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9. ABSTRACT

The kind and scope of research to be conducted in Bangladesh to assist the government in its efforts to improve food grain storage processes and stock management is investigated in this pilot study. Discussed are the food grain supply, warehousing of government-owned stocks, government warehouses, warehouse conditions, warehouse improvement and expansion, government food grain stock and facility requirements, and private sector functions. Also reviewed are current and anticipated activities and grain storage programs conducted by such other donor agencies as Denmark, Great Britain, Australia, Canada, Japan, World Food Programs, Mennonite Mission, UNDP, FAO and IBRD. Recommendations are made concerning scopes of work for public-sector studies of storage, handling, and marketing of food grains, and for a private-sector study of commercial storage and milling of rice. Terms of reference for analyses of on-farm storage and drying facilities are also provided.

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Bangladesh Food Grain Storage and Stock Management Study

FOOD & FEED GRAIN INSTITUTE
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BANGLADESH FOOD GRAIN STORAGE

AND STOCK MANAGEMENT STUDY

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SUMMARY STATEMENT

The objective of our study is to assemble information and to develop detailed scopes of work for a study of food grain storage which will contribute to a comprehensive food grain policy and management program in Bangladesh.

In reviewing fo grain storage policys and problems, the following items are briefly discussed: (1) food grain supply, (2) warehousing of Government owned stocks, (3) Government warehouses, (4) warehouse conditions, (5) warehouse improvement and expansion, (6) Government food grain stock and facility requirements and (7) private sector.

Also reviewed are the current and anticipated activities and programs on grain storage in Bangladesh by donor agencies other that USAID such as Denmark, Great Britian, Australia, Canada,UNDP, FAO, IBRD, World Food Programs, Mennonite Mission and Japan.

Recommendations include scopes of work for public sector study of storage, handling and marketing of food grains and for a private sector study of commercial storage and rice milling. Terms of reference for analysis of on-farm storage and drying facilities in Bangladesh will also be recommended.

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Mr. Joe Toner, Director, USAID/Bangladesh and other USAID/Bangladesh personnel were very helpful. We especially extend our appreciation to Mr. Dennis Brennan, Mr. James Gardner, Mr. Joe Stephanek and Mr. Edward Ceaser in USAID/Bangladesh for providing us information and other services while in Bangladesh.

PREFACE

The objective of the KSU team is to "assemble information and develop detailed scopes of work for a study of foodgrain storage which will contribute to a comprehensive foodgrain policy and management program. In doing so, the team will:

1. Discuss with BDG officials relevant foodgrain storage policy or alternative policies.

2. Review other donor assistance for grain storage.

3. Prepare terms of reference for analysis of management and organization in all phases of grain storage including training that is needed for the system to work effectively.

4. Storage facilities:

   A. Develop scope of work to determine criteria for warehouse site selection, with emphasis on creation of up-country storage capacity.

   B. Establish scope of work to determine feasibility of alternative methods and materials for construction of small warehouses, e.g., concrete slab, brick, and corrugated iron, including a thorough examination of the costs.

   C. Assess proportion of new construction which could be met through the use of PL 480 Title I grant-back mechanism.

   D. Develop terms of reference for analysis of problems involved in construction of on-farm storage and drying facilities, including a financial analysis from the farmer's standpoint.

5. The team will estimate the man-months required for the subsequent study, recommend the types of expertise needed to prepare the study, and recommend the BDG agencies to cooperate in the study.

6. The team will leave a rough draft of its recommendations for further investigations with USAID/Dacca, before departure, and complete its final report within a month of returning to the U. S.

I. SUMMARY OF FOOD GRAIN STORAGE POLICIES AND PROBLEMS

Food Grain Supply

Food grain production in Bangladesh is currently estimated at 12 to 14 million tons. Imports in 1975-76 were 1.5 million tons. Estimates of import requirement for 1976-77 range from 1.5 to 2.0 million tons. Marketable surplus from domestic production is estimated from 15 to 25 percent of production, roughly 2.0 to 2.5 million tons. Domestically produced grain remains largely in private hands although BDG is increasingly seeking domestic grain procurement for distribution through ration shops, food-for-work and other government programs. Government procurement in 1975-76 was 425,000 tons (about 3.4 percent of total production). Import food grains are all public sector transactions. Government agencies handled about 2.0 million tons through import and domestic procurement combined (13.5 percent of total food grain supply).

Warehousing Of Government Owned Stocks

Stocks are distributed throughout the year by the Food Ministry. Until the present buildup in stocks, warehouses operated by the government were essentially transit facilities in which stock turnover occurred every 60 to 90 days. Because of good crops and bunched imports, stock levels controlled by the government increased sharply beginning in June 1975. Beginning monthly stocks of grain in BDG inventory averaged 475,000 tons in calendar year 1972; 375,000 in 1973; 206,000 in 1974; 260,000 in January-June, 1975; 702,000 in July-December, 1975 and 898,000 tons in January-June, 1976. Monthly Food Grain Stocks, Arrivals and Offtake figures are indicated in Appendix I.

Longer-term storage resulting from stock buildup requires substantially different storage management practices than with short-term transit storage. Stocks stored up to 6 months through monsoon conditions absorb moisture above maximum moisture for safe storage (See Appendix II for atmospheric and grain moisture conditions at several locations). Insect activity and mold development increases at higher grain moisture levels and grain quality will deteriorate very rapidly.

Government Warehouses

Expanded stocks of grain have exceeded storage capacity controlled by the Food Ministry under recommended storage procedures. The Food Ministry reports available storage on July 12, 1976 as follows:

Flat warehouses	800,000 tons
Silos	225,000 tons
Total	1,025,000 tons
Less unserviceable warehouses	200,000 tons
Total serviceable	825,000 tons

The Ministry also reports use of space for 162,000 tons in rented warehouses much of which is unsuitable for food grain storage.

Warehouses were observed in which sacks were stacked 18 to 20 bags high to accommodate more grain than was possible with the recommended 14-bag height. Insect infestation was not severe in storages which were observed, however, severe infestations were reported in warehouses which were not inspected because of time constraints. Mold development on wheat was observed in the two bottom layers that had been in storage at Savar LSD for 6 months.

Warehouse Conditions

The BDG is improving and expanding existing food grain storage on its own initiative and with the aid of donor agencies as described in a subsequent section. Condition of existing warehouses was described as follows by Pfost in January 1976 (D. Pfost, "Study of Rehabilitation and Construction of Food Grain Storage Structures" FAO/OSRO Consultant, January 1976):

> "Now that food grain stocks are taxing the total warehouse space available in the country and grain stocks will be held in storage, not for a few weeks but for months, adequate protection is mandatory to prevent excessive losses from moisture, insects and theft.
>
> The roofs of many of the godowns leak and tarpaulins are not available in sufficient numbers to protect the stocks of grain below the leaks until the roofs can be repaired. Roof repair should have the highest priority.
>
> Many of the floors in the government godowns require repair, however, most can be utilized temporarily to store bagged grain on pallets (dunnages) but good housekeeping practices will be difficult or impossible due to the rough, cracked condition of the floors. Thus, insect control becomes more difficult. Whenever the damaged floors are not occupied, the floors should be repaired immediately to be readied for proper storage.
>
> Many of the plastered walls have cracked or spalled, resulting in crevices which make insect control difficult. These areas must be chipped and cleaned off, then replastered and whitewashed. This work is being done as fast as funds permit.
>
> Poorly fitted, damaged and deteriorated doors and thresholds, which allow rodents to enter the godowns, are common. The concrete threshold areas are being replaced in several units visited. If the door has deteriorated, or never fit tightly, major repairs or replacement is required.
>
> Some of the vents in the sidewalls do not have proper screens and weather hoods. In one CSD that was visited, the vents did not have grills adequate to prevent theft from the godowns. Screens, bars and hoods should be installed to make the ventilation openings rodent-tight, bird-tight, rain-tight and theft-tight.

Disintegrating loading docks are a common problem, apparrently due to a lack of thick walls and floor slab of a high-strength concrete. Walls and floor slab should be 6" thick well reinforced and made with a minimum of 2,000 psi concrete strength. Too much reliance has been placed on brick construction in lieu of reinforced concrete.

The bitumen moisture barrier now used in floor construction could be replaced by a 0.006" thick polyethylene plastic sheet between the fill sand and the reinforced concrete floor for less cost."

Warehouse Improvement And Expansion

The Secretary of the Food Ministry indicated recent completion (July 12, 1976) of 47 warehouses of 750 tons each (35,250 tons total) and 212 warehouses (120,750 tons capacity) under construction. With some rehabilitation of facilities this year. Secretary Murshed estimates a total of one million tons of storage will be available to the Ministry by December 31, 1976. Donor countries including Denmark, Australia, England and Canada have proposed or initiated assistance in warehouse expansion or improvement (details in a later section).

Government Food Grain Stock And Facility Requirement

BDG has expressed a need for storage capacity for food grains of 2,000,000 tons. Estimates of need for security stocks vary from 400,000 tons to 1,000,000 tons. Expressed proposes of security stocks are:

(i) direct relief feeding program for the calamity stricken people;
(ii) the additional demand of the rationing system which arises due to increase in food grains price in the open market as a result of the calamity.

Observations suggest that a figure of 400,000 tons for amelioration of the affects of the calamity may be high. Annual variation in national food grain production figures are not extremely high, suggesting that

famine conditions tend to be local and may be met with a smaller stock if reasonable stock mobility and communication exits.

Another purpose of security stocks is market stabilization. Stock requirements for this purpose tend to be substantially larger than for famine relief. On a worldwide basis, USDA estimates emergency famine relief requirements at "perhaps around 10 million tons" whereas quantities sufficient to protect against large fluctuations in grain supplies and price would "range from perhaps 56 million to 80 million tons." FAO recommends security stocks of 60,000 tons of rice for Philippines in contrast to 1,000,000 tons in Indonesia where stocks are for multiple uses including intensive monitoring of the private marketing system.

Food grain prices in Bangladesh are highly dependent upon government policy in procurement and distribution of stocks. Imported food grain (by government transaction) sold to Bangladesh consumers at a stable price is essential to market price stability. Government distribution has varied from 2.0 to 2.5 million tons in recent years. Commercial sales through private channels of domestically produced grain (based on 20 percent marketable surplus) is probably 2.2 to 2.5 million tons annually.

Rice prices in Bangladesh are hence highly dependent upon import conditions. Bangladesh's external financial position is weak. Foreign exchange reserves were severely drained in 1973 by commercial purchases of food grains. The nation's trade balance is reported in deficit in the amount of $850 million last year. Financial ability in Bangladesh to absorb world market price and supply stocks through subsidy and foreign exchange outlays is highly limited.

On the other hand, orderly increase in production and political stability to urban centers may require a substantial degree of price stability and steady availability of food grains. Uncontrolled price movements in cereals markets are often abrupt. Price level and price behavior for cereals are subject to some measure of control in nearly every country in the world.

Control of producer and consumer prices throughout Bangladesh through food grain stock management can be achieved only with pervasive information and a highly efficient stock control system. Prices must be collected and reported on a daily basis. Knowledge of location and condition of government stocks and related transport conditions must also be thoroughly developed for adequate operation of such a system.

Bangladesh has a system of government warehouses throughout the country In new construction the government is giving priority consideration to locating warehouses in those political sub-divisions (Thanas) where no facility exists. Major storage depots exist throughout the country in broadly distributed CSDs. With improvement in communications and stocks reporting systems, control information to the Food Ministry in Dacca could be kept up-to-date.

Food Ministry employees at LSD and CSD facilities could also provide market price and potential supply information to the Food Ministry. Such information is necessary for daily decisions concerning stock control in a cereals market in which market tone is influenced through release or procurement of stocks by the government. Similar information systems used to identify calamity situations can assist the government to respond to local shortages and reduce the size of stocks required to avoid famine.

Storage stocks required to meet the needs of ration shops, food-for-work and other government distributions requirements under current programs are variously estimated from 400,000 to 800,000 tons. Storage needs for regular distribution of food grains will depend on the level at which ration shop distribution is maintained; the efficiency of the systems for distributing stocks; the scheduling of imports and the division of BDG stocks between domestically procured and imported stocks.

If encouragement of domestic production is successfully pursued and dependence upon imports reduced, the pattern of flow of grain to urban areas will be substantially modified. If ration shop distribution is decreased and a greater portion of urban food grain requirements satisfied through private marketing channels, size of stocks for normal distribution may also be reduced.

The option of a controlled rice distribution system based on substantial back-up stocks has not been available to Bangladesh in the past. Adoption of a plan that will provide supply control through a system of reserve stocks will require careful analysis of storage environment and facilities that will prevent spoilage in relatively long-term storage, administrative and control systems that will permit effective management; and a pattern of facility expansion for physical maintenance of storage stocks.

Private Sector

Nearly all domestically produced rice and wheat has remained in the private sector in Bangladesh. In 1975 procurement was only 3.5 to 4 percent of production. Reports differ concerning storage difficulties and

storage losses in producer and dealer storage in the private sector. Use of highways as drying surfaces when weather permitted is evidence that drying problems were present. Danish experiments with small drying units and U.S. Mennonite Missionary experiments with various means of seed storage are attempts to improve private sector handling of food grain. The private sector also must store rice in atmospheric moisture and temperature conditions in which it is difficult to maintain grain quality.

II. DONOR ASSISTANCE (JULY, 1976 STATUS)

In this section, a brief review of the current and anticipated activities and programs on grain storage in Bangladesh by various donor agencies other than USAID is presented.

Denmark

a. Pre-fabricated Steel Warehouse.

The Danish Government has agreed to provide $1.5 million (U.S.) for construction of 50 pre-fabricated steel warehouses (500 ton unit) on turnkey basis. An estimated construction cost is $60/T. The Ministry of Food, BDG has selected the sites for the construction of the above warehouses.

b. Additional Credits

The Danish Government is considering providing $1.3 million (U.S.) under a credit basis to BDG for constructing additional new warehouses.

c. Drying Project

In 1972 an agreement was signed between BDG and the Government of Denmark to cooperate on a pilot project on mechanical rice drying in Bangladesh. The pilot project was conducted for 3 years at Bamail, Shibpur and Murandnagar Bazar villages in Comilla district, and Shimulia village in Jessore district. The types of dryers tested were sack dryer with a diesel burner, batch dryer operated by electrical power with a diesel burner, batch dryer operated by a diesel engine with a diesel burner, and batch dryer with a husk

burner. Though benefits resulting from the use of mechanical dryer for drying paddy were demonstrated by the project, adaptability of such systems for paddy drying was not well received by producers, even at the cooperative level.

Australia

a. Pre-fabricated Steel Warehouses

Based on recommendations of the Australian storage team to Bangladesh in February 1975, the Australian Government has agreed to donate 10 pre-fabricated steel warehouses with insulation of 500 tons each to BDG. An estimated total construction cost is $1.0 million (U.S.). Currently, the site selection and final design of warehouses are being considered by an Australian engineering firm.

Great Britain

a. Rehabilitation of Existing Warehouses

The Government of the United Kingdom is currently considering providing financial assistance for rehabilitating existing warehouses in Bangladesh, pending the outcome of the final report to be prepared by the British storage team.

b. Technical Assistance

The Government of U.K. is also considering providing a storage specialist recruited through the Tropical Product Institute to BDG for the conduction of a training program on stock management for inspectors and officers in charge of depots.

Canada

The Canadian Government had originally considered providing financial assistance of $15 million (U.S.) for constructing 400 pre-fabricated steel warehouses of 500 T unit to BDG, with a warehouse maintenance training

program. After discussing with BDG officials, they are now considering providing $5 million (U.S.) for constructing about 130 pre-fabricated steel warehouses of 500 T/unit. The construction cost is estimated to be $75/T. Recently, the Canadian Railway improvement team provided technical assistance to modify 50 railcars of 25 T/unit previously used for hauling rocks and coal for transporting bulk grains. These cars are successfully operating for transporting wheat in bulk from Chittagong silo to Ashuganj silo.

UNDP

a. UNDP Warehousing Project

Recently the UNDP Warehousing project has been approved by both BDG and UNDP, with UNDP contribution of approximately $770,500 (U.S.) and BDG contribution of approximately Tk. 5,267,000 for a period of 4 years. The project is mainly designed to: (1) undertake a comprehensive inventory and evaluation of existing storage facilities, (2) assist in the design of storage facilities, (3) appraise the technical and financial feasibility of specific rehabilitation and construction proposals, (4) assist in the improvement of storage conditions, with particular emphasis on storage problems near production areas, (5) assist in the preparation and implementation of a training program for stock management at warehouses, and (6) assist in achieving uniform grading in marketing of paddy, milled rice and other commodities.

The project manager has been appointed and is in the process of recruiting eight external technical experts for the project (three economists, four storage specialists and one civil engineer).

b. Food Supply and Management Adviser

UNDP has agreed to provide a food supply and management adviser to the Ministry of Food, BDG for 1 year, with UNDP contribution of $64,500 (U.S.). The adviser will assist in the formulation of overall food grain policy with reference to food grain production, pricing, imports, domestic procurement and reserve buffer stock, and assist in the improvement of grain storage facilities and management. He will also review the staff positions at the silos, CSDs and LSDs, the present condition of port handling and internal transportation of food grains with a view to their improvement.

FAO

a. FAO/FRG Logistic Program

Currently technical assistance is provided to BDG under the FAO/FRG logistic project to improve grain handling and movement in Bangladesh, particularly at Chittagong.

b. FAO Food Security Mission

In May 1976 the FAO Security Mission team reviewed the Bangladesh food grain marketing system, domestic grain procurement and food grain import programs, with particular reference to food security. The team report is not yet available.

IBRD

a. Silo Management Program

Recently the contract was awarded to Agroprogress Engineering firm in FRG to provide management and maintenance training programs for silo operations, under IBRD loan.

b. Food Grain Storage Project II

In April 1974, the Ministry of Food, BDG, retained the services of Carl Bro, International A/S and Operations Analysis Corporation A/S, Denmark to conduct a feasibility study for the Food Grain Storage Project II under the credit agreement between BDG and IDA. The above study was completed in October 1975. A summary of recommendations includes additions to silo storage for the purpose of moving imported grain into northern areas of the country and to a smaller degree for storing domestic procurement. The International Bank has proposed additional project work in grain storage but is currently awaiting a response from BDG on the Carl Bro study.

World Food Program

World Food Program personnel are working closely with the Food Ministry (BDG) in monitoring food and food grain storage problems. World Food Program has been a substantial donor of food for relief purposes. In 1975-76, World Food Program also supplied 100,000 tons of wheat to Bangladesh on a concessional basis. World Food Program also facilitated import of three airplane loads of phostoxin in 1975-76 in response to an urgent need to control insect infestation in grain during storage.

Mennonite Mission

Under Mennonite Central Committee Agricultural Program, seed and food grain tests were conducted in order to develop improved storage methods at farm level and cooperative level. For wheat seed storage at farm level, kerosene tins and clay pots (Motkas) with tar coating and a plastic liner were tested under simulated monsoon conditions during the 1975-76 season. Also tested were the uses of the absorbents such as salt and lime in kerosene tins and clay pots in order to preserve the germination of seed. For grain storage at a cooperative level, Ferro-cement bin ("Thailo") and Pusa bin (brick and mortar with a plastic liner) of about 4 T capacity were constructed and tested with paddy.

The MMC report indicated that further testing, refinement and especially economic feasibility of new or modified storage methods, are needed before recommending the use of storage methods tested.

Japan

The Government of Japan is considering providing $4 million (U.S.) for constructing grain storage facilities in Bangladesh from their 1977-78 budget.

III. RECOMMENDATIONS

Our recommendations include the study of both public and private sectors of storage, handling and marketing of food grains in Bangladesh. Priority should be given to the analysis of the public sector. Private sector analysis proposals are included for subsequent consideration by BDG and USAID.

A. Public Sector Study

Overall Objectives

The overall objective of the study is to analyze BDG policies related to import, domestic procurement, marketing and distribution of food grains; to project from those policies future storage facility, administration and management program needs; and to define potential areas for U.S. technical assistance related to those needs. Food grain storage facility and program needs for the public sector will be determined by (1) relative emphasis on imports versus domestic procurement of stocks for government distribution, (2) target size of security stocks, (3) price and supply stabilization programs, and (4) size and character of food grain distribution through ration shops and other distribution programs.

The study will focus on optimum functioning of a public food grain stocks and storage program that will benefit small producers, low-income consumers and foster a privately operated marketing system by providing an institutional framework and infrastructure that will promote economic development. A program of sizeable security stocks designed to protect against large fluctuations in supplies and prices of imports will require intensive and pervasive monitoring of domestic price and supply relationships and substantial administration and control systems used to promote price stability for the benefit of producers and consumers alike.

Problem Areas to be Studied

1. Interfacing of Imports and Domestic Procurement: BDG has obtained stocks for government distribution largely from imports but is increasingly emphasizing domestic procurement and the promotion of domestic production. Reduced imports reduces government revenues from sale of donor imports. Domestic procurement increases government expenditures for operation of a food grain program. Analysis by the study team would seek to project the rate of which a transition to domestic procurement can be carried out, based on (i) food grain production potential and (ii) budgetary constraints.

2. Procurement Objective: Domestic procurement may be simply for the purpose of providing a stock of food grain from each harvest for government use in satisfying stated priority needs. In this case, procurement may be on a obligatory quota basis with little recognition of price behavior or of surplus or deficit areas. Alternatively procurement may be the consequence of a price floor established to provide a guaranteed minimum price for producers. Patterns of acquisition will be substantially different in each case and very significant in determining storage facility needs. The study team will consider storage needs for each alternative.

3. Security Stock Needs: The study team will review FAO recommendations and any other reports on security stock requirements and make any further analysis required by developments subsequent to FAO analysis. The study team will estimate probable target level of security stock, the rate at which security stocks can be developed, and the storage facility requirements associated with estimated development of security stocks. Security

stock levels will vary greatly depending upon BDG objectives in the use of security stocks. Type and size of facility requirements for such stocks will vary depending upon management of the program and upon projected development of transportation and communications infrastructure.

4. Ration Shop Distribution: The study team will review BDG policies of food grains distribution through statutory and modified ration programs. Ration card distribution accounted for approximately 70 percent of BDG sales (offtake) of food grains in calendar years 1972, 1973 and 1974. Projected use of this method of distribution will be a major determinant of grain storage program needs. The study team will project facility, administration and management needs for the program based on distribution by location, source of procurement and transportation requirements for stock.

5. Facility Requirements: Based on the study teams estimates of food grain stock requirements, the team will project a pattern of storage facility requirements including a coordinated system of facility types and by general location. Type of facility will include consideration of additional silos for bulk storage and warehouses for bag storage. The team will also study in detail the comparative merits of various types of warehouses for use in Bangladesh based on comparative cost of construction and maintenance and on the influence of structure on the ability to maintain grain quality. Studies must be closely coordinated with other donor agencies studies especially IBRD.

6. Storage Environment: The study team will analyze records on atmospheric moisture and temperature to determine storage environment in various areas of Bangladesh throughout the year. The team will make recommendations for modification or control of storage environment in warehouses if

necessary for preservation fo stocks. The team will also recommend silo and warehouse management practices for preservation of grain quality in long-term storage. This work must be coordinated with other agencies for complimentary total effort, especially with the warehouse management training efforts of UNDP, silo management program of IBRD and grain drying and quality preservation studies of DANIDA.

7. Storage Administration and Control: The study team will review the techniques of administrative control of the Food Ministry over grain stocks with the objective of improving the quality and currency of information concerning stocks available to the Ministry. The team will also review techniques of control over stocks in storage and transportation in an effort to identify and measure any unaccounted or unrecorded disappearance from government stocks.

Coordination with Other Programs

Upon arrival in Bangladesh, the team will determine the current status of all other donor agency programs reviewed in the previous section. The team will coordinate efforts with all other agencies for a unified evaluation effort building on previous study and avoiding unnecessary duplication of effort in each aspect of analysis. Especially closely related to the objectives of this study are the activities of IBRD, UNDP, WFP, FRG, DANIDA and the Mennonite Missionary group.

Qualifications of the Study Team

The study team will consist of four members, including (1) a grain marketing economist, (2) a specialist in warehouse management and administration, (3) a grain sanitation and storage environment specialist and (4) a grain storage and handling engineer. The team members will be familiar with food marketing and distribution problems in developing

countries and with problems of rice and wheat production and storage in subtropical climates. One member of the team will be designated as team leader with management responsibilities for the team and the team report.

1. Grain Marketing Economist: The grain marketing economist will be qualified to analyze the costs and benefits of alternative (a) policies of procurement of stocks for BDG distribution, (b) levels of food grain stocks maintained for security purposes or other reasons, (c) types and locations of storage facilities, (d) warehouse stock management programs and (e) stocks and warehouse administrative and control programs.

2. Warehouse Management and Administration Specialist: The warehouse management and administration specialist will have practical knowledge and experience in accounting and systems control in elevator management. He will be sufficiently knowledgeable in grain handling and transportation techniques to enable him to recommend handling and transport techniques that will minimize physical losses of grain within the system. He should be familiar with price and supply reporting techniques and ways in which such reports can be used for system management purposes. He will be competent to recommend accounting systems that will minimize the accounting effort required yet provide thorough management information and control.

3. Grain Sanitation and Storage Environment Specialist: The grain sanitation and storage environment specialist will be qualified to determine proper storage management and environment requirements to minimize losses of grain quality under Bangladesh conditions. He will be qualified to analyze and diagnose existing problems causing quality losses in the handling

and storage of grains from insects, molds, rodents, birds and other pests. He will be qualified to assess the effectiveness of sanitation in existing structures and/or management practices to make them more effective. He will be qualified to assess the benefits and costs of alternative methods of reducing storage losses in rice and wheat.

4. Grain Storage and Handling Engineer: The grain storage and handling engineer will be able to appraise the requirements for, and the effectiveness of, alternative (a) storage structures for paddy and milled rice and wheat, (b) handling methods and equipment, (c) transport methods and equipment and (d) processing methods and equipment. He also will be able to assess requirements for the effectiveness of alternative materials handling systems as applied to the assembly movement and loading of rice, both in bulk and in bag.

Each member of the team will compliment and supplement the expertise of each other member. Each member will be able to contribute to solutions in each problem area addressed by the team. It is anticipated that the team will spend 6 weeks to 2 months in Bangladesh.

Counter-part Personnel

USAID/Dacca and BDG will assign counterpart personnel to the study to participate actively in the design of in-country study procedures, in assembly of information and relevant date, in analysis of data and in formulation of recommendations. It is especially important that the Bangladesh government representatives become thoroughly acquainted with the study for purposes of expediting and interpreting information available to the team; to provide insights into the operation of food grain systems not apparent to an outside study team; and to participate in formulation of workable recommendations. Counter-part personnel would be expected

to provide in-country understanding of recommendations, after the team leaves, that will facilitate implementation of recommendations. Counter-part personnel should have technical knowledge relating to each of the fields of expertise of the study team and a familiarity with food grain operations and personnel of the Food Ministry.

Team Reports

Before leaving Bangladesh, the team will prepare a complete draft report summarizing (1) the methods and results of the analysis, (2) the consequences, costs and benefits of viable alternatives, (3) recommended priorities and scheduling of development and (4) recommendations for technical assistance by donor agencies in implementing study recommendation. The report will be presented to USAID/Bangladesh and appropriate BDG agencies for review and interaction with team members before their departure from Bangladesh.

Upon review and acceptance of the report, analysis and recommendations by USAID and BDG, 50 copies of the report will be prepared for distribution through established channels by USAID/Washington and USAID/Bangladesh.

B. Private Sector Study

Commercial Storage and Rice Milling

1. Overall Objectives: The overall objectives of the study are to review the existing storage and rice milling facilities of the private sector in Bangladesh; to improve grain storage and rice milling facilities; administration and stock management practices; and to define potential areas for U.S. technical assistance related to development of efficient and effective grain storage and rice milling systems in the private sector.

Prior to 1975-1976, virtually all the domestic food grains entering the market were handled by the private sector. Only in 1975-1976, an appre-

ciable amount of food grains domestically produced (425,000 tons) was handled by the public sector through BDG's procurement program. Although a higher procurement of domestically produced food grains by BDG would continue in good crop years, the private grain marketing sector will continually play a major role in food grain marketing of domestically produced grains in Bangladesh

The study will focus on development of effective and efficient grain storage and rice milling systems in the private sector that will not only benefit both producers and consumers but also promote overall economic development of Bangladesh. It is recommended that the private sector study will be conducted after completion of the public sector study.

2. Problem Areas to be Studied: Though a few studies on food grain storage situations in the public sector were conducted by external donor agencies in cooperation with BDG, the study on food grains storage and especially rice milling situations of the private sector in Bangladesh, with respect to facilities, administration and stock management practices, and milling efficiency, has not been conducted. It should be noted that development of efficient and effective rice milling industry in the private sector will be a vital necessity as the BDG's paddy procurement program increases.

a. Existing Storage Facilities: The study team will review the existing facilities in terms of type, size, location, condition, capital and recurrent costs, grain quality and quantity losses, maintenance, transportation, communication system, handling, and drying facilities.

b. Existing Rice Milling Facilities: The study team will review the existing rice milling facilities, in terms of type, size, location, condition, milling efficiency, capital and recurrent costs, quality and quantity losses. Transportation, handling, drying and storage facilities. Also the study team will conduct the experiments to obtain information needed at a few selected mills in different regions if such information is not available.

c. BDG and Other Institutions: The study team will examine BDG and other institutional capabilities to carry out the programs for improving grain storage and rice milling situations in its private sectors. They will also examine grain storage warehouse rice mill licensing mechanisms and National Standards and Grades for both paddy and milled rice for assessing the values of products and processed products.

d. Storage Facility Requirements: Based on both the public sector study team's recommendations and the study team's review on the private sector, the teams will recommend the rehabilitation programs for existing storage facilities and also project a pattern of new storage facility requirements including types, sizes, locations, handling and drying systems.

e. Rice Milling Facility Requirements: The team will study in detail the comparative merits of various types of rice milling units and rice mill facilities with and without mechanical unit and drying systems for use in Bangladesh based on comparative cost of installation, operation and maintenance, and on milling quality and rice quality preservation. The team will also advise and recommend the rehabilitation and modernization programs of the rice milling industry in Bangladesh.

f. Administration and Management of Storage and Milling Facilities: The team will review administrative and management techniques used by both storage and rice milling facilities in the private sector. The team will also examine technical capabilities of personnel operating and managing rice milling facilities. The study team will advise and recommend improved administration and management procedure and practices to be used by the private sector, including training and research programs. The team will also advise and recommend proper storage warehouse and rice mill licensing mechanisms and sound, practical National Standards and Grades for paddy and milled rice to be adapted in Bangladesh.

3. Qualifications of the Study Team: The study team will consist of three members including a grain marketing economist, a grain storage and handling engineer and a rice milling specialist. The team members will be familiar with food grain marketing and distribution problems in Southeast Asian countries and with problems of rice and wheat production, storage and processing in sub-tropical climates. One member of the team will be designated as the team leader with management responsibilities for the team and the team's report. It is anticipated that the team will spend 3 to 4 months in Bangladesh. Personnel requirements are as follows:

a. Grain Marketing Economist:

The grain marketing economist will be qualified to analyze the costs and benefits of alternative types and locations of storage and rice milling facilities, warehouse stock management program, stock and warehouse administrative and control programs and rice mill administrative and management programs.

b. Grain Storage and Handling Engineer:

The grain storage and handling engineer will be able to appraise the requirements for, and effectiveness of, alternative storage structures for paddy and milled rice and wheat, handling methods and equipment, transport methods and equipment and processing methods and equipment. He also will be qualified to analyze and diagnose existing problems causing grain quality losses in handling and storage and to assess the effectiveness of sanitation in existing storage structures and to suggest modifications in existing structures and/or management practices to make them more effective.

c. Rice Milling Specialist:

The rice milling specialist will be able to appraise the requirements for and its effectiveness of, various rice milling methods and equipment. He

will be qualified to assess the benefits and costs of various rice milling methods. He also should be able to develop proper rice mill licensing mechanisms and sound, practical standards and grades for paddy and milled rice.

4. Counter-part Personnel: Same as those stated in Counter-part Personnel section of the Public Sector Study.

5. Team reports: Same as those stated in Team Reports section of the Public Sector Study.

Analysis of On-Farm Storage and Drying Facilities

It is estimated that about 90 percent of the population in Bangladesh is subsistence and peasant farm families. Therefore, a major part of total harvested rice is stored and consumed on the farms. The rice crop is harvested almost completely by hand. All crops harvested are dried by a natural, sun-drying method and stored on the farms at some time whether they are destined for eventual sale or on-farm consumption.

Although exact extent of grain losses during the post-harvest period in developing countries is not known, it is a well recognized fact that a substantial amount of food grain production in developing countries, especially those located in tropical and sub-tropical zones, is lost every year during the post-harvest period due to improper and inadequate post-harvest handling, drying and storage methods. In addition to the grain quantity loss, it is believed that considerable food grain quality loss is experienced in developing countries. This is of vital importance to the subsistence level families because their daily nutritional requirements are extracted mainly from cereal grains.

Currently, emphasis has been placed on increased food grain production through the use of production inputs, especially improved seeds, fertilizer, chemical pest control measures and irrigation. Practically no attention has

been given to on-farm storage aspects by BDG. It is indeed ironic to spend sums of money on increasing production only to lose a substantial amount of grains produced through improper and inadequate storage and drying methods.

Therefore, it is recommended that technical assistance through USAID/Bangladesh be given to BDG for improving on-farm storage and drying.

Technical Assistance Experts: A storage specialist, either entomologist or agricultural engineer who is familiar with tropical and sub-tropical grain storage and marketing problems at the farm level, preferably with some knowledge of economics.

Duration of Study: 3 months.

Terms of Reference:

1. Visit Tropical Stored Product Center, Slough; Kansas State University, Manhattan; FAO, Rome and International Institute of Tropical Products, Ibadan to discuss with scientists and engineers who are working with on-farm storage, drying and handling problems in developing countries, and also obtain improved storage, drying and handling methods that may be applicable to Bangladesh and other relevant materials before arriving in Bangladesh.
2. Equipped with a well calibrated, portable moisture tester, thermometers, a sling psychrometer, sample probe and pans, sieves for paddy and milled rice and a magnified glass.
3. Review the current on-farm grain storage methods in Bangladesh in terms of type, size, location, grain quantity and quality losses and quality control methods. Also review on-farm grain drying methods with respect to location, season, it's effectiveness, efficiency, milling quality and losses.

4. Review the programs or activities to improve on-farm storage and drying methods by BDG, other institutions and donor agencies. Also examine BDG and other institutional capabilities to carry out the programs for improving on-farm grain storage and drying situations.
5. Conduct a survey of traditional on-farm grain storage losses and drying methods at a few selected locations in cooperation with BDG counterparts and UNDP storage experts under Warehousing Project.
6. Analyze farm structure (size), grain production, consumption and marketing patterns at farms.
7. Analyze seasonal and regional price fluctuations of paddy and rice at different qualities.
8. Conduct economic analysis of a modified or new (non-traditional) storage and drying methods. For economic analysis, seek assistance from economists in USAID/Bangladesh or economists under UNDP Warehousing Project if assistance is needed.
9. Examine socio-economic feasibility of adapting an improved method by farmers.
10. Prepare the report with the recommendations for improvement of on-farm grain storage and drying situations in Bangladesh, including extension programs.

APPENDIX

APPENDIX I

Bangladesh Foodgrain Stock, Arrival and Offtake figures [1/]

		1972	1973	1974	1975
Jan	S	279	139	271	204
	A	213[2/]	229	38	194
	O	84	146	129	143
Feb	S	407 (408)[3/]	218 (222)	192 (180)	321 (255)
	A	213	194	91	79
	O	134	160	123	129
March	S	310 (487)	543 (256)	174 (148)	240 (205)
	A	213	468	99	172
	O	196	178	133	146
April	S	217 (504)	501 (546)	140 (114)	251 (231)
	A	213	212	147	138
	O	188	210	139	131
May	S	209 (529)	379 (548)	185 (122)	265 (238)
	A	213	179	224	316
	O	234	257	132	125
June	S	269 (508)	303 (470)	215 (214)	265 (429)
	A	213	126	134	418
	O	250	217	155	142
July	S	365 (471)	301 (379)	217 (193)	445 (705)
	A	354	83	292	172
	O	255	154	155	165
Aug	S	463 (570)	222 (308)	355 (330)	740 (712)
	A	295	159	225	188
	O	297	156	185	166
Sept	S	365 (568)	202 (311)	392 (370)	635 (734)
	A	272	263	29	105
	O	307	173	180	188
Oct	S	338 (533)	226 (401)	219 (219)	611 (651)
	A	161	288	76	214
	O	285	190	154	205
Nov	S	217 (409)	336 (499)	215 (141)	660 (660)
	A	227	59	194	277
	O	196	148	158	190
Dec	S	223 (440)	272 (410)	139 (177)	707 (747)
	A	108	82	244	248
	O	154	125	122	116
Totals for year:					
Arrivals:		2,695	2,342	1,793	2,521
Offtakes:		2,580	2,114	1,765	1,846
Ave. Monthly Offtake:		215	176	147	154

Notes:

1. These figures from Government sources, are rounded to the nearest thousand metric tons. Stocks (S) include all grain - rice, wheat and wheat flour in the Government ration system. These stock figures also include amounts procured domestically which have not been separately identified out. Arrivals (A) refer to food imports regardless of their method of financing. Offtakes (O) refer to the release of grain through the Government's ration system to the public for all eight ration categories including food for work.

2. For the first six months of 1972 the monthly breakdown of food grain arrivals is not available; the monthly average has been used as an estimate of the monthly arrivals.

3. Two stock figures have been included. The first is the Government's figures, and the second is that calculated as a cumulative residual every month assuming that the January 1st stock level is correct. Discrepancies have not been carried through to the following year.

SOURCE: USAID/Bangladesh

Bangladesh Foodgrain Beginning Monthly Stocks and Offtake

January - June, 1976

Month	Offtake	Stock
January	124	892
February	139	949
March	118	989
April	101	931
May	94	822
June		802

Source: USAID/Bangladesh

APPENDIX II

NORMAL MONTHLY HUMIDITY AT FIVE LOCATIONS IN BANGLADESH AND APPROXIMATE EQUILIBRIUM MOISTURE CONTENT OF WHEAT (IN PARENTHESES)

Month		Chittagong	Narayanganj	Sreemangal (Sylhet)	Khulna	Dinajpur
January	(M)	81 (16)	80(15.8)	87 (18.2)	72(1.3)	86 (18)
	(E)	59 (12.5)	53(12.4)	70 (13.9)	61(12.6)	50 (10.9)
February	(M)	76 (15)	76(15)	81 (16)	72(14.3)	77 (15.2)
	(E)	58 (12.5)	50(10)	59 (12.3)	58(12.3)	47 (10.5)
March	(M)	76 (15)	76(15)	77 (15.2)	72(14.3)	63 (13)
	(E)	67 (13.5)	45(10.3)	54 (10.2)	54(11.5)	30 (8.5)
April	(M)	73 (14.5)	71(14.1)	80 (15.8)	76(15)	68 (13.6)
	(E)	70 (13.9)	52(12.3	59 (12.3)	62(12.8)	30 (8.5)
May	(M)	79 (15.6)	73(15.6)	82 (16.5)	78(15.4)	78 (15.4)
	(E)	78 (15.4)	73(14.5)	75 (14.9)	74(14.6)	61 (12.6)
June	(M)	84 (17.3)	86(18)	87 (18.2)	82(16.6)	87 (18.2)
	(E)	84 (17.3)	78(15.4)	83 (17.0)	82(16.6)	77 (15.2)
July	(M)	87 (18.2)	87(18.2)	87 (18.2)	85(17.5)	88 (18.9)
	(E)	86 (18)	79(15.6)	85 (17.5)	84(17.3)	77 (15.2)
August	(M)	87 (18.2)	87(18.2)	87 (18.2)	86(18)	88 (18.9)
	(E)	86 (18)	78(15.4)	86 (18)	84(17.3)	78 (15.4)
September	(M)	86 (18)	84(17.3)	87 (18.2)	83(17)	87 (18.2)
	(E)	84 (17.3)	87(18.2)	86 (18)	82(16.6)	78 (15.4)
October	(M)	85 (17.5)	80(15.8)	87 (18.2)	78(15.4)	83 (17)
	(E)	79 (15.6)	73(14.5)	86 (18)	76(15)	74 (14.7)
November	(M)	84 (17.3)	78(15.4)	89 (19.3)	72(14.3)	80 (15.8)
	(E)	71 (14.1)	66(13.4)	86 (18)	70(13.9)	67 (13.5)
December	(M)	85 (17.5)	82(16.6)	87 (18.2)	72(14.3)	84 (17.3)
	(E)	68 (13.4)	84(17.3)	87 (18.2)	66(13.4)	63 (13)

(M) Morning Reading in Percent
(E) Evening Reading in Percent

Equilibrium moisture contents are for description at 77 degrees and may be 1 to 2% lower for adsoption at 90 degrees F.

Source: D. Pfost, Study of Rehabilitation and Construction of Food Grain Storage Structures (Bangladesh), FAO, Rome, January 1976.