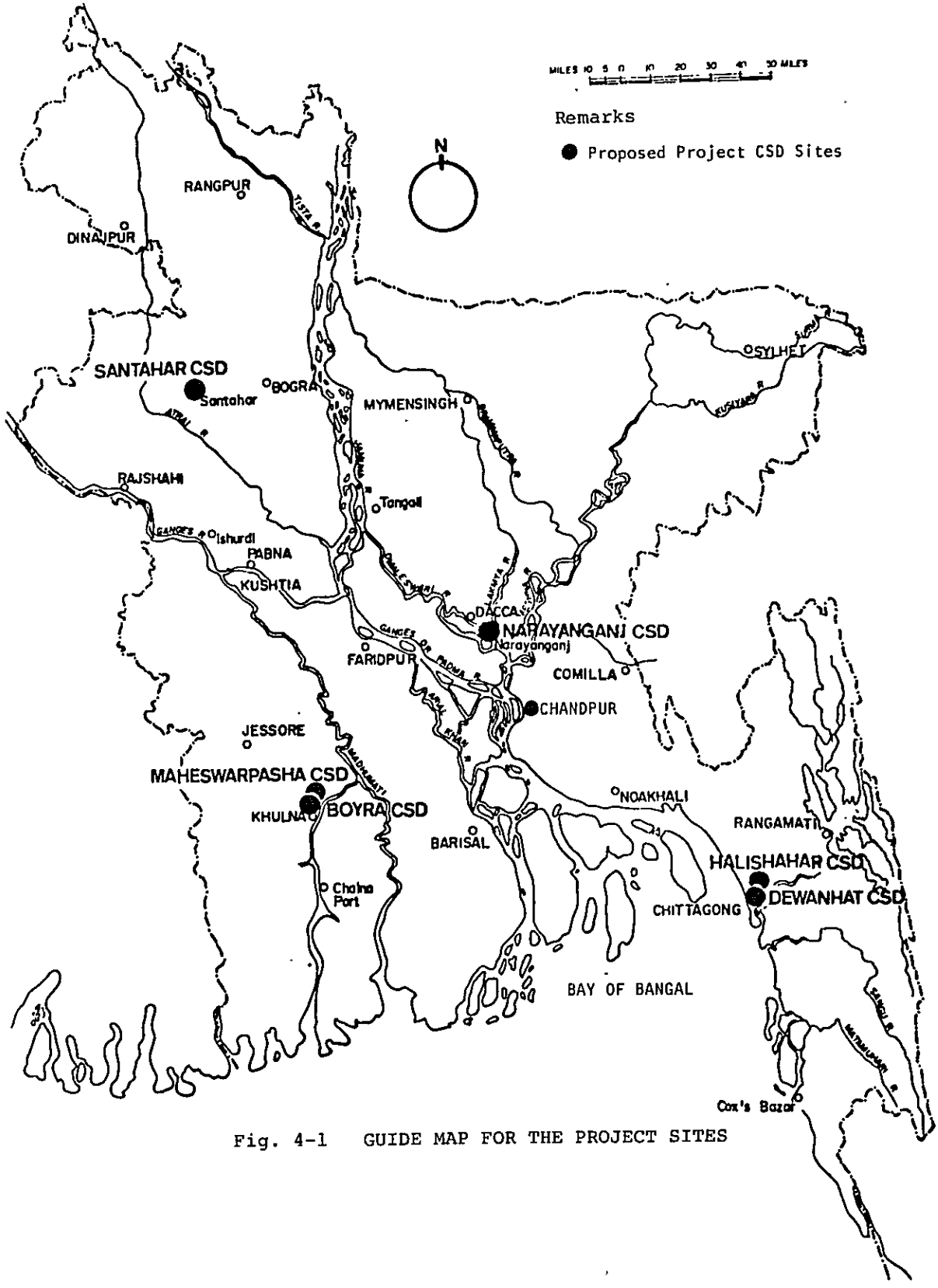


Fig. 4-1 GUIDE MAP FOR THE PROJECT SITES

As for the conditions for judgement in each area, necessary information was collected with emphasis laid on the major grain production and consumption, the transportation capacity, the storage capacity and the situation of storage management as for conditions of demand and supply of staple-food, the situation of construction sites, and the availability of construction machinery and materials and the transportation capacity for the materials as for conditions of construction.

4-2 Conditions of Each Area

4-2-1 Santahar CSD, Bogra District

(1) General

Santahar is located almost at the center of northwestern region of Bangladesh and has a population of about 13,000. Bogra which has a population of about 50,000, is located in the distance of about 40 km to the east side of Santahar. This region is very hot in summer, and less rainfall. Santahar stands on a major position in railroad transportation. It is not only a transfer station between broad gauge railway and meter gauge railway, but it plays a role as the contact point of the pipe connecting the western region and the eastern region of this country through railroads.

The broad gauge railway which runs across the western region goes up north to Chilhati starting from Khulna, and further to the territory of India and to the border of Nepal. On the other hand, meter gauge railway is laid in capital city, Dacca, and in towns Chittagong and Mymensingh as well as in the eastern districts. As the pipeline which connects these different railways, the meter gauge railway starting from Santahar leads to the railroad network in the eastern region through the wagon ferry.

(2) Situation

Thirty-two storehouses, office buildings and staff quarter are located on the site of about 40 acres as shown in Appendix-IV, Fig. IV4-1. The space for construction of new storehouses is currently used as paddy field, and there are no obstacles in particular. This site was selected as the site for construction of new storehouses based on the

condition that the ground will not be flooded if minor banking is made to the level of the roads in the site.

(3) Geology

The ground of this area is made of silt layer, and it seems that the sand layer is not in presence. The test pits were mainly in paddy fields. Penetration depth was 110 ∿ 190 cm, and the depth of distribution of bearing layer is considered as around 2.0 ∿ 3.0 m. q_u-value showed 1.69 ∿ 2.19 kg/cm^2. The soil characteristics of the silt layer accumulated on the bearing layer are unknown, and therefore, it is necessary to carry out consolidation test and other necessary tests before commencement. The ground water level was obserbed at plot No.2 and No. 3 only. It is informed that the site is not flooded in the rainy season. (Refer to Appendix-III, Fig. III-1.)

(4) Materials

With respect to availability of local materials, almost nothing is available except for hand-made bricks. Therefore, the methods and places of procurement of the major materials are as follows.

Cement, steel, steel fittings, paint	Import
Aggregate (sand, gravel)	Domar area
Soil for banking and back filling	Jamuna River Coast
Bricks (machine-made)	Dacca area
Bricks (hand-made)	Local

(5) Labor Force

The labor force can be supplied from Bogra and Rajshahi areas.

(6) Transportation

Refer to Appendix-IV, Fig. IV4-2 attached hereto for the means and routes of transportation.

4-2-2 Narayanganj CSD, Dacca District

(1) General

Narayanganj is about 20 km in the south east of the capital city of Dacca, and its population is about 270,000. The climate in summer is

moderate compared to other areas, and rainfall is also medium. Narayanganj is located at the southmost end of the central plateau, and its elevation is lower than that of Dacca to a considerable extent. As for transportation, the road network and railroad are extended from Dacca. Narayanganj also plays the role as the unloading port for Dacca for the goods brought by ship and as an important place for transportation by waterway.

(2) Situation

Thirty-five storehouses, office buildings, and staff quarter are located on the site of about 12 acres as shown in Appendix-IV, Fig.IV4-3. In the space for construction of new storehouses, it is necessary to remove a small brick-made building and bricks. This site was selected for construction of new storehouses based on the condition that banking is not required and that flooding will not occur in the rainy season.

(3) Geology

The subject site can be geologically classified into slightly high ground on the existing storehouse side, and low ground on the river side which floods in the rainy season. The difference in height between both grounds is around 2.5 ∿ 3.0 m, that is equivalent to the river terrace which is not formed by embanking. According to the results obtained at plots No. 1 through No. 3, the ground of existing storehouses is composed of sandy silt layer, and thus it was found that the geological condition was good. The low ground section of the test pits is mainly composed of silt layer, penetration depth is 65 ∿ 145 cm, and the depth of distribution of bearing layer is considered to be around 1.5 m. q_u-value showed 1.57 ∿ 1.82 kg/cm^2. Therefore, except for the situation where banking is required, it is hardly said that geological condition is particularly inferior. Ground water is not present within the penetration depth, and flooding occurs up to the level of 60 cm below the road surface in the rainy season. (Refer to Appendix-III, Fig.III-2.)

(4) Materials

The methods and places of procurement of materials are as follows.

The methods and places of procurement of materials are as follows.

Cement, steel, steel fittings, paint	Import
Aggregate (sand, gravel)	Sylhet
Soil for banking and back filling	Local
Bricks (machine-made)	Dacca area
Bricks (hand-made)	Local

(5) Labor Force

The labor force can be supplied from Dacca.

(6) Transportation

Refer to Appendix-IV, Fig.IV4-4 attached hereto for the means and routes of transportation.

4-2-3 Boyra CSD and Maheswarpasha CSD, Khulna District

(1) General

Khulna is located at the center of southwestern section of this country. It is the third largest town in Bangladesh with a population of about 440,000. The mean atmospheric temperature is higher than the national average, and rainfall is relatively low. With respect to transportation, Khulna is the starting point of the broad gauge railway that runs across the west region of this country, and Chalna Port, which is an international trading port, is located nearby. Thus, Khulna is located in an important position. Transportation to the eastern direction is not convenient because roads are disconnected by Jamuna River, etc., and ferries are commonly used for connecting river sides. An air route is available between Dacca and Jessore.

(2) Situation

Boyra CSD: Eighty-seven storehouses, office buildings, and staff quarter are located on the site of about 65 acres as shown in Appendix -IV, Fig.IV4-5. In the space for construction of new storehouses, the majority of unoccupied ground is low land, and the grounds for construction of new storehouses were selected out of the places where the extent of banking required was relatively minor, but old storehouses may be razed.

Maheswarpasha CSD: Fifty-five storehouses in total including eleven storehouses built under Japanese Grant of 1977, office buildings and staff quarter are located on the site of about 45 acres as shown in Appendix-IV, Fig.IV4-6. The space for construction of new storehouses was determined out of the grounds where banking is not required and no obstructs are existing, and which are closest to the jetty.

(3) Geology

Boyra CSD: A large part of this site is occupied by tanks, and tank side of the site is composed of silt layer and the elevated side is composed of silty fine sand layer. Penetration depth is 105 ∿ 195 cm, and the depth of distribution of bearing layer is considered to be around 2.5 m, but the thickness of the soft layer at the center of the tank which contains water all the year round is questionable. q_u-value is 1.69 ∿ 1.98 kg/cm^2. The ground water level is affected by the water level in the tank. Flooding occurs at the level of 30 cm below the road surface in the rainy season. (Refer to Appendix-III, Fig. III-3.)

Maheswarpasha CSD: This site is mainly composed of silt layer. Penetration depth is 110 ∿ 295 cm, and the depth of distribution of bearing layer is considered to be around 2.0 ∿ 3.0 m. Penetration at plots No. 2 and No. 6 are slightly deep, that is, 295 cm, 240 cm respectively. Because the soil characteristics of this silt layer are unknown, it appears to be necessary to carry out consolidation test and other tests when considering the fact that newly constructed storehouses are planned on the adjacent grounds. q_u-value is 1.24 ∿ 1.82 kg/cm^2. Ground water level could not be observed at plot No. 5 and No. 6 on the river side. It is known that flooding will not occur in the rainy season. (Refer to Appendix-III, Fig.III-4.)

(4) Materials

The methods and places of procurement of materials are as follows:

Cement, steel, steel fittings, paint	Import
Aggregate (sand, gravel)	Sylhet
Soil for banking and back filling	Magra
Bricks (machine-made)	Dacca
Bricks (hand-made)	"

(5) Labor Force

Skilled labor force can be supplied from Dacca and other labor force is available locally.

(6) Transportation

See Appendix-IV, Fig.IV4-7 attached hereto for the means and routes of transportation.

4-2-4 Halishahar CSD and Dewanhat CSD, Chittagong District

(1) General

Chittagong is the second largest city, next to the capital city of Dacca, with a population of about 890,000. The heart of the city is located on level grounds, and this city is well consolidated in comparison with other local cities, except for Dacca. Mean atmospheric temperature is higher than the national average, but difference in the atmospheric temperature throughout the year is the lowest in the country. Rainfall is of very high level and is particularly high during the rainy season. Chittagong Port is the largest international trading port in Bangladesh, and the majority of imported goods are unloaded at this port. As for the railroad transportation, Chittagong is the starting point at southern end of meter gauge railway in the eastern region, and it can be said to be an important place also because Chittagong is a distributing center of imported goods. Land routes crossing rivers by ferries are actively used for traffic to and from Dacca. As for water routes, the use of small size ships is not very popular because passage to the ocean is involved.

(2) Situation

Halishahar CSD: Fifty-nine storehouses including two storehouses built under Japanese Grant of 1977, office buildings and staff quarter are located on the site of about 50 acres as shown in Appendix-IV, Fig.IV4-8. The space for construction of new storehouses was selected in a place that does not require banking, but removal of obstacles, that is, bricks and empty drum cans, is necessary.

Dewanhat CSD: Forty-eight storehouses including two storehouses built under Japanese Grant of 1977, office buildings and staff

quarter are located on the site of about 20 acres as shown in Appendix-IV, Fig.IV4-9. The space for construction of new storehouses was determined in a space that does not require banking, but removal of obstacles, that is, empty drum cans, is necessary.

(3) Geology

Halishahar CSD: This site is composed of silt and fine sand layer. Penetration depth is 5 ∿ 35 cm except for the excavated length of test pit, and geological condition appears to be good. Penetration at plots No. 9 through No. 14 by the tank is 20 ∿ 60 cm, and it appears that there are no problems in particular. The depth of distribution of the bearing layer is considered to be around 1.0 ∿ 1.5 m. q_u-value is 1.20 ∿ 1.98 kg/cm^2. The ground water level could not be checked except for the test pits by the tank. It is known that flooding occurs up to the level of 75 cm below the floors of existing storehouses. (Refer to Appendix-III, Fig.III-5.)

Dewanhat CSD: This site is mainly composed of sandy silt layer, and development of soft layer was not observed even in the low paddy field section. Penetration depth is 55 ∿ 95 cm and the depth of distribution of the bearing layer is considered to be around 1.0 ∿ 1.5 m. q_u-value is 1.20 ∿ 1.74 kg/cm^2. The ground water level is 1.0 m or less from the ground surface. It is known that flooding will not occur in the rainy season. (Refer to Appendix-III, Fig.III-6.)

(4) Materials

The methods and places of procurement of materials are as follows.

Cement, steel, steel fittings, paint	Import
Aggregate (sand, gravel)	Sylhet
Soil for banking and back filling	Local
Bricks (machine-made)	Dacca
Bricks (hand-made)	Local

(5) Labor Force

The labor force can be supplied from Chittagong.

(6) Transportation

Refer to Appendix-IV, Fig.IV4-10 for the means and routes of transportation.

4-3 Selection of the Construction Sites

The Survey Team confirmed, as a result of field surveys, that the sites requested by the Government of Bangladesh are the areas where the needs for increase of storage capacity are high, and it was determined to fix the order of priority depending on the conditions of the surveyed sites and to make allocation of the capacity of each construction site out of the 30,000 ton capacity.

For selection of construction sites and for fixing the order of priority, the effects of the increase of storehouses was naturally taken into account. When the current situation of demand-supply of staple-food in Bangladesh is taken into consideration, the fact that considerable shortage of the capacity of storehouses in the rice production and supply zones in the northern region and northwestern region of the country, as compared to that in the consumption areas in general, is a large constraint that restricts the volume of procurement for the government rationed rice.

The frequency of use of storehouses in large consumption areas is extremely high, particularly in Dacca, and deterioration of existing storehouses is conspicuous. Because of absolute shortage of the capacity of food storage and continued concentration of population to large cities, it is apprehensive for that the situation of rationing of staple-food in large cities will become worse in the future.

With respect to the imported food grain storage at international ports, even though there is no problem in the quantity at Chittagong, the largest port, it is not sufficient in the Khulna area. Although construction of storehouses is urged at Chalna Port in a long run, the expansion of the system for acceptance of imported food grain which are brought in by a large quantity at a time, should be made urgently because imported food grain storage would be continued at the CSDs in Khulna as of the current situation.

Under the circumstances stated above, it was decided to take the following matters into account as the criteria for judgement of the construction sites from the standpoint of demand-supply of staple-food.

1) Key areas in rice producing and supply zones
2) Increase of capacities in large consumption areas
3) Consolidation of acceptance capacity at international ports

With respect to the conditions of construction, it was decided to put emphasis on the following items as the criteria for judgement from the standpoints of minimizing construction costs and shortening of construction period in particular.

1) The number of storehouses which can be built in one area
2) The situation of the construction site
3) The availability and unit prices of construction materials and labor force
4) The availability of transportation

The Survey Team made examination of the conditions of food grain marketing, conditions of construction described above with each one of the site, and also had discussions with officials of the Ministry of Food of Bangladesh.

The Ministry of Food established the order of priority of areas as follows:

1. Bogra area
2. Dacca area
3. Khulna area
4. Chittagong area

However, the Survey Team established the order of priority from the standpoint of food marketing as follows:

1. Bogra area
2. Dacca area
3. Chittagong area
4. Khulna area

Further, the survey team established the order of priority from the standpoint of construction as follows:

1. Santahar CSD (Bogra)
2. Halishahar CSD (Chittagong)
3. Maheswarpasha CSD (Khulna)
4. Dewanhat CSD (Chittagong)
5. Narayanganj CSD (Dacca)
6. Boyra CSD (Khulna)

Based on the integral judgement of the above, the Survey Team determined allocation of the number of storehouses to be constructed at each site as shown in the following table.

Table 4-1 Judgement of Proposed Sites

Construction Sites	Condition of Staple-food Marketing	Condition of Construction	Number* to be Constructed
Santahar CSD (Bogra)	Supply area, base of transportation	Large space available, good site	10
Narayanganj CSD (Dacca)	Large consumption area	Small space, with obstacles	2
Boyra CSD (Khulna)	Import storage and consumption area	Small space, inferior site	13**
Maheswarpasha CSD (Khulna)	Import storage and consumption area	Large space available, good site	0
Halishahar CSD (Chittagong)	Consumption and import storage area	Large space abailable, with obstacles	5
Dewanhat CSD (Chittagong)	Consumption and import storage area	Large space availabe, with obstacles	0
		Total	30

* Capacity of a storehouse is assumed as 1,000 tons.
** By the request of the Bangladesh Government on the condition of withdrawal of dilapidated storage.

Justification:

The Santahar CSD in the Bogra District is located at the center of the northwestern district, is the main production center of rice in this country, and a majority of rice for large consumption areas is shipped from this area. However, the capacity of storehouses in the supply zone is small. In addition, Santahar CSD can be said to be an important key point from the standpoint of transportation strategy because it is the point of contact between the broad gauge railroad which covers the entire western region of this country and India and the meter gauge railroad which provide a network in the eastern region. From the standpoint of conditions of construction, there is sufficient space which enables construction of storehouses without obstacles, and construction can be commenced after doing some banking of only minor extent. With respect to procurement of

construction materials and a labor force, even though some of the major materials should be dependent on import, there will be no difficulty which requires special remarks. This condition is identical with other areas. Due to the reasons stated above, it is suggested to construct ten (10) storehouses out of the total of thirty (30) storehouses assuming 1,000 tons each.

Narayanganj CSD in the Dacca area is located behind the capital city of Dacca, which is a large consumption center, and plays an important role in supplying staple food for a population of two million. The Dacca area has a large necessity of increase of storehouses because deterioration of the existing storehouses is excessive and the frequency of use of storehouses is very high. However, because possible sites of construction are limited, only a site for two storehouses was found in Narayanganj CSD. As for conditions of construction, it is necessary to withdraw an old brick structure existing on the site.

Khulna area includes the Chalna Port which is one of the two international ports of this country. Because the Chalna Port does not provide a sufficient function as a port today, imported food grain is brought to the CSDs in Khulna by barges. Therefore, the Khulna area is playing an important role in the storage of imported food grain. Because eleven (11) storehouses have already been constructed by the last grant aid from Japan in the Maheswarpasha CSD, the necessity is rather lager for the Boyra CSD. However, site situation is poor in the Boyra CSD and space for construction is extremely limited. By the request of the Bangladesh Government, it is proposed to construct thirteen (13) storehouses in the Boyra CSD and none in the Maheswarpasha CSD in the Khulna District, on the condition that the Government of Bangladesh disbands necessary number of old storehouses. As for the effect of the Project, it has to be noted that the construction of new storehouses by withdrawing old ones will reduce its expansion effect because the capacity of withdrawal offsets that of new construction at certain rate. In addition, it will also reduce investment effect because of the cost of withdrawal. Nevertheless, the withdrawal of dilapidated storages for the Project is taken into consideration, partly because of the request by the Government and partly because of the judgement that dilapidated storages shall be renewed sooner or later.

Chittagong is a large city that is next to Dacca, and it is also the largest international port in the country. Even though a 100,000 ton silo has already been constructed for storage of imported food grain, it may be necessary to construct five (5) storehouses in the Halishahar CSD and none in the Dewanhat CSD for the reserves of staple food. As for conditions of construction, sufficient space is available. However, since empty drum cans are piled on the grounds, withdrawal of these drums is necessary prior to commencement of construction works.

CHAPTER V : THE PLAN

5-1 General

5-1-1 General Situation

Many buildings in Bangladesh which have walls, floors and roofs are constructed by using materials that provide good heat insulation, such as bricks and plaster, and windows provide good ventilation although they are of rather samll sizes. Such style of construction of buildings is because of the fact that, although atmospheric temperature is high, humidity is relatively low except for the rainy season, and it easly withstands the heat, as long as strong direct sunlight is avoided.

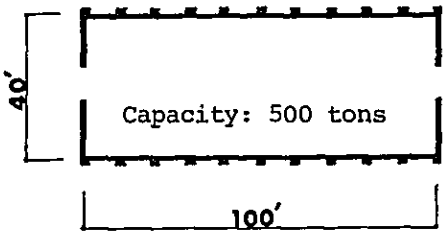
As for construction of buildings in this country, construction materials of a considerable extent are covered by those produced in the country. However, the majority of equipment is dependent on imports. The speed of progress of the construction works is slow except in special cases, and therefore, it is probably necessary to allow a longer term in regards to construction work. As a result of observation of actual work in the country, it can be judged that construction work and the quality of a certain extent can be expected as long as a sufficient term is allowed, and suitable supervision is provided.

Labor is in abundance in Bangladesh, and there is no problem as for the local construction methods. For the construction methods which are not currently used in Bangladesh, however, guidance and instructions at site are required with specialists dispatched to the site.

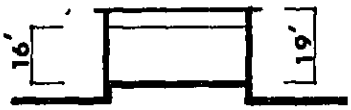
Various types of storehouses can be observed with respect to the size and structure, ranging from considerably old ones through recent ones. The major ones are described below.

1) Dacca type

This is the newest type among CSDs, and it is almost the standard type today. Ventilation efficiency, etc. are the best of all.



PLAN

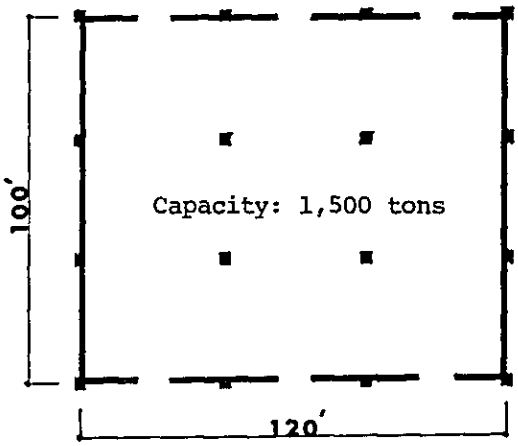


SECTION

Structure: Reinforced concrete with brick walls and with a concrete floor.

2) Shell type

This type is provided in various sizes.

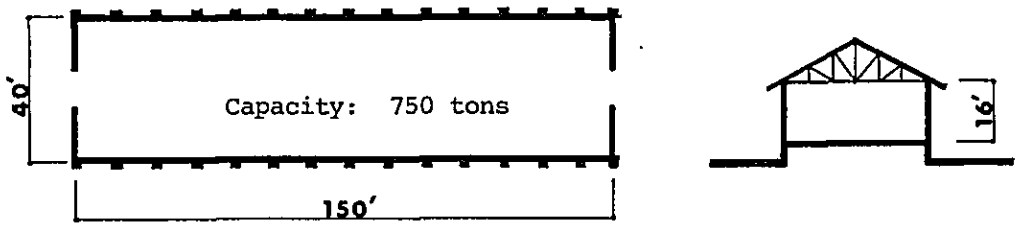


PLAN

SECTION

Structure: Reinforced concrete with a roof of shell structure with brick walls and with a concrete floor.

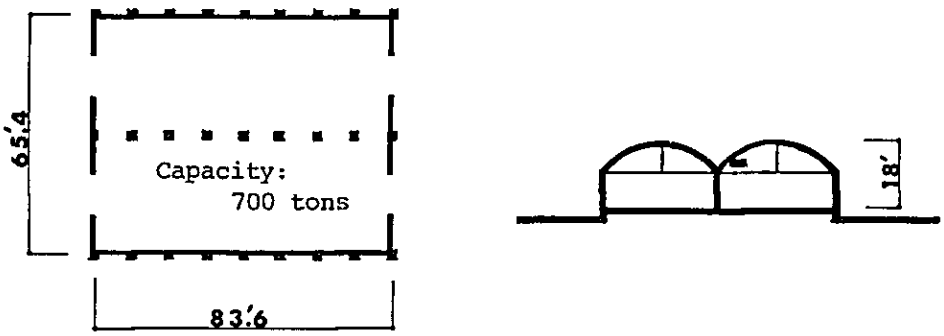
3) Calcutta type



PLAN SECTION

Structure: Brick walls, steel truss covered with corrugated galvanized sheet iron roof, concrete floor.

4) Pakistan type (Twin-Nissen type)



PLAN SECTION

Structure: Both external walls and the roof are covered with corrugated galvanized sheet iron, chord beam, post structural steel

Typical storehouses of four representative types are indicated above. But the principle floor area is considered to be 40 ft x 100 ft (capacity: 500 tons).

5-1-2 Structure

As for the structure of permanent buildings in Bangladesh, brick structures are common for the buildings which have small number of stories, and reinforced concrete rigid-frame structure with bricks is used for the buildings of slightly large scale and up. Also buildings of special structures can be found on occasion.

No fixed standards for structural design have yet been provided in Bangladesh, and therefore, the entire design and construction are up to the judgement of the designers. With respect to the load conditions, although consideration against wind is made, little consideration is made against earthquakes. Establishment of conditions regarding these factors, therefore, are left to the judgement of the designers.

Because the subsoil in almost the entire country provides weak bearing capacity of soil, pile work is made for the foundation of buildings of slightly large scale and up, but as a customary standard in this country, no piles are used for the buildings of four stories or less.

A long period of time should be allowed for reinforced concrete works due to extreme shortage of forms combined with a little capacity of concrete mixers. However, it can be expected to obtain concrete of relatively good quality.

5-1-3 Facilities

The facilities of high degree for buildings are not provided in Bangladesh. A number of hotels, etc. in Dacca and Chittagong are exceptionally equipped with air conditioning facilities. However, the others use natural conditions such as heat insulation and ventilation together with ceiling fans or desk top fans.

An outline of the facilities regarding storehouses is described below.

(1) Plumbing facilities

- Water works and sewerage : Not provided for CSDs.
- City gas : Not provided for CSDs.

. Equipment and materials	:	Little equipment is produced in the country, and the majority of them are imported and expensive.
. Standards and codes for design and execution of works	:	not specified

(2) Electrical facilities

. Transmission of power	:	Three-phase three-wire system, 11 KV, 50 Hz
. General use	:	Three-phase three-wire system, 240 V, 50 Hz
. Electrical equipment and materials	:	Little equipment is produced in the country, and majority of them are imported and expensive.
. Standards and codes	:	No standards or codes have been specified in the country.

5-1-4 Laws and Regulations Related to Buildings

Laws and regulations have not been established in particular. Therefore, a design matched with local condition should properly be considered, based on laws and regulations of Japan.

5-2 Basic Design

5-2-1 Principles of General Plan

Consideration was put on the following matters in particular on planning of the Project storehouses:

a) To apply the principle characteristics of the storehouses by the previous Japanese Grant completed in 1978.

b) To adopt fully the characteristics of the current storehouses in Bangladesh.

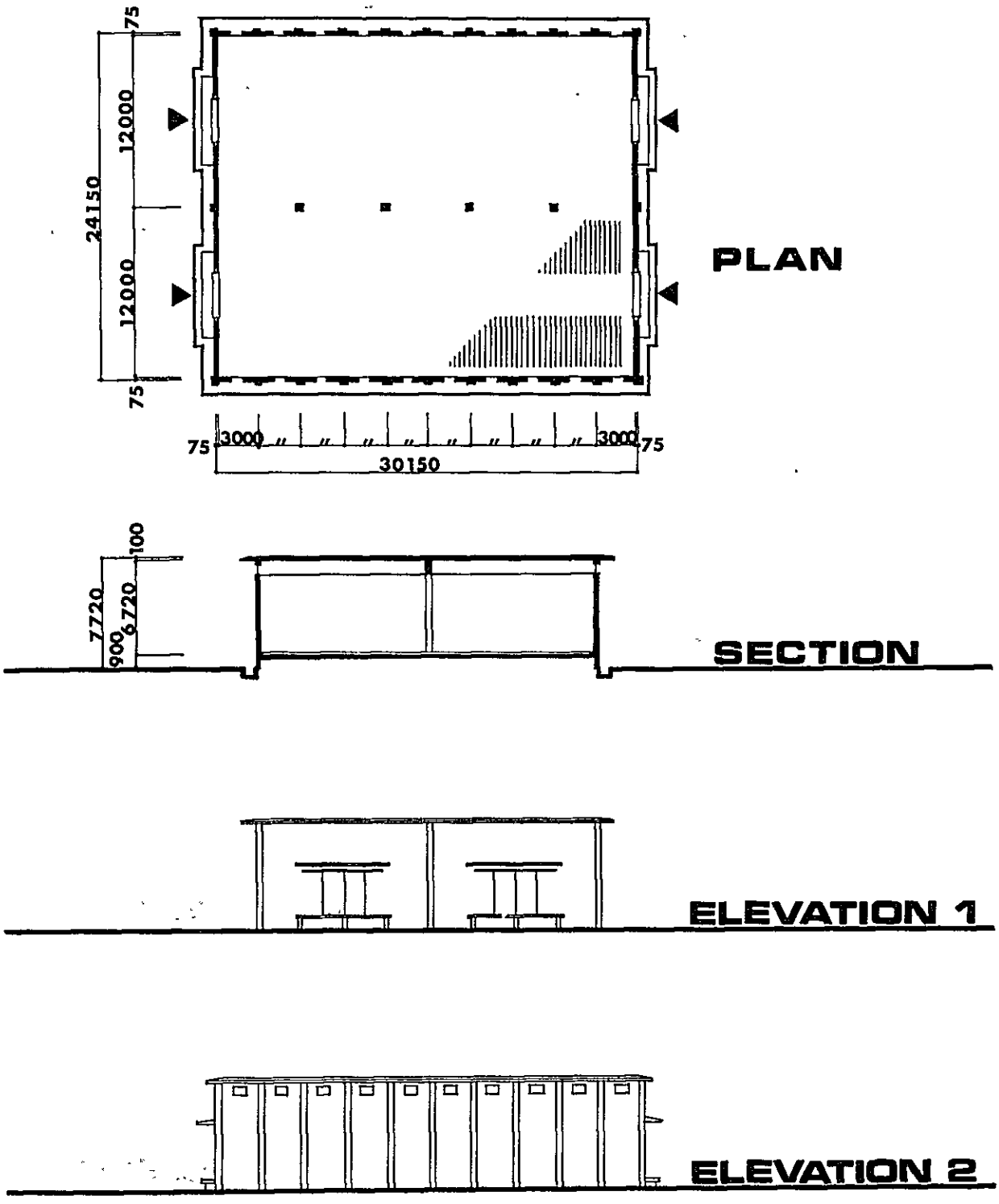
c) To adopt materials and construction techniques available in Bangladesh as much as possible.

d) To adopt the labor force available locally as much as possible.

5-2-2 Layout Plan

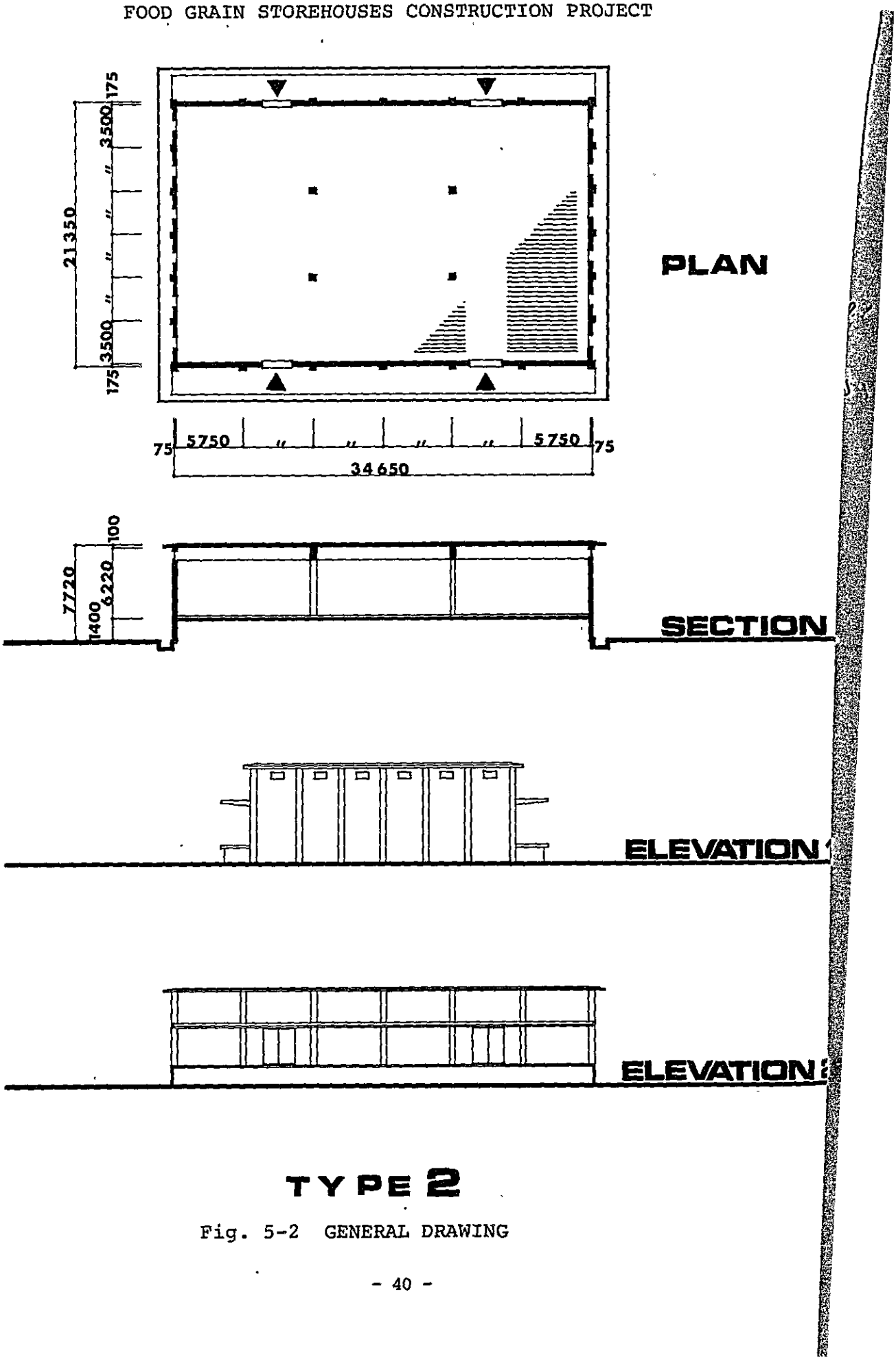
Normal capacity of each one of food storehouses which have been conventionally built in Bangladesh is in the range from 400 to 1,000 tons, and the food storehouses which can be most commonly observed are of Dacca type providing a capacity of 500 tons.

The layout plan is shown as 40 ft x 100 ft (capacity: 500 tons) for a basic unit in the Project. In the construction in practice, however, the actual dimension of a storehouse becomes 80 ft x 100 ft (capacity: 1,000 tons) which is two basic units united together for the purpose of better effects on planning and on storage use. This is considered to be a standerd type for the Project. As a supplementary type, 70 ft x 115 ft of 1,000 tons capacity is provided, in addition, for the purpose of adjustment in the space of a site. It was also decided to prepare the entrances in two types. That is, gable-side entry for the standerd type and ridge-side entry for the supplementary type so that the type can be matched with each CSD dependent on the site situation. (Refer to Figs. 5-1,5-2.)



TYPE 1

Fig. 5-1 GENERAL DRAWING



TYPE 2

Fig. 5-2 GENERAL DRAWING

5-2-3 Structural Plan

It is desirable, from considering various characteristics, that reinforced concrete should be adopted as the structure of storehouses. Therefore, reinforced concrete will be used for the foundation, the posts the beams and the floor plates and bricks (machine-made, class 1) for the walls. Because each CSD site is of relatively weak bearing capacity of soil of 6 tons/m^2 at average, continuous footing should be considered for the foundation.

The external forces and loads which are applied to the buildings are set as follows:

1)	Seismic force	K = 0.05∿0.1 (to be selected depending on the site)
2)	Wind	Wind velocity due to cyclone: 66 m/sec
3)	Bearing capacity of subsoil	To be determined after being specified.
4)	Concrete strength	
	Design standard strength	Fc = 180 kg/cm^2
5)	Live load	Floor: 2 tons/m^2

5-2-4 Delineation

General plan of storehouses was as already described. For the purpose of improving the functions of storehouses, design will be carefully exercised with provisions for storehouse doors, draft, ventilation, and prevention of damage from insects and rats. The size and finish of various sections will be as follows:

(1) Dimension

Floor area	Type 1 (Standard type, 80 ft x 100 ft). 24.150 m x 30.150 m = 724.500 m^2
	Type 2 (Supplementary type, 70 ft x 115 ft) 21.350 m x 34.650 m = 739.778 m^2

Story and height	One storied	
	Building height	7.720m (approx. 25 ft)
	Floor height	0.900m (approx. 3 ft)
	Height to bottom of of beam	5.520m (approx. 18 ft)

(2) Exterior Finish

Roof	:	Lime terracing waterproof
Wall	:	Mortar finish, waterproof paint finish
Wainscot	:	Mortar finish (FL + 150 mm)
Platform	:	Mortar finish
Berm	:	Mortar finish
Eaves	:	Top; lime terracing. Ceiling; mortar finish, waterproof paint finish
Steel part	:	Rust resisting paint preparation, waterproof paint finish
Fittings	:	Door; air-tight steel door, rust resisting paint preparation, water proof-paint finish, with Saga latch and net-screen door. Window; aluminum sash window, with operator and stainless steel screen
Side ditch	:	Reinforced concrete, mortar finish

(3) Interior Finish

Floor	:	Reinforced concrete, mortar finish with expansion joint. Damproof course. Polyethylene film (t ≈ 0.1 mm)
Baseboard	:	Mortar finish; 150 mm above floor level
Wall	:	Mortar finish, emulsion paint finish
Ceiling	:	Insulating material (t = 100 mm)

(4) Equipments

Sleeper	:	Wooden sleeper (90 x 90 mm) Placement: 300 mm center to center
Aluminum folding ladder:		(L = 5.2 m)
Rat prevention	:	Checkered steel plate, paint finish

5-2-5 Facility Plan

(1) Modification of the Storehouses by the Japanese Grant of 1977

The storehouses constructed by the previous Japanese Grant Aid were generally accepted as high grade storeage. In the project of this time, the plan in general takes the principle of the above into consideration. However, some modification or improvement are made after examination of the above storehouses in operation. (Refer to Appendix -II.)

a. Roof-top Ventilator ..... Omitted
b. Roof Insulation ..... Thickened
c. Top Windows ..... Widened
d. Bottom Windows ..... Omitted
e. Wicket Door ..... Omitted
f. Keys and Locks ..... Simplified and lessened
g. Placement of Sleepers ..... Narrowed

a. Roof-top Ventilator:
It is omitted in the project because of difficulty in preventing blow-in rain water, depending on mode of the rainfall, and because it will avoid roof maintenance trouble in the future. This refers to following items, b - d.

b. Roof Insulation:
The roof receives more radiation heat than walls do because the altitude of the sun is high in Bangladesh. Thus, heat insulation of roof is inevitable.

c. Top Windows:
In order to increase ventilation efficiency, the top windows shall be widened and placed on the highest portion of the storehouses. To ventilate inside air, a draft effect by letting in fresh air from two entrances and outlets from top windows is fully taken into account.

d. Bottom Windows:
They are effective for ventilations, but also bear some troubles such as rain-beating and grain steal on the bottom. Thus, these

windows are frequently kept closed particularly in rainy season. Hence, the bottom windows are omitted, and top windows are widened, instead.

e. Wicket Doors:

Since there are two entrances which include internal door of steel net and external door of steel board, wicket doors of each make the sturcture and handling of them complicate. Therefore, wicket doors which are practically less important are omitted.

f. Keys and Locks:

As mentioned above, to provide many different keys and locks for each door makes its handling complicate. This shall be improved by simplifing and by lessening the number.

g. Placement of Sleeper:

Wooden sleepers are important to keep the grain bags off the floor. Although lattice type is requested by the Ministry of Food to be installed in the Project storehouses, it is not recommended since this type of sleeper is improper to keep the floor clean and to make the air free at the bottom of stowage. Therefore, single wooden sleepers are chosen, but the placement distance between sleepers is narrowed.

(2) Lighting

Lighting will be made by natural light taken through top windows in the day time, and lighting with electric lamps will be used at night time.

(3) Others

As the other facilities, open conduits will be provided around buildings for leading rain water to tanks located in low grounds of each site. Water supply installation will not be provided in particular.

5-3 Construction Plan

5-3-1 Construction Materials and Machinery

The construction materials available in Bangladesh will be used as much as possible as a rule. However, imported goods will be effectively used if they provide merits with respect to the functions and/or costs.

Construction machines will be used for mixing concrete which is important from the structural standpoint and which requires homogeneity. For other work, methods of execution of the work will make use of abundant labor force in order for local employment effect.

The construction materials which can be produced in Bangladesh are cement, bricks, reinforcing bars, sand, gravel, wood, etc. Even though cement plants are located in two places, that is, Sylhet and Chittagong, because the demand in Bangladesh is more than twice of the annual production of these two plants, it is necessary to depend on import for supply of cement.

- Reinforcing bars:

  Both variety and quantity are minor and quality such as strength cannot be expected. Therefore, imported ones will be used, but processing can be made at site.

- Structural steel:

  None. But assembling can be made at site.

- Gravel and crushed stone:

  Because almost all of Bangladesh is covered with clayey layer, collection of gravel is limited to Sylhet area and Domar area. As grain size is not uniform and excessive length of time is required for procurement of it, which is relatively expensive. Therefore, rather than the use of natural gravel as aggregate, it is safer if crushed stones are used as aggregate, also it is better from the standpoint of strength. As for the crushed stones, which are made by manually crushing them with hammers, rubble stones of granite series or limestone series which are collected in Sylhet area and Domar area will be used.

- Sand:

  Sand from the Sylhet area and the Domar area will be used as fine aggregate for concrete.

- Wood:

  Even though Chittagong teak, Tal Suck, Sil, Korai and Chamkli are available, they are unsuitable as sleeper wood for storehouses. Therefore, imported wood will probably be used.

- Bricks:

  As machine-made bricks, products of major factories manufacturing sufficient quality bricks will be used.
  Besides, hand-made bricks to be used for cobble stones are produced in various places. In addition, Jhama bricks, which are produced by crushing bricks, and are used as coarse aggregate for concrete and cobble stones, are also available.

5-3-2 Materials, Labor and Construction Costs

With respect to materials, labor and construction costs, unit prices were calculated with data obtained from A company, which is a Japanese corporation located in Bangladesh, and B company, which is a local corporation, with the Schedule of Rates for 1977 used as the reference because the Schedule of Rates for 1978 is under preparation by PWD. Refer to Appendix-IV, Table IV5-1 and IV5-2. As for rail transportation rates, the data indicated in Appendix-IV, Table IV5-3 was obtained from the freight section of the Dacca Station.

5-3-3 Term of Construction Work

The term of the construction work will be fifteen (15) months including two dry seasons. (Refer to Fig. 5-3.) Since earth works in the commencement and finishing works in the completion are easily influenced by rainy weather, it is important to commence and to complete the works in the dry seasons, on the view point of progress control of the construction.

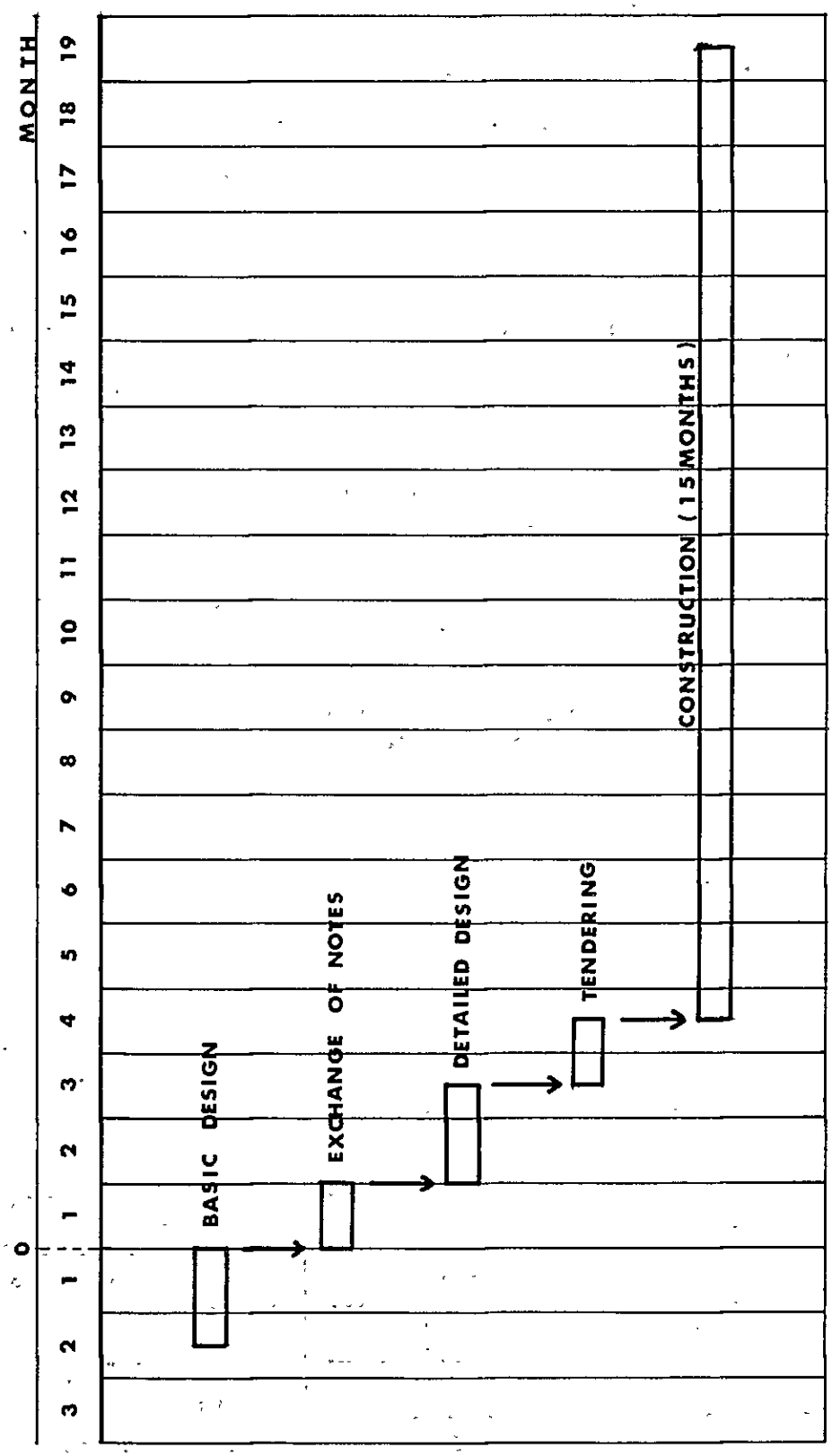

SCHEDULE
MONTH
0
1
2
3
BASIC DESIGN
EXCHANGE OF NOTES
DETAILED DESIGN
TENDERING
CONSTRUCTION (15 MONTHS)

Fig. 5-3

5-4 The Scope of Work

A. Work included in the section 5-5, "Approximate Construction Costs"

1) Construction of Storehouses buildings

2) Detailed design and construction supervision

3) External transportation of construction materials up to the port of disembarkation in Bangladesh.

B. Not included in 5-5, what are to be borne by the Government of Bangladesh

1) To secure lots of land necessary for the construction of the storehouses and to clear the sites. (Refer to Table 5-1.)

2) To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the sites.

3) To ensure prompt unloading and customs clearance at the ports of disembarkation in Bangladesh and internal transportation therein of the construction materials purchased under the Grant.

4) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the materials and the services.

5) To accord Japanese nationals whose services may be required in connection with the supply of the materials and the services such facilities as may be necessary for their entry into Bangladesh and stay therein for the performance of their work.

6) To bear all the expenses, other than those to be borne by the Grant, which are necessary for the construction of the storehouses as well as for the transportation.

Table 5-1 Necessary Site Clearance

Construction site	Withdrawal of existing structure	Removal of obstacles on the ground	Other clearance
1. Santahar CSD	-	-	drainage and preparation
2. Narayanganj CSD	old bick buildings	a number of bricks	preparation
3. Boyra CSD*	necessary number of dilapidated storages	-	drainage and preparation
4. Halishahar CSD	-	a number of bricks and drumcans	Preparation

* The withdrawal of dilapidated storages necessary for 13 new storehouses is requested by the Government of Bangladesh in the comments on the Draft Report.

5-5 Approximate Construction Costs

The survey team made rough estimates of the construction cost as of December 20, 1978 based on the data collected in the survey as follows:

Rough Estimates of Construction Cost

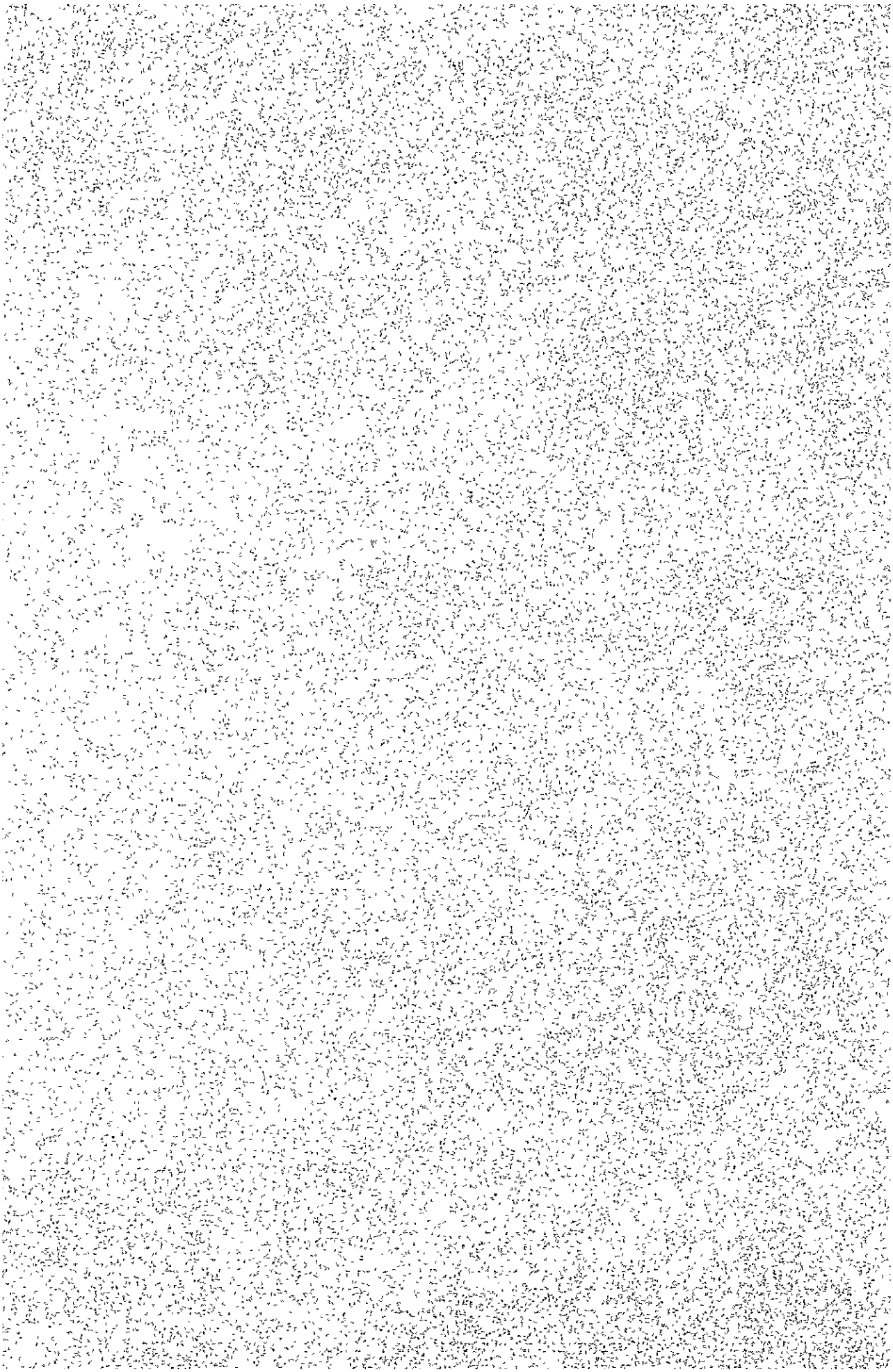
1. Storehouses Building Construction (including the external transportation costs)		¥ 2,381,500,000
a) Santahar CSD, Bogra	10 buildings, 7,400 m^2	
b) Narayanganj CSD, Dacca	2 buildings, 1,480 m^2	
c) Boyra CSD, Khulna	13 buildings, 9,620 m^2	
d) Halishahar CSD, Chittagong	5 buildings, 3,700 m^2	
2. Detailed Design and Supervision Fee		¥ 118,500,000
Total		¥ 2,500,000,000

Note 1: This estimates is calculated in accordance with the conditions in 5-4, "Scope of Work".

Note 2: With respect to the roughly calculated amount per storehouse building, indexes of construction costs in local towns were determined as follows based on the amount in Dacca as 100. As the conditions of assessment, relative difficulty of construction, availability of construction materials, etc. were taken into account.

Narayanganj	102
Chittagong	107
Khulna	110
Santahar	110

APPENDIX-I : MINUTES



MINUTES OF THE DISCUSSIONS ON THE BASIC DESIGN SURVEY FOR FOODGRAINS STOREHOUSES CONSTRUCTION PROJECT

At the request of the Government of the People's Republic of Bangladesh for the grant in order to contribute to the development of Bangladesh, the Government of Japan through Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic design Survey Team (hereinafter called " the Survey Team ") headed by Mr. Kyoichi Hanado, the Ministry of Agriculture, Forestry and Fisheries. Based on the results of this Survey Team, the Government of Japan would provide grant aid for the construction of foodgrains storehouses to the Government of Bangladesh.

The Survey Team stayed in Bangladesh for eighteen days from 14th November, 1978 for the purpose of having discussion with Bangladesh authorities concerned and undertaking field surveys on the project so that JICA would be able to prepare basic designs for the construction of the foodgrains storehouses.

The Survey Team held a series of active discussions with the Bangladesh authorities concerned and exchanged views of construction of new storehouses. Both parties have agreed to recommend to their respective Governments to take further necessary action for the promotion of the foodgrains storehouses construction project under the possible Japanese grant in the fiscal year 1979 that begins in April.

Minutes of the discussion are attached herewith.

Dacca December 1, 1978.

12/1/78

Mr. A. Z. Khan
Joint Secretary
Ministry of Food

Kyoichi Hanado. 12

Mr. Kyoichi Hanado
Team Leader
Japanese Basic Design
Survey Team

MINUTES

1) The Survey Team have achieved its objectives with active cooperation of Bangladesh authorities concerned, the Ministry of Food, Central Storage Depot (hereinafter referred to as "CSD") and the Ministry of Finance.

2) The Survey Team conducted field surveys at Narayanganj CSD, Halishahar CSD, Dewanhat CSD, Boyra CSD, Maheshwarpasha CSD and Santahar CSD. The result of the field survey is shown in Annex I.

3) Because of the limitation of Japanese grant aid for the project, it would not be possible to build the all proposed storehouses in above mentioned CSD's. Therefore, the Survey Team made careful efforts to select some of sites for the storehouses to be granted in view of conditions on food marketing and constructions in Bangladesh. After having discussion with the Ministry of Food, the Survey Team listed up the construction sites with priority and accordingly reports the result to the Government of Japan as shown in Annex II. Actual number of storehouses and locations will be indicated in the draft report to be submitted by the Survey Team.

4) Both parties agreed on the demarcation of responsibilities in excuting construction works that shall be carried out after the approval of basic design by the respective Governments. The fundamental works and auxilliary facilities indispensable for construction of the storehouses shall be provided by Bangladesh side. The works under this category are shown in Annex II The sites proposed by the Survey Team shall be made available for the construction of new storehouses under Japanese grant aid. The buildings and attached facilities shall be provided by Japan side.

5) The Government of Japan must send the draft report for basic design of foodgrains storehouses to the Government of Bangladesh by 5th February, 1979. The Government of Bangladesh must return the comment on the draft to the Embassy of Japan in Bangladesh by 20th February, 1979. If the Government of Bangladesh would not send it by the time, the Government of Japan considers that Bangladesh agreed with the draft report.

Results of Field Survey

Unit: 1000 ton

Available Land at Each CSD

	Dacca	Chittagong		Khulna		Santahar	Total
Site Condition	Narayangonj	Halishahar	Dewanhat	Boyra	M-pasha		
Ready land	0	3	3	0	6	14	26
Brick Removal	0.5	9	0	0	0	0	14.5
Drumcan "	0		5	0	0	0	
Building "	2	0	0	1	0	0	3
Wet Field or Tank	0	0	2	2	0	0	4
Total	2.5	12	10	3	6	14	47.5
Foundation Depth	1.5 m	1.5 m	1.5 m	2.5 m	2.0~3.0 m	3.0 m	

Annex II Priority list of construction sites for foodgrains storehouses

		(Condition)
1.	Santahar CSD	
2.	Narayanganj CSD	Removal of bricks and old storage
3.	The CSD's in Khulna	Earth filling and removal of old storage
4.	The CSD's in Chittagong.	Removal of drumcans and old storage

K.H

ANNEX III Items the costs of which are to be born by the Government of Bangladesh.

(1) Fundamental Works.

a) Site clearance; removal of obstacles on and under the ground, earth filling with compaction where necessary.

b) Water and power supply to the sites for construction.

c) Space of temporary site office and material storage for the construction.

(2) Construction Materials

a) Unloading and custom clearance of imported construction materials and equipments

b) Internal transportation of (2)-a) to the construction sites.

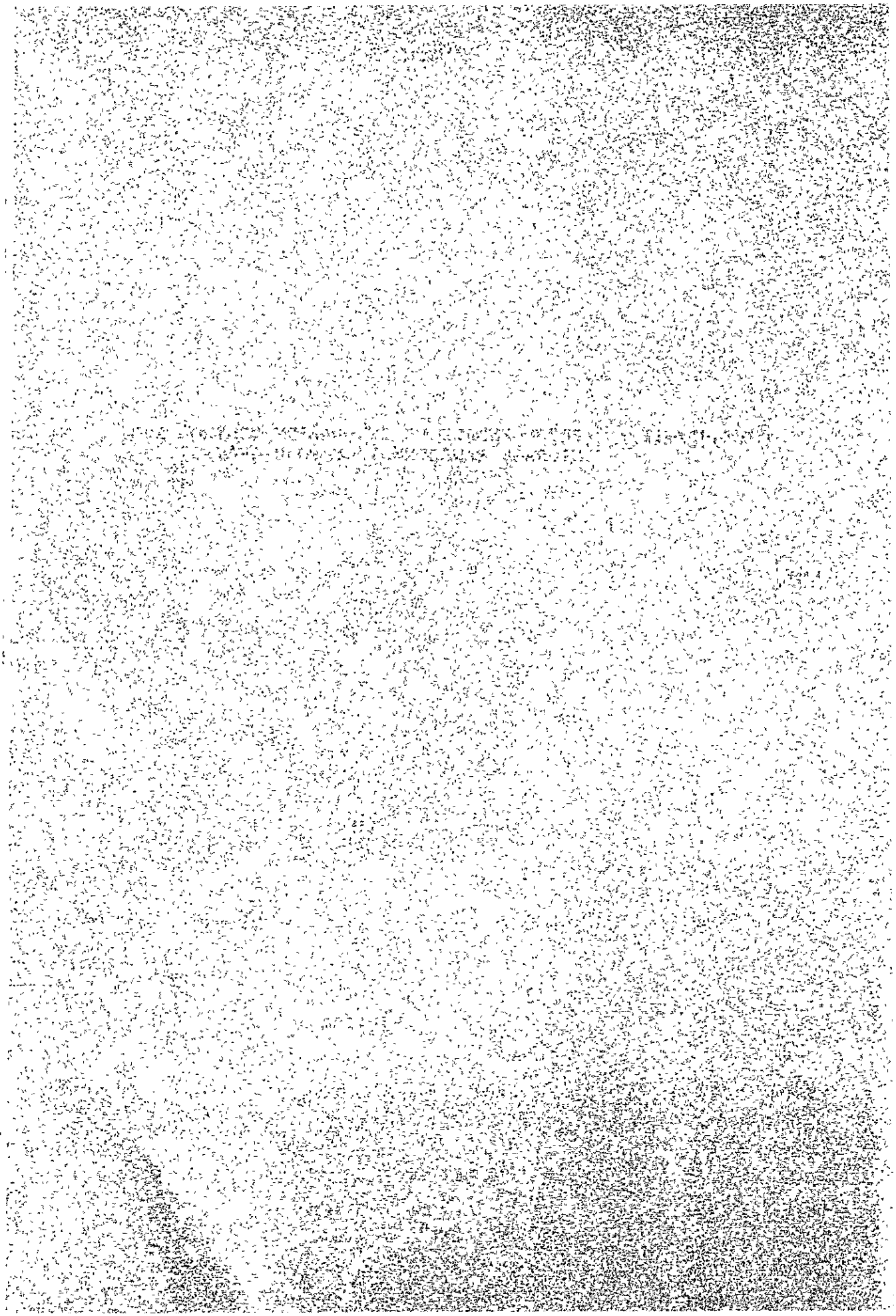
(3) Privileged Person

a) Application of "Privileged Persons" Baggage Rule, 1974" to the Consultants and the Contractors

b) Free access to the Secretariat by issuing Gate pass to the consultant

K.H.

APPENDIX-II : RECOMMENDATIONS ON QUALITY CONTROL AND STORAGE MANAGEMENT OF FOOD GRAINS



APPENDIX-II : RECOMMENDATIONS ON QUALITY CONTROL AND STORAGE MANAGEMENT OF FOOD GRAINS

Controling of the grain storage is undoubtedly depending on both the storing facilities and the technique of storage, and also depend on both the temperature and humidity inside the storehouse and the moisture content of the grain. In the case of the grain having a high moisture content and high grain temperature, the quality of the grain deteriorates not only due to the action of natural decay, but also spreads damage by micro-organism and harmful insects.

In the case of storing grain under natural climatic conditions, ambient high temperature and high humidity are the factors in circumstances to which most careful attention must be paid. But, even under severe storing conditions, preventing quality deterioration and supplying the valuable national reserves by mean of good storage management is the duty of storing personel. Below is an outline of the points for consideration and measures to be taken in regard to performing storing management in the case of storing grain under the natural climatic condition.

1. Controlling of the Condition of Air (Control of Temperature and Humidity)

When the storehouse is tightly closed up, the relative humidity inside the storehouse is influenced by the moisture content of the stored grain. But in the long term, the ambient temperature and humidity inside the storehouse is affected by atmospheric temperature and humidity, and ultimately increase or decrease in the moisture content of the grain. This change (in ambient temperature and humidity inside storehouse) is caused by the conduction of heat and the flow of air from outside to inside and vice versa (Ventilation). Heat conduction and ventilation of air are mostly influenced by the structure of the storehouse, but control of the air within the storehouse, that is, to maintain both lower temperature and humidity inside than outside as much as possible, can be achieved by either allowing or not allowing outside air to flow inward by opening or closing the flaps and window as the case may be. Equipping the storage depot with both upper windows and lower windows provide for ventilation which serves both to prevent a rise in tempra-ture as well as to reduce the inside humidity. Thus, the introduction of

ventilation to stored grain will, to some degree, result in more favorable conditions of a reduction in both temperature and humidity.

Therefore, when the ambient temperature and humidity inside the storehouse are higher than those outside, it is necessity to open the window so as to exchange outside air which is low temperature and humidity for inside air. Conversely, when the ambient temperature and humidity inside the storehouse are lower than outside, the windows must be close. But there is also absolute humidity in addition to relative humidity, as a basis, and whenever the air temperature changes the amount of the water vapor that can be held in the air also changes. That is, if the air temperature rise 10 degrees Centigrade, the air can hold about 2 times more moisture.

For example, in case the outside temperature is higher than inside, it is possible that the absolute humidity outside may be higher than inside even though the relative humidity is lower. In such a case, allowing outside air to enter the storehouse would mean to allow air containing more actual water vapour to enter. In case the inside temperature decreases, even if the inside temperature remain constant, it means that we have allowed the entry of air having a higher relative humidity than before. And also, we must take this relationship into account in the controlling the condition of the air. Refer to the Table II-1 concerning the relationship among temperature, relative humidity and absolute humidity.

Furthermore, the grain is at all time acting equilibristicly by absorbing moisture from the air or discharging the moisture it holds in response to variations in the temperature and humidity of the air. There is an "equilibrium moisture/humidity ratio" between the moisture content of the grain and the relative humidity in the air.

The equilibristic moisture/humidity ratio for rice at 30°C is as follows:

Moisture content in rice	Equilibristic relative humidity
14.45 %	71.02 %
14.96	75.38
15.75	80.98
16.90	84.92
18.09	87.91
20.32	92.12

Source: National Research Institutes, Ministry of Agriculture, Forestry and Fisheries, Japan

As the difference in temperature between top and bottom increase, warm grain on the upper layers dries up, conversely cool grain on the bottom layer absorbs moisture. When the difference in grain temperature increases about five degrees centigrade, it cause dew condensation at the portion of the bottom layer that is tightly pressed against a dunnage lumber, and moisture content increases. Then, fungi appear, and grain quality deteriorates.

An example of the relationship between the appearance of fungi and moisture content at as follows:

Layer	Appearance of fungi in	Moisture content
Bottom layer	100 %	17.5
2 "	87.1	15.8
7 "	63.8	15.1
11 "	48.8	15.0

Source: National Food Research Institutes, Ministry of Agriculture, Forestry and Fisheries, Japan

For making adjustments to obtain the most suitable conditions of air, it is important to determine the grain moisture as well as to determine the temperature and humidity both inside and outside the storehouse.

At the present time, it seems that the determination of the temperature and humidity of both inside air and outside air and of the grain moisture is seldom carried out in Bangladesh, but if the adjustments are expected to bring about the suitable condition of the air, these determinations

are essential. Also the equipment for both the window and the ventilator so as to be easily opened and closed is required.

2. Measures of Insect Control

Insects that infest our stores of cereal foods constitute one of the most serious threats to our present day society.

It is estimated that insects destroy at least 5 % of the world's production of grain.

There are many kinds of harmful insects to the grain. The multiplying of insects is related to grain moisture and temperature. The moisture content that is most suitable for insects to multiply depends on the species of insect, but for example it is about 15 to 18 % in the case of the rice weevil (Sitophilus oryzae L.). The most suitable temperature for most major insects to live in is the range between 25 to 35 °C.

For example, here is data on the multiplication of the rice weevil (Sitophilus oryzae L.):

Relationship Between Multiplication of Harmful Insects and Moisture Content (28 °C)

Grain moisture content	11.4 %	14.5 %	16.8 %	17.8 %	19.0 %
Number of rice weevils	0.16	25.8	41.1	43.0	38.9

Condition: One pair of rice weevils was placed in 40 grams of brown rice, and kept breeding for 40 days in 28 °C room temperature. Then, the number of insects is counted.

Source: National Food Research Institutes, Ministry of Agriculture, Forestry and Fisheries, Japan

Prevention measures against harmful insects are;
i) cleaning, ii) keeping humidity low, iii) keeping the temperature low, iv) the use of insecticide.

In order to exterminate the insects that already infested the grain, fumigation is necessary.

3. Measures for Fungi Control

It is impossible to avoid the existence of micro-organisms which is apt to grow in the stored grain.

An example of the relationship between multiplication of micro-organism and moisture content is as follows:

Moisture content in rice	Number of bacteria	Number of Fungus	References
12.6	1,743	160	Cannot discriminate by naked eye.
14.7	4,360	1,120	"
15.7	2,080	1,460	Can find fungi growth by naked eye, but color and brightness are poor.
16.8	1,080	2,600	Very poor appearance.
17.3	560	3,100	Extremly poor appearance.
19.4	1,240	4,120	Fungus growth covers the entire surface of kernel. Color and brightness are extremely poor.

Condition: Figures indicate number of micro-organism etc. on one kernel of rice.

Sources: National Food Research Institutes, Ministry of Agriculture, Forestry and Fisheries, Japan

Most fungi cease their activity when both the moisture content of grain is below about 14.5 % and the temperature is below 15 °C Centigrade. Generally speaking, the growth rate increases as the moisture content increases. And the range of temperature required for growth is from 15 to 30 °C for most kinds of fungi, however, if either the temperature condition or the humidity condition is not fulfilled, the fungi can not remain active and grow.

The data of the experiment on the interrelation among temperature, humidity in which fungi commence its spore germination and the number of days till the date of its commencement are shown below:

Temperature / Relative humidity	28 °C			18 °C
	75 %	81 %	86 %	87 %
Aspergillus chevalieri	26 days	9 days	5 days	13 days
Aspergillus restrictus	36 days	12 days	5 days	18 days
Aspergillus candidus	98 days	15 days	6 days	28 days

Source: National Food Research Institutes, Ministry of Agriculture, Forest and Fisheries, Japan

It is obvious that low temperature and low humidity is essential for the safe storage of grains. Particularly low humidity is more important.

4. Fumigation

The best moment for fumigation is the initial stage when insects commence multiplying or fungi commence growth.

The dosage of fumigant is determined in accordance with the volume of the storehouse in case of storehouse fumigation, or with the volume of the sealed space in case of gastight cover fumigation. The standard dosage per cubic meter and the duration of fumigation are shown below. (On the condition that fumigation is performed when the temperature is over 20°C.)

Fumigant	Phostoxin	Methyl Bromide
Dosage	0.5 tablet (1.5 gm)	10.5 gm
Duration	5 days	3 days

If it is necessary to shorten the duration of the gastight fumigation, the dosage should be two tablets of Phostoxim per one cubic meter provided that the duration is not less than three days.

Fumigation for preventing insect infestation is carried out frequently in short intervals in Banlgadesh, however, it is possible to reduce the number of times of fumigation by using PGP* or vaporizing insecticide in parallel with the fumigation process, and this is effective in maintaining the quality and is economical as well.

Little attention is presently paid to fungi control, since the period of storage of the food is generally short. However, the deterioration by fungi should be watched thoroughly, especially in conditions of high temperature and high humidity. Since the effect of methyl bromide against fungi is stronger than that of phostoxin, the kind of fumigant should be chosen in accordance with the condition of infestation.

Remark: *Phrenone Grain Protectant

5. Rodent Control

After a thorough examination of the whole structure of the storehouse, to close the gate way of rats is of top priority. Every opening such as windows and drainage and ventilation should be covered with a net.

The inside of the storehouse and the area surrounding it and even the auxiliary buildings within the complex should be properly cleaned. It is also very important to prevent rats from making nests in the area. Those measures are environmental extermination to create a surroundings, that is unsuitable for rats to live in. Use of poison baits together with the above mentioned measures improves the effectiveness.

Poison bait is now used in Bangladesh, but the use of poison bait alone is not sufficiently effective because there are rich foods in the storehouse which allow the rodents to avoid eating the poison baits. Therefore, the application of repellents together with poison baits is more effective.

6. Dunnage Lumber

Dunnage lumber are employed to avoid the deterioration of grains in bags laid at the lower level of the pile of bags.

Common materials for dunnage lumber are well-dried square pieces of lumber having a thickness of about 10 cm.

In the sectors of the storehouse where humid air can easily enter from the lower windows, etc., and where dunnage lumber are used grain deterioration may be caused by dew condensation absorbed from the bags when the relative humidity of the air in the space below the dunnage lumber rises because the temperature drops due to nightfall, etc., causing condensation which is subsequently absorbed by the bags at the points where it makes contact with the dunnage lumber. Therefore, careful attention should be paid to the management (opening and closing) of the lower windows, etc.

In the case of the outside air being moist, use of styrene boards is desirable. Furthermore, a careful examination should be conducted to detect cracks in the floors and walls, especially in the corners, and the cracks must be filled up using filling materials. Lattice type dunnage lumber that is commonly in use at the present time is unsuitable not only from the viewpoint of cleaning and ventilation but also because they make it difficult to perform the tight work around the hem of the tent in the fumigation operation. Also, bags on the bottom layers of piles were seen touching the floors in some places because the distance between the underlays was too wide. Dunnage lumber must be moved closer together to prevent the bags from coming into contact with the floor.

7. The Effects of Insulation and Airtightness of the Storehouses

As mentioned above, the effects of insulation and airtightness of the storehouse are important factors. In areas where high temperatures prevail, such as Bangladesh, the temperature of the walls and ceiling of the storehouse which are exposed to the sun increase considerably and consequently cause the temperature inside the storehouse to rise.

Reduction of the inside temperature can be realized by covering the inside surface of the walls and ceilings with heat insulating materials. Also, airtightness is required for the purpose of effectively controling the conditions of the air and for the purpose of fumigation.

8. Stowage

In the process of distribution of food grain goods not just stowed in the storehouse; but the goods should be stowed in such a manner as to utilize the storehouse capacity to its fullest extent and to facilitate handling and the operations of fumigation, inspection, and tallying.

For maximum effects of fumigation, bags of grain must be stowed in such a manner so as to allow for smooth circulation of the fumigant gas throughout the space enclosed within the gastight cover.

There are certain basic methods of stowage which facilitate tallying, but the methods being employed at the present seem to make it somewhat difficult.

Two examples of basic method.

(1) Method of stowing in units of four bags.

First layer Second layer

This method allows for effective ventilation and fumigation, but the capacity for stowage is small.

(2) Method of stowing in units of five bags.

First layer Second layer

This method gives good stability to the pile of bags, and the capacity for stowage is large.

Table II-1 Conversion Table for Absolute Humidity

(Number of grams of absolute humidity in relation to both of relative humidity and temperature)

Relative humidity(%) \ Temperature (°C)	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
100	39.2	37.2	35.3	33.4	31.7	30.0	28.5	27.0	25.6	24.2	22.8	21.6	20.4	19.2	18.2	17.2	16.2	15.2	14.4	13.5	12.8	12.0	11.2	10.6	10.0
92	36.1	34.2	32.5	30.7	29.2	27.6	26.2	24.8	23.6	22.3	21.0	19.9	18.8	17.7	16.7	15.8	14.9	14.0	13.2	12.4	11.8	11.0	10.3	9.8	9.2
91	35.7	33.9	32.1	30.4	28.8	27.3	25.9	24.6	23.3	22.0	20.7	19.7	18.6	17.5	16.6	15.7	14.7	13.8	13.1	12.3	11.6	10.9	10.2	9.6	9.1
90	35.3	33.5	31.8	30.1	28.5	27.0	25.7	24.3	23.0	21.8	20.5	19.4	18.4	17.3	16.4	15.5	14.6	13.7	13.0	12.2	11.5	10.8	10.1	9.5	9.0
89	34.9	33.1	31.4	29.7	28.2	26.7	25.4	24.0	22.8	21.5	20.3	19.2	18.2	17.1	16.2	15.3	14.4	13.5	12.8	12.0	11.4	10.7	10.0	9.4	8.9
88	34.5	32.7	31.1	29.4	27.9	26.4	25.1	23.8	22.5	21.3	20.1	19.0	18.0	16.9	16.0	15.1	14.3	13.4	12.7	11.9	11.3	10.6	9.9	9.3	8.8
87	34.1	32.4	30.8	29.1	27.6	26.1	24.8	23.5	22.3	21.1	19.8	18.8	17.7	16.7	15.8	15.0	14.1	13.2	12.5	11.7	11.1	10.4	9.7	9.2	8.7
86	33.7	32.0	30.4	28.7	27.3	25.8	24.5	23.2	22.0	20.8	19.6	18.6	17.5	16.5	15.7	14.8	13.9	13.1	12.4	11.6	11.0	10.3	9.6	9.1	8.6
85	33.3	31.6	30.0	28.4	26.9	25.5	24.2	23.0	21.8	20.6	19.4	18.4	17.3	16.3	15.5	14.6	13.8	12.9	12.2	11.5	10.9	10.2	9.5	9.0	8.5
84	32.9	31.2	29.7	28.1	26.6	25.2	23.9	22.7	21.5	20.3	19.2	18.1	17.1	16.1	15.3	14.4	13.6	12.8	12.1	11.3	10.8	10.1	9.4	8.9	8.4
83	32.5	30.9	29.3	27.7	26.3	24.9	23.7	22.4	21.2	20.1	18.9	17.9	16.9	15.9	15.1	14.3	13.4	12.6	12.0	11.2	10.6	10.0	9.3	8.8	8.3
82	32.1	30.5	28.9	27.4	26.0	24.6	23.4	22.1	21.0	19.8	18.7	17.7	16.7	15.7	14.9	14.1	13.3	12.5	11.8	11.1	10.5	9.8	9.2	8.7	8.2
81	31.8	30.1	28.6	27.1	25.7	24.3	23.1	21.9	20.7	19.6	18.5	17.5	16.5	15.6	14.7	13.9	13.1	12.3	11.7	10.9	10.4	9.7	9.1	8.6	8.1
80	31.4	29.8	28.2	26.7	25.4	24.0	22.8	21.6	20.5	19.4	18.2	17.3	16.3	15.4	14.6	13.8	13.0	12.2	11.5	10.8	10.2	9.6	9.0	8.5	8.0
79	31.0	29.4	27.9	26.4	25.0	23.7	22.5	21.3	20.2	19.1	18.0	17.1	16.1	15.2	14.4	13.6	12.8	12.0	11.4	10.7	10.1	9.5	8.8	8.4	7.9
78	30.6	29.0	27.5	26.1	24.7	23.4	22.2	21.1	20.0	18.9	17.8	16.8	15.9	15.0	14.2	13.4	12.6	11.9	11.2	10.5	10.0	9.4	8.7	8.3	7.8
77	30.2	28.6	27.2	25.7	24.4	23.1	21.9	20.8	19.7	18.6	17.6	16.6	15.7	14.8	14.0	13.2	12.5	11.7	11.1	10.4	9.9	9.2	8.6	8.2	7.7
76	29.8	28.3	26.8	25.4	24.1	22.8	21.7	20.5	19.5	18.4	17.3	16.4	15.5	14.6	13.8	13.1	12.3	11.6	10.9	10.3	9.7	9.1	8.5	8.1	7.6
75	29.4	27.9	26.5	25.1	23.8	22.5	21.4	20.3	19.2	18.2	17.1	16.2	15.3	14.4	13.7	12.9	12.2	11.4	10.8	10.1	9.6	9.0	8.4	8.0	7.5
74	29.0	27.5	26.1	24.7	23.5	22.2	21.1	20.0	18.9	17.9	16.9	16.0	15.1	14.2	13.5	12.7	12.0	11.2	10.7	10.0	9.5	8.9	8.3	7.8	7.4
73	28.6	27.2	25.8	24.4	23.1	21.9	20.8	19.7	18.7	17.7	16.6	15.8	14.9	14.0	13.3	12.6	11.8	11.1	10.5	9.9	9.3	8.8	8.2	7.7	7.3
72	28.2	26.8	25.4	24.0	22.8	21.6	20.5	19.4	18.4	17.4	16.4	15.6	14.7	13.8	13.1	12.4	11.7	10.9	10.4	9.7	9.2	8.6	8.1	7.6	7.2
71	27.8	26.4	25.1	23.7	22.5	21.3	20.2	19.2	18.2	17.2	16.2	15.3	14.5	13.6	12.9	12.2	11.5	10.8	10.2	9.6	9.1	8.5	8.0	7.5	7.1
70	27.4	26.0	24.7	23.4	22.2	21.0	20.0	18.9	17.9	16.9	16.0	15.1	14.3	13.4	12.7	12.0	11.3	10.6	10.1	9.5	9.0	8.4	7.8	7.4	7.0
69	27.0	25.7	24.4	23.0	21.9	20.7	19.7	18.6	17.7	16.7	15.7	14.9	14.1	13.2	12.6	11.9	11.2	10.5	9.9	9.3	8.8	8.3	7.7	7.3	6.9
68	26.7	25.3	24.0	22.7	21.6	20.4	19.4	18.4	17.4	16.5	15.5	14.7	13.9	13.1	12.4	11.7	11.0	10.3	9.8	9.2	8.7	8.2	7.6	7.2	6.8
67	26.3	24.9	23.7	22.4	21.2	20.1	19.1	18.1	17.2	16.2	15.3	14.5	13.7	12.9	12.2	11.5	10.9	10.2	9.6	9.0	8.6	8.0	7.5	7.1	6.7
66	25.9	24.6	23.3	22.0	20.9	19.8	18.8	17.8	16.9	16.0	15.0	14.3	13.5	12.7	12.0	11.4	10.7	10.0	9.5	8.9	8.4	7.9	7.4	7.0	6.6
65	25.5	24.2	22.9	21.7	20.6	19.5	18.5	17.6	16.6	15.7	14.8	14.0	13.3	12.5	11.8	11.2	10.5	9.9	9.4	8.8	8.3	7.8	7.3	6.9	6.5
64	25.1	23.8	22.6	21.4	20.3	19.2	18.2	17.3	16.4	15.5	14.6	13.8	13.1	12.3	11.6	11.0	10.4	9.7	9.2	8.6	8.2	7.7	7.2	6.8	6.4
63	24.7	23.4	22.2	21.0	20.0	18.9	18.0	17.0	16.1	15.2	14.4	13.6	12.9	12.1	11.5	10.8	10.2	9.6	9.1	8.5	8.1	7.6	7.1	6.7	6.3
62	24.3	23.1	21.9	20.7	19.7	18.6	17.7	16.7	15.9	15.0	14.1	13.4	12.6	11.9	11.3	10.7	10.0	9.4	8.9	8.4	7.9	7.4	6.9	6.6	6.2
61	23.9	22.7	21.5	20.4	19.3	18.3	17.4	16.5	15.6	14.8	13.8	13.2	12.4	11.7	11.1	10.5	9.9	9.3	8.8	8.2	7.8	7.3	6.8	6.5	6.1
60	23.5	22.3	21.2	20.0	19.0	18.0	17.1	16.2	15.4	14.5	13.7	13.0	12.2	11.5	10.9	10.3	9.7	9.1	8.6	8.1	7.7	7.2	6.7	6.4	6.0
59	23.1	21.9	20.8	19.7	18.7	17.7	16.8	15.9	15.1	14.3	13.5	12.7	12.0	11.3	10.7	10.1	9.6	9.0	8.5	8.0	7.6	7.1	6.6	6.3	5.9
58	22.7	21.6	20.5	19.4	18.4	17.4	16.5	15.7	14.8	14.0	13.2	12.5	11.8	11.1	10.6	10.0	9.4	8.8	8.4	7.8	7.4	7.0	6.5	6.1	5.8
57	22.3	21.2	20.1	19.0	18.1	17.1	16.2	15.4	14.6	13.8	13.0	12.3	11.6	10.9	10.4	9.8	9.2	8.7	8.2	7.7	7.3	6.8	6.4	6.0	5.7
56	22.0	20.8	19.8	18.7	17.8	16.8	16.0	15.1	14.3	13.6	12.8	12.1	11.4	10.8	10.2	9.6	9.1	8.5	8.1	7.6	7.2	6.7	6.3	5.9	5.6
55	21.6	20.5	19.4	18.4	17.4	16.5	15.7	14.9	14.1	13.3	12.5	11.9	11.2	10.6	10.0	9.5	8.9	8.4	7.9	7.4	7.0	6.6	6.2	5.8	5.5