Final Draft

PUBLIC PROCUREMENT OF PADDY & RICE IN BANGLADESH MILLING AND STORAGE ADJUSTMENT FOR EFFICIENCY

Mahfoozur Rahman

International Food Policy Research Institute (IFPRI)
Bangladesh Food Policy Project

Funded by USAID under Contract No. 388-0027-C-00-9026-00

May, 1992

A List of Selected Abbreviations and Acronyms

ADP	- Annual Development Programme
BADC	- Bangladesh Agricultural Development Corporation
BARI	- Bangladesh Agricultural Research Institute
BBS	- Bangladesh Bureau of Statistics
BD	- Bangladesh
BIDS	- Bangladesh Institute of Development Studies
BJMA	- Bangladesh Jute Mills Association
BJC	- Bangladesh Jute Corporation
BJMC	- Bangladesh Jute Mills Corporation
BRDB	- Bangladesh Rural Development Board
BKB	- Bangladesh Krishi Bank (Agricultural Bank)
BSB	- Bangladesh Shilpa Bank (Industrial Bank)
BB	- Bangladesh Bank (Central Bank)
BR	- Bangladesh Railways
BRRI	- Bangladesh Rice Research Institute
BSTI	- Bangladesh Standard and Testing Institution
CIF	- Cost, Insurance and Freight
CSD	- Central Storage Depot
DGDP	- Directorate General of Defense Purchase
DGF	- Directorate General of Food
FAO	- Food and Agricultural Organization (of the United Nations)
FCI	- Food Corporation of India
FFYP	- Fourth Five Year Plan
FM	- Flour Mill
FOB	- Free on Board
FS	- Free Sales
GDP	- Gross Domestic Product
GOB	- Government of Bangladesh
HYV	- High Yielding Variety
IFRI	- International Food Policy Research Institute
LAC	- Lakh,(One Hundred Thousand)
LC	- Letter of Credit
LSD	- Local Storage Depot
MES	- Military Engineering Service
MO	- Marketing Operation
MOF	- Ministry of Food
NBR	- National Board of Revenue
OMS	- Open Market Sales
PFDS	- Public Foodgrain Distribution System
PR	- Palli (Rural) Rationing
PWD	- Public Works Department
SR	- Statutory Rationing
TR	- Test Relief
US	- United States (of America)
USAID	- United States Agency for International Development
USDA	- United States Department of Agriculture
WQSC	- Weight Quality and Stock Certificate

CURRENCY EQUIVALENTS

The exchange rate of Bangladesh currency, Taka (Tk) is tied to a basket of currencies, with prime linkage to United States Dollars. The official rate as on 2nd February 1992 was Tk. 38.9326 per US Dollar.

US $ 1 = Tk. 38.9326

Tk. 1 = US$ 0.2569

Weights, Measures and Units of Number

1 maund (md) = 0.03732 metric ton (MT)

1 long ton (British) = 1.016 metric ton (MT)

Lakh, lac = Hundred thousand (00,000)

Crore = Ten Million (00,000,000)

Financial Year(FY)

July 1 - June 30.

Public Procurement of Paddy and Rice
in Bangladesh Milling and Adjustments
for Efficiency

Table of Contents

		Page
I.	INTRODUCTION	1
II.	STABILIZATION POLICIES	3
	1. Need to Support Producer Prices	
	2. Positive Price Support to Producers	
III.	THE MAJOR OPTION: RICE OR PADDY	6
	1. Variety and anatomy of paddy Grain	
	2. Imperatives of Safe Storage	
	3. Recent Scenario in Bangladesh	
	4. Types of Storage	
	5. Storability of Paddy and Rice	
	6. Producer price Support Option by Paddy	
IV.	IRRI/BORO - MANAGEMENT OF WET SEASON HARVEST	12
	1. Growing Production of Wet Season Crop	
	2. problems of Wet Season Harvest	
	3. Post Harvest Problem of IRRI/Boro Crop	
V.	THE QUESTION OF MOISTURE	15
	1. Importance of Grain Moisture for Storage	
	2. Equilibrium Moisture Content	
	3. Impact of Climatic Condition on Procurement	
VI.	PROCESSING TECHNOLOGY	21
	1. Parboiling	
	2. Drying	
	3. Milling	
	4. Typical Nomenclatures	

VII. MILLING RATIOS 26

(1) Major Variables and Testing Methods

(2) Procedures in Bangladesh

(3) DGF Milling Ratios

(4) Fixation of a Uniform Milling Ratio

VIII. PUBLIC PROCUREMENT OF FOOD GRAINS IN INDIA 31

(1) A Short History

(2) Objectives

(3) Mechanisms of Procurement

(4) Food Grain Prices and Stabilization

(5) A Recent Sconario

IX. A DISCOUNTING SYSTEM 36

(1) A need for Allowances

(2) Deduction and Discounts

(3) Deduction of Price (Batta)

(4) Deduction of Weight (Jalta)

(5) Practical Solution to Paddy Drying Problem

X. MILL GATE PURCHASE - ITS WEAKNESSES 39

(1) Brief Description

(2) Major Weaknesses

(3) Realities of the Situation

(4) Its Impact Upon Price Support

XI. A SUM UP 42

XII. CONCLUSION AND RECOMMENDATIONS 44

XIII. ADDENDUM : RICE EXPORTS 47

Some Technological Possibilities for Rice Processing and Value Addition.

List of Tables

Table		Page No.
1	Foodgrain Balance FY 1984-1991	4
2	Alternative Scenario for Foodgrain Supply and Demand	5
3	Comparative Advantages-Disadvantages of Flat and Bulk Storage for Paddy/Rice	9
4	Storage Losses in Traditional Storage Structure	11
5	Foodgrain Production FY 61-90	13
6	Safe Storage Life of Paddy	16
7	Hygroscopic Equilibrium for Paddy	17
8	Hygroscopic Equilibrium of Rice	18
9	Typical Mill Yields and Composition of Products	27
10	Rice : Production and Market Arrivals (India)	33
11	Procurement Prices Paddy and Rice (India)	35
12	Weekly National Milling Status Report	41

Public Procurement of Paddy and Rice
in Bangladesh

Milling and Storage

Adjustments for Efficiency

EXECUTIVE SUMMARY

1. In recent years, the growth of paddy production in Bangladesh has shown steady upward trends. Such production gains have been most noticeable in the Boro Crop where the use of modern agricultural inputs and use of power pumps for irrigation are wide spread. With such trends and a selfsufficiency in rice production, the traditional methods and objectives of public procurement are becoming increasingly out of tune with the real situation. The major objective, thus can now be to give price support to producers towards a stabilization program so that prices do not fall during harvest season. Such public procurement entail collossal amount of scarce financial resources of the Govt. Therefore, attempts to improve the efficiency of procurement is a vital requirement.

2. Under the present situation, the form of procurement is taking the shape of a buffer stock operation. The recent foodgrain balance indicate a positive rice balance which is likely to grow rapidly in the expected favourable situation. With increasing surpluses, the role of the Govt. Department will be mainly to hold stocks for long range storage either for future shortfalls or for export.

In either case, the need for safe keeping of the precious foodgrain stock is supreme and without which the whole program is bound to get into serious difficulties. It is not only good enough to have an efficient procurement policy, it should also be implemented well so that all major objectives are achieved with least bugdetary costs.

3. The major objectives of price support to farmers are best served by procurement of paddy and not rice as is presently practised. Paddy keeps well in storage for a longer period than rice. The climatic conditions of wet months make milling and storage very difficult. In such a climate rice spoils very quickly after a maximum shelf life of 2-3 months. This compells the Govt. to release the rice into another procurement season. The dumped rice puts downward pressure on the price, necessiating additional quantities of procurement. Here the surplus stock must be taken off the market and stored for a long period safely. Under the present state of milling and storing technology of Bangladesh, it can only be done in the form of paddy. Moderately wet paddy can be bought with a system of discounting for extra moisture. Indian and local experience indicate that such paddy can be kept safely under present storage technology.

4. Many other reforms can enhance the efficiency of procurement. They are (a) Discontinuation of Mill Gate Purchase Scheme (b) Fixation of Uniform milling ratio (c) Procurement of rice for PFDS by tender (d) Procurement of paddy only at farmer level. If implemented, they will certainly reduce budgetary costs of procurement with better price support for farmers. But, these are ad-hoc solutions only. The real solution lie in long term development of crop-dryers, silo storage plants, modern milling industry and an export trade in rice with all the economic benefits of such a modern and efficient post harvest sector.

PUBLIC PROCUREMENT OF PADDY AND RICE IN BANGLADESH
MILLING AND STORAGE

ADJUSTMENTS FOR EFFICIENCY

I. INTRODUCTION

1. Ever since the great Bengal famine of 1943, successive Governments of territories now comprising Bangladesh, attempted to ensure food security for the people. Chronic deficits of food grain were met by imports and at the same time, a program of internal public procurement continued for the last five decades. Since independence in 1971, the Government of the infant state of Bangladesh pursued vigorously the objective of attaining self sufficiency in food grains. At the same time,internal procurement of paddy and rice was continued for various reasons. The technology of green revolution in the form of HYV seeds, chemical fertilizer, irrigation and use of modern pesticide has silently revolutionized the paddy production in recent years. Inspite of many natural disasters like cyclones and catastrophic flooding at regular intervals, the rate of growth of paddy production maintained a steady and sustained upward trend over the recent years. Specifically, dissiminition of irrigation technology in the form of deep and shallow mechanized tubewell pump have made possible to bring into production once fallow lands to harvest a second crop where once, only one grew fed on rain. Inspite of these impressive growth statistics, the per unit area yields are well below Pakistan, Burma, Indonesia, Malaysia, Sri Lanka and the Philippines. As a matter of fact, the present country wise average yield of 1.52 MT/hectare of milled rice is only one third of what the BARI varieties have achieved in farm level experimental plots. Therefore, the often repeated fears of reaching a technological plateau of production at which laws of diminishing return apply, are a long way away in Bangladesh. All these and the various analyses which indicate Bangladesh's evident comparative advantage in paddy production justifies fully, the effort to increase production leading to export in foreseeable future.

2. In the past, the Govt. procured rice and paddy by various coercive methods. Levys on producers, rice mills, cordons, restriction on movement of grain in selected areas were some but not all of the methods the administration used to build up the "food security" stock. Outright confiscation under "Anti-Hoarding" laws and forced lifting of rice in border belts were also practiced. But with near self sufficiency in the recent past, the major object of internal procurement can only be to provide price support to the grower. The advantages of a well organized and effective prices support programme is evident in case studies in India, Kenya and Pakistan. Like in any social benefit program, there is an essential cost element in internal procurement which the society must bear towards its present and future benefits. While there are conflicting opinions for and against a price support programme, there is no difference of opinion for enhancing efficiency in the implementations of such a

program. There is again no controversy about the ill effects of an ineffectual expenditure of public funds and such funds, are scarce in today's Bangladesh. WB reports that over 4 billion dollars are in the pipeline "awaiting" disbursement for a multitude of development programs, each with its own priorities and compulsions,but all with high IRR. The opportunity cost of public funds in Taka form is difficult to determine, but certainly never been higher than at the present moment. To implement an effective procurement with high efficiency should therefore be a top priority policy objective. To be otherwise, will not only entail wastage and leakages of scarce revenue resources, the ill effects have and are having far reaching social and economic repercussions detrimental to the objectives of social benefits.

3. Given that the internal procurement is essential to provide the vital price support to the impoverished paddy growers of Bangladesh attempt must be made for devising methods to usher in as much efficient as possible. The limitations of affecting an effective price support programme of gigantic proportion is well known especially in a poor third world country like Bangladesh. Structural weaknesses in public administration, lack of physical infrastructure, antiquated post-harvest technical services and poor transportation in a wet tropical climate ideal for rapid deterioration of food grain quality,are some of the inherent constraints under which any planner is doomed to work. Nonetheless, if the task is challenging, the rewards are far reaching. Any improvement in this program will have an immediate positive impact upon the production of paddy. Any added wealth thus accrued in the rural areas, where the poorest of the poor in the present day world live, have such human impacts that are difficult to visualize for persons who have no personal knowledge of what abject poverty means. In such circumstances all efforts should primarily be channeled towards providing a higher share of the procurement price to the grower who never receives, nor is likely to receive,the total public support price. Any percentage improvement of his share is an improvement indeed ! Therefore, efforts will be made to suggest ways and means to bring about greater efficiency into the public procurement of paddy/rice in Bangladesh, its principal instruments of milling and storage to implement the program. The old question as to the choice of procurement in paddy or rice form will be attempted to be resolved. Optimization of existing post harvest technology and improvement of storage procedures will also be suggested. With a case study of India, these structural adjustments, if implemented are expected to bring about considerable saving of resources both in monetary and stock quality terms. All there reforms are designed to achieve the primary objective of internal procurement:to provide price support to the grower. As to the consumer interests, and providing relief to the vulnerable, there are other venues and mechanisms which must not be confused with the objectives of internal procurement. Improving the distribution system is another matter altogether, to be belt with separately.

II. STABILIZATION POLICES

(1) The Need to Support Producer Price

1. In the opinion of many rice marketing specialists, there is no difference between price stabilization at producer level and maintenance of a national buffer stock. A stabilization agency acquiring stocks to implement a floor price in a year of good harvest will hold a part of them for the following year to be sold at greater advantage,should the harvest be less favorable that year. This stock may be termed by various names, but in reality it is a buffer stock. The function of this stock may be likened to that of a shock absorber in an automobile to take care of bumps to make the ride smooth. Stocks thus held must also be released at regular intervals and replenished, also regularly otherwise,the quality is bound to deteriorate to serve no useful purpose. Besides it will cause large financial losses to the stabilizing agency. It is, perhaps, reasonable to distinguish between two stocks - one for normal and seasonal stabilization of prices, the other national buffer stock to take care of emergency shortages. Such emergencies could result from any or a combination of :

(a) A severe crop failure due to floods, drought and pests

(b) Disasters like cyclones and floods which not only reduce production but also cut communications and disrupt marketing

(c) War or political upheavals to upset trade patterns.

2. Thus, in practice, a buffer,reserve and distribution stocks all may operate together. It is only the quantum of stocks and the intended mode of use in which one may find a distinction.

3. Rice producing or consuming countries in which stabilization of prices are in vogue,generally fall into three categories :

(a) production is much less than consumption (25-50% shortages)

(b) production is close to consumption but some imports are necessary (5-25% shortages)

(c) production is in excess of consumption with need to export the surplus quantities.

Bangladesh is presently in the category (b) with situation rapidly leading to condition (c).The most recent food grain balance from an authoritative source is given below:

Table : 1. Foodgrain Balance, FY 1989-1991

Financial year	FY 89	FY 90	FY 91 (Budget)	FY 91 (Projected)
Population in Million :	109.5	111.9	114.4	114.4
		(Millions of MT)		
Foodgrain Consumption norm (16 Oz/Cap/day)	18.17	18.56	18.98	19.98
Gross Production	16.56	19.29	19.50	19.50
Seed/Feed/Losses (11%)	1.82	2.12	2.14	2.14
Net Production	14.74	17.17	17.36	17.36
Imports	2.38	1.71	2.03	1.74
Food aid	1.44	1.11	1.78	1.70
Commercial	0.94	0.60	0.25	0.04
Foodgrain Supply	17.12	18.88	19.39	19.10

Source : World Bank (Food Policy Review, Aug.,1991)

3. For a number of reasons, it is a fact that rice production is showing positive upward trend leading to a nominal surplus. In such a borderline situation, without an effective producer price support programme, the price will definitely fall leading to an artificial glut in the domestic market with terrible repercussions on the next season's production, perhaps leading to deficiencies again.

4. In Bangladesh,the possibilities of increased production is tied to basically expansion of Boro production. This season is marked by wide spread use of HYVs,irrigation and low risks of flooding. The expansion of low lift and shallow tubewell irrigation has been very rapid,specially with the liberalization of irrigation equipment since 1988. Recently, the introduction of manually operated treadle pump - an indigenous invention - is bringing about another silent revolution. For farm sizes of one acre or below, there really was no efficient system of irrigation. This manually operated pump-in one form using bamboo pipes - is ideal for subsistence agriculture for farms at or below one acre size. Therefore, the rate of expansion of production is expected to accelerate, provided the farmer somehow recoups, at least his production cost of Boro paddy. The mid term projections of supply and demand are thus :

Table : 2. Alternative Scenarios for Foodgrain Supply and Demand

(000 MT)

Base Scenario (D1 & SII)

Year	1990	1991	1992	1993	1994	1995	2000	2005	2010
Foodgrain Balance(Supply -Demand)	17	-89	264	604	958	1274	3260	3235	1622
Percent Surplus	0.1%	-0.5%	1.3%	2.8%	4.3%	5.6%	12.0%	10.9%	5.3%
Rice Balance (Supply-Demand)	1220	600	987	1362	1751	2103	4277	4456	3040
Percent Surplus	6.6%	3.3%	5.2%	6.9%	8.5%	9.8%	16.6%	15.8%	10.5%

Source : WB (Food Policy Review - Aug 1991)

In such circumstances, the emphasis must be to increase production. In otherwords, the positive trends and dynamism generated by a multitude of factors has to be maintained. Here the support to producers should be the prime policy objective to sustain these positive trends.

(2) Positive Price Support to Producers

1. The foregoing discussion indicate a need for an effective price support in the form of an efficient procurement programme which must reach farmer level. Among other factors for an effective price support scheme for farmers, from implementation point of view, the following are considered most important :

(a) Form of Procurement for effective price support to farmers

(b) Choice of grain (rice or paddy)

(c) Management of the procured stock (call it reserve stock)

(d) Utilization of the procured stock in that :

(i) Milling paddy into rice by most efficient method available

(ii) Lowering costs of such conversion by fair and realistic milling ratio

(iii) Support to private sector mills to operate efficiency so that higher quality rice is delivered to the Government at a lesser cost.

2. The objects of all these policies are mainly two told :

(a) To provide the producers a price support which gives enough incentives to maintain the present trend

(b) To bring about efficiency in management of procured stock to reduce marketing costs to the Government.

Thus, if the Government could obtain a higher ratio on its procured paddy and a better product by more efficient use of technology, the ultimate cost of stabilization will reduce. Further, if costs of storage, distribution and processing are kept as low as possible by greater efficiency at every level, and if the seasonal price depression at harvest time can be reduced, the share of the total costs of procurement which goes to the farmers can be substantially increased. In this way, farmers can be provided with greater incentives without increasing or, infact, reducing the budgetary costs of stabilization programme. The contradictory demands of thus providing higher incentives to farmers at a lesser cost to the State are not an unsurmountable problem, provided the efficiency of operations are optimized to maximum under the objective situation.

III. THE MAJOR OPTION : RICE OR PADDY

1. As seen earlier, the major object of public procurement in Bangladesh today is to provide price supports to the producer. To do so entails a question as old as the history of public intervention in market itself; what to procure, paddy or rice ? It is not an easy question to answer briefly. There are technical, financial, managerial and even socio-political implications to this apparently simple problem. Before any attempt is made to find a logical solution to this thorny problem in Bangladesh context, a brief description of the paddy grain itself is in order.

(1) Variety and Anatomy of the Paddy Grain:

1. An understanding of the basic varieties and gross anatomy of the paddy grain is felt necessary for the following :

(a) To appreciate various options of the milling process

(b) To appreciate the causes of deterioration in storage

(c) To understand the problem of storage for prolonged safekeeping of grain

(d) To have basic information about various varieties- with special attention to HYVs.

2. The culture of rice cultivation goes back to great antiquity. It is recorded as cultivated in China at about 2800 BC and in India, not later than 1500 BC. There are more than 20 species of rice (genus oriza), though only two species are today cultivated commercially - Oryza Sativa and Oriza Glabberrima. The main species of rice, Sativa,is grown in all the rice growing countries of Asia. This species is again grouped into three distinct types, (a) Indica (b) Japonica (c) Javonica. For once,the Latin munching scientists have named them easy enough to locate, India, Japan and Java (Indonesia) varieties which grew originally in those regions. Indica varieties are characterized by tall, slender and droopy leaves, distinct photoperiod sensitivities and high grain dormancy. By crossing these tall Indica varieties with dwarf Japonica varieties, the first High Yielding varieties were developed in 1960s. These hybrids are of many types. But they all are semi-dwarfs, heavy tillering, having erect leaves and are non sensitive to changes in the photo period. These modern varieties respond to nitrogen fertilizer without lodging but have comparable or even lower yields to traditional varieties with low nitrogen inputs. In collaboration with IRRI, BRRI has now developed a number of HYVs for use in Bangladesh environment, named by numbers e BR-II, BR-6 etc. Present research is now directed to develop a deep water B. Aman and a salt resistant variety for the coastal areas. Besides, resistance to major pests, diseases, and environmental stresses are also being gradually incorporated by selected breeding programs into newer varieties. As far as the specific interests of a market operator is concerned, two negative aspects must be borne in mind for HYVs in Bangladesh :

(a) Low dormancy ie propensity to sprout under certain climatic condition

(b) Non sensitivity to photoperiod ie no distinct season for plantation.

4. The rice grain rough rice or paddy consists of husk and the kernel (caryopsis). The outer layers of kernel (brown rice) are the pericarp, seed coat, nucellus and aleurone layer which coat the kernel (endosperm). The embryo or germ is adjacent to the starchy endosperms at the basal ventral position of the caryopsis. The germ is 1-2% by weight of the brown rice. The lemma and plea of the husk interlock to form a tight protective cover over the kernel. The pericarp is water-impervious and retards water absorption. The starchy endosperms consists of thin walled cells completely filled with compound starch granules. It is this starchy cells that may result in breakage of grain as a result of impact or thermal or moisture stresses during harvesting, storing and processing. There is a distinct gap between the husk and the caryopsis. When the surface of the pericarp is damaged, as it must be during milling process, it results in damage to the oily layers beneath the pericarp that release lipase enzyme. This results in enzymatic hydrolysis of the oil to produce free fatty acids that causes rancidity. The radiating configuration of the starchy cells of the endosperms makes breakage very easy in the grain. Random stresses imparted to the grains in manual threshing

cause much breakage as compared to mechanical threshing where force is applied only to the ends of the grain. This short description on anatomy of paddy grain reveal several facts for Bangladesh post harvest problems :

(a) Unless ideal conditions are ensured,milled rice will become rapidly rancid.

(b) Poor post harvest techniques result in much breakage in milling, resulting in low recovery.

(c) Paddy is naturally protected,and is resistant to humidity and other stresses than milled rice. But low dormancy of HYV is a danger in paddy storage.

(3)Imperatives of Safe Storage

1. The need for storage is felt necessary because harvest of paddy is seasonal but demand for milled rice is fairly uniform throughout the year. From a national point of view, storages are necessary for both deficit and surplus productions. If exports are contemplated, then the entire exportable surplus stock must not only be stored, but kept in prime condition to fetch good prices. Any deterioration of quality may spell disaster for the exporter. For price stabilizing operations, the need for safe storage is supreme. By primarily equalizing supply regardless of seasonal or yearly fluctuations in production, safe storage is prerequisite to any effective stabilizing programme.

(4) Recent Scenario in Bangladesh

2. The major objective for procurement in Bangladesh being price support to producers now, the need for long storage is felt essential. For PFDS, the storage needs may perhaps be no more than three months. With two distinct seasons and a growing trend for a third crop, the storage for PFDS are becoming more of a transit point than a proper storage per se. But storage needs for maintaining farm prices are another matter. With increased production and a distinct rice excess balance, the surplus must be held as a 'reserve stock' or whatever name it may be called. The primary condition for such a stock to be effective,is the basic storability of the grain. Unless the grains can be held safely for a considerable period, the whole programme of stabilization may collapse with disastrous loss to the Govt. Apart from any other condition of storage, keeping other factors constant, the most important consideration is now long storage of stock for price stabilization at producer level,as against consumer price stabilization which have been pursued sofar owing to chronic deficits over last fifty years.

(4). TYPES OF STORAGE

1. A very brief survey of types of storages is felt necessary to appreciate the physical constraints under which the grains are stored in Bangladesh. Limitations of storage technology dictates

policies in marketing as well. For example,if grains can not be stored over a known period (say six months), the marketing of the grain must be planned to be accomplished within this period. This compulsion may have far reaching consequences on the operator who must release his stock within this period or else suffer stock deterioration to the extend of total loss in extreme case. Capital and operating costs also are deciding factors in selection of type of storage.

2. Storages for paddy and rice are broadly classified as either "bulk"or bag". In bulk storage units, grains are kept in bulk in moisture proof structures which may be built of RCC, steel, asbestos reinforced material or even fiberglass sheets. It may not be a traditional 'Silo' which is vertically oriented. 'Flat' bulk storages are now popular owing to low capital costs. 'Bag' storage imply a warehouse or 'flat' storage. Grains are normally kept in gunny (burlap) bags. Various improvements include moisture proof plinth, easy access by ramp, rodent proofing, controlled ventilation, fumigation etc. Nevertheless, they need much manual labour and control of humidity is not possible. The largest single cost of a 'bag store'is the bag itself which deteriorate over time or in numbers of uses. Now a days, the use of flat storage is going out of vogue due to these limitations. Even in India, there is now concerted effort to develop suitable bulk storage units to replace flat stores in a planned manner. (Paddy and Rice storage in India-FAO 1986). A summary comparison is given below as regards advantages and disadvantages of two types of storage for paddy/rice.

Table : 3. Comparative Advantages - Disadvantages (Flat and Bulk Storage for Paddy/Rice)

Sl. No.	Bulk Storage	Flat Storage
1.	Operating costs are low	1. Operating costs are comparatively higher
2.	Handling of grain is very fast	2. Handling is slow due to labour use
3.	Uses much less manpower	3. Needs large manpower
4.	It is totally bird and rodent proof	4. It is difficult to make it proof against birds and rodents
5.	Losses through spillage are negligible	5. Handling losses are high
6.	Fumigation is effective and economical	6. Fumigation is difficult

7. Atmosphere is controlled through aeration	7. There is little control on atmosphere
8. All operations are mechanical	8. All operations are manual
9. High moisture grain can be stored safely	9. High moisture grain can not be stored for any length of time
10. It occupies little space since its orientation is vertical	10. It uses large land area
11. Long storage life is possible for all kinds of grains	11. Storage life is limited
12. High (90-95%) volume is utilized	12. Low (50-60%) volume is utilized
13. Initial capital cost is high	13. Low initial capital cost
14. It is inflexible ie only one grain may be stored	14. It is flexible in use for storage of many items.

Note : Operating costs include (a) interest on capital, depreciation, maintenance, repair (b) establishment (c) dunnage (d) fumigation (e) insurance and utilities (f) depreciation of gunny bags (g) loading and unloading and stacking charges. In Indian case study (circa 1984) the costs of storage per ton per year was calculated at US$ 4.68 for a silo plant and US$ 5.88 for bag storage.

Source : Authors evaluation

3. In Bangladesh, there is no bulk storage for paddy and rice. The silo plants are exclusively used for handling imported wheat for which they have been most useful and efficient. One inland silo located at Santahar is also used for handling wheat only. There is no silo or bulk storage unit in private ownership in Bangladesh. Flat storages (godown in Indo-English parlance) are exclusively used for handling paddy and rice. CSDS and LSDS are all bag storage units. They differ only in size and capacity; here is no difference in technology of storage. The storage losses are mostly calculated on pro-forma basis. There is little or no data on actual storage losses for paddy and r[illegible] which can be considerable when stored in bagged condition for any period of time over 3 months. Stock deterioration ie loss of commercial value due to storage has never been estimated. The total nominal storage capacity in DGF is 1.5 million tons, but a percentage of it is always occupied by non grain items like oil, sugar, gunny bags etc.

(5) STORABILITY OF PADDY AND RICE

1. Paddy is naturally protected by its hard husk against many hazards. It is somewhat immune to insect attacks in many cases. It is moisture resistant and do not change its chemical properties over period of time. It is the accumulated experience of storage experts that reasonably dry paddy can be stored in conventional warehouse storage in worst of storage condition for upto two years. The conditions in which the paddy was stored were very favorable for insect propagation and mold growth (70% relative humidity and 25^{o}-30^{o}C temperature all the year round). Under the same condition milled rice with the best known storage management and disinfestation methods,deteriorates considerably after about 6 months. Without close attention to cleanliness and disinfestation, it can deteriorate considerably in much shorter a time ie within 3 months. This assumes that both paddy and rice are dried to 14% moisture. In actual practice, specially in Boro season, grains at this optimal moisture content is rare indeed. This question of moisture will be addressed in detail later. But suffice it to say that paddy under actual, less than ideal condition, can be stored safely for 2 years where as milled rice will deteriorate badly after 3 months with serious loss of quality. After 6 months,which is about the maximum limit under wet tropical conditions, total loss may occur.

2. Losses in storage may be classified into various heads :

(a) weight loss (b) food loss (c) quality loss (d) monetary loss (e) loss of good will (f) seed loss. As far as the DGF is concerned, the most important loss to avoid is loss of food quality ie nutrient value of grain, the monetary loss being secondary to it. Milled rice, if stored for longer period, lose their vitamin and other food values. With insect attacks and enzymatic action, the starchy endosperms is affected next resulting in near total food value loss of the grain, although it may still have some commercial value. Total storage losses for paddy and rice in India stored under various conditions are given below :-

Table :4 . Storage Losses in Traditional Storage Structures

Storage Facility	Initial Moisture Content (Percent)	Paddy Per year Storage Losses	Rice (per-cent)
1. Conventional bag storage godowns	16-18%	2-3%	-
2. Conventional bag storage godowns	18-22%	5-6% *	
3. Conventional bag storage godowns	15%	-	1.5-2.5%
4. Silo plant	17-18%	1.5-2.0%	-
5. CAP storage	17-18%	2-3%	-

* Due to weight loss in coastal and humid regions where Kharif or kurval paddy is harvested during winter monsoon

Source : Paddy and Rice Storage in India-FAO 1986

Author's Note ; CAP is cover and plinth method of storage. In drier regions of India, paddy is stored over concrete plinths in open air with only a turpuline or plastic sheet cover over the stack. The figures indicate that even at high moisture, paddy can be stored with relative safety. Under the same moisture and storage condition, rice would result in near total loss.

3. However, there is one disadvantage of storing paddy. It takes approximately 33% more volume to store paddy than comparative quantity of rice. Paddy also needs to be converted into rice for consumption. Paddy accumulates in large quantities during harvest but is converted into rice according to the milling capacity of the mills using such paddy. Mills will only buy those quantities of paddy which it may process or its stores can hold whichever is higher. For a price support operation for producer, it is thus a serious limitation if milled rice only is bought. The aggregate supply in such case will surely exceed aggregate demand which will be a function of the milling capacity in such a scenario.

(6) PRODUCER PRICE SUPPORT OPTION BY PADDY

1. The very essence of a floor price operation is in buying all the produce that are offered. Farmers do not produce rice, they produce paddy which must be bought if price support to them is intended. FAO has this to say on this issue :

"When a buffer stock is primarily intended to maintain prices to farmers, these is no option but to buy and store paddy in the first instance ..... . Ideally, the buffer stock operation takes off the market any excess of paddy which if it passed through ordinary trading channels, would depress the market price below the minimum considered appropriate for the farmers" -Rice Marketing, FAO Rome 1974.

It is thus imperative to procure paddy from farmers for technical reasons, as well as to implement the objectives of procurement. Under considerations of an effective floor price principle, there is in fact no other option but to procure in the form of paddy from surplus zones of Bangladesh to given an effective price support to the producers.

III. IRRI/BORO - MANAGEMENT OF WET SEASON HARVEST

(1) Growing Production of Wet Season Crop

1. Rice production in Bangladesh has registered steady growth of about 2% per annum since 1961. This growth is characterized by great changes in composition of output. The share of HYVs in total production has increased from about 30% in 1974 to about 56% in 1989. By 1990, more than 90% all Boro output is in HYV compared to only 38% of Aman and 26% of Aus. The spectacular progress in this second crop is characterized by all the modern inputs in Bangladesh. Chemical fertilizers, mechanical pumps for irrigations, pesticides and modern seeds are essential for production in Boro season.

The rice production figures for 1961-1990 periods are :-

Table : 5 . Foodgrain Production FY 61-90

	000 MT				Percentage of Annual Growth *			
	FY 61	FY 70	FY 80	FY'90	FY61-70	FY70-80	FY80-90	FY61-90
Rice	9627	11344	12539	18489	2.4	1.8	2.7	2.0
Aus	2537	2726	2809	2489	2.7	1.5	- 1.4	0.6
Local	-	-	1979	1866	-	-	- 0.2	-
HYV	-	-	830	623	-	-	- 1.8	-
Aman	6679	6980	7303	9500	0.3	2.1	1.1	0.8
Local	-	-	5595	-	-	-	- 1.7	-
HYV	-	-	1882	-	-	-	4.7	-
Boro	455	1638	2427	6500	17.9	0.7	9.2	8.7
Local	-	-	545	-	-	-	- 4.5	-
HYV	-	-	1882	-	-	-	-10.9	-
Wheat	33	59	823	800	12.5	22.5	- 0.3	16.2

* Trend growth rates are computed using semi-logarithmic trend equations fitted to the time series data, using the least square method.

Source : WB (Food Policy Review Aug. 1991)

This most impressive production growth of over 9% per year is also characterized by massive market arrivals of paddy. Public procurement, if ever needed, is in Boro harvest season with all the classic symptoms of a buyer's market and gluts in points of time and space.

(2) Problems of Wet Season Harvest

1. Climatic : Traditionally, the major crop,Aman, in Bangladesh was harvested in the cold season. This period is characterized by low atmospheric humidity, low temperature,and uninterrupted sunshine. All climatic factors which help easy drying of paddy, and temperature-humidity condition which suppress micro-organisms and insect growths. The wet season (April-Oct),on the other hand,bring about the worst conditions for paddy preservation and processing. High humidity, high precipitation and high temperature arrive simultaneously. This period accounts for 85% of all yearly rainfall ranging from 1200 to 3500 mm. Towards the end of April winds blowing from NW cause violent storms with heavy showers," the Norwesters " with occasional tornadoes. " These storms herald South-West monsoon - the rain given of India - which 'bursts' about middle of June when rain descend upon the parched earth in torrential downpours accompanied by thunder and lighting" (The World - J.H. Stembridge). This can hardly be called a conducive climate to harvest, dry and process paddy .

2. Infrastructural : Heavy rains routinely wash out roads and culverts. The muddy village roads which are marginally truckable in dry season are rendered inaccessible to motor vehicles. Even animal draft is limited - only the buffalo cart remain serviceable in heavy mud of N.W. regions. Storms cause frequent power failures and interruptions in tele communications as well. While inland waterways expand in rest of the country, in the N.W. (Rajshahi) regions with little or no inland waterways communication for market operations it becomes extremely difficult, time consuming and expensive to transport field produce.

All these difficulties put negative pressures on marketing operations of Boro paddy.

(3) Post Harvest Problem of IRRI/BORO Crop

1. The climatic conditions and the high incidence of HYVs in Boro season are major constrains to reap the full benefits of the harvest. FAO anticipated the post-harvest problems of the green-revolution in the early '70's and says :

"It seems certain that high yielding varieties will make a major impact on the economics of rice producing countries, the more so since they are adopted to the countries where increased supplies of rice are most urgently needed. In any case, the advent of high yielding varieties will increase enormously the volume of rice moving through domestic markets and make still more urgent the need to modernize rice marketing in developing countries. This

will necessitate major improvements in rice marketing, including expansion of drying, transport, storage and milling facilities and greatly increase provision of working capital, credit and entrepreneurial initiative. (Emphasis added)

(Rice Marketing : Abbott, Barter et al, FAO, 1972)

2. What are the general constraints of post-harvest in Bangladesh are accentuated manifold in Boro season. The problems start with harvesting, threshing, carrying and end in processing into rice. However, for the purpose of this paper, only the difficulties encountered in drying and milling of Boro paddy will be discussed.

(a) Drying : All HYVs are characterized by low dormancy and low photo period sensitivity. For many reasons,Boro paddy is to be harvested with high moisture of (20-25%), sometimes with even higher moisture content when rain-soaked,or harvested from flooded fields. Having low dormancy, this high moisture paddy will deteriorate quickly and eventually sprout unless dried immediately. But drying in drying yards is a very slow process. Besides, only rice mills are equipped with concrete drying yards whose performance also deteriorate due to low solar radiation due to perennial cloud cover and high at mospheric humidity. Drying of field paddy by mechanical driers is unknown in Bangladesh, although it is an absolutely mandatory step in many rice producing advanced country like USA and Italy. Even S. Korea and Thailand now routinely dry their field paddy for long preservation.

Parboiling : Most paddy in Bangladesh (over 70%) is parboiled. The process will be described in some detail later.But suffice it to say that the urgent need to dry parboiled paddy also creates great difficulties for traditional mills who dry their paddy on concrete yards. The solar radiation reduces on the average to about 40%. Coupled with high humidity, the paddy takes much longer time to dry. If there is rainfall, it just cannot be dried. In a couple of days, the paddy develops a bad odor due to micro-organic action and becomes rancid. Besides, it generates aflotoxins which render it harmful to humans,if consumed.

Milling: Since parboiled paddy is to be milled as well, the milling capacity of a traditional mill also reduce proportionately. Under these circumstances, there is a general tendency to mill paddy with high moisture (16% upward). This high moisture not only cheats the consumer, such rice are quite unfit for storage for any length of time. The storage life of such rice is no more than a few days after which it becomes discolored and unfit for consumption.

Storage : Unless the stores are designed specifically vapor proof, leakages of water vapor afflict the stored grain. Leaky roofs, damp floors and walls all contribute to stock deterioration, even if the grain is fully dry before storage. Only a proper silo or 1st class R.C.C. structure are fit to save the grain in driving rain and damp weather conditions. In fact,there

is no paddy/rice silo in Bangladesh. Which is ideal for such climate .The loss due to faculty storage, though never calculated, are estimated to be very high indeed in terms of loss of nutritional value of grain alone.

V. THE QUESTION OF MOISTURE

(1) Importance of Grain Moisture for Storage

1. Low moisture is the key to safe storage of any food grain including paddy and rice. For inherent anatomical characteristics, paddy is less affected by moisture content than milled rice. Biological activities occur only when moisture is present in the grain. A minimum quantity of moisture, which vary from grain to grain, then again varietally, is needed for germination. When paddy is stored wet, it begins to heat rapidly resulting in mold growths. Various deteriorations follow suit. Bad odor, discoloration and rancidity are the symptoms of wet paddy storage. Eventually, the grain turns brown and insects growths proliferate .Under these conditions, most varieties of paddy will also germinate. The new HYVs with low dormancy and next to nothing photo period sensitivity are most prone to deteriorate in wet storage conditions. This writer has seen HYV paddy germinated in stalk when submerged in flood waters for a few days in 1988/89. Resistance to water shown by some our local varieties of Aus and deep water Aman is totally absent in these new varieties. Time of safe storage of wet paddy vary mainly on grain temperature and moisture content. IRRI estimates the safe storage life at different moisture levels and grain temperatures for paddy thus :

Table : 6. Safe Storage Life of Paddy

Grain Temp. (OC)	Safe storage life (days) at indicated moisture content					
	14%	15.5%	17%	18.5%	20%	21.5%
38	8	4	2	1	0	-
32	16	8	4	2	1	0
27	32	16	8	4	2	1
21	64	32	16	8	4	2

Source : Paddy Rice Post Harvest Industry : Wimberly,IRRI 1983.

2. A viable program to safe keeping of grain is by (a) lowering of grain temperature and/or (b) Drying of paddy before storage. A combination of both is the best solution. Aeration in bulk storage not only lowers the grain temperature, but also removes small quantities of grain moisture,if the relative humidity of blown air is low. Initial drying is of course the best method along

with cleaning of paddy to remove straws, leaves, other organic matter, clay, dung etc which all attract insects and increase deterioration process. Indian experience shows that moderately high paddy moisture of 17-18% can be tolerated if modern storage procedures and methods are utilized. Of course, 14% or below moisture level is ideal for safe-keeping of paddy but is a tall order to procure such paddy in monsoonic climate. Long storage of Boro harvest, therefore, is a very difficult and expensive technical task.

(2) Equilibrium Moisture Content

1. All foodgrains have their characteristic moisture balance in relation to the water vapor present in the atmospheric air. This is known as moisture content/relative humidity equilibrium pattern or commonly as equilibrium moisture content (EMC). When foodgrain containing a certain amount of moisture is exposed to air, moisture will move from one to other until there is a balance between the moistures in the grain and in the air and equilibrium is reached. This phenomenon will depend upon (a) initial moisture content of the grain (b) relative humidity of air (c) ambient temperature. Each grain has its characteristic equilibrium curves, sometimes referred to as humidity balance curve. Agricultural engineers obtain these curves by plotting a graph of moisture content against R/H in the air, the resulting graph is an isotherm which is, in fact, a guide only since variety and type will impart small variations. Direction and rate of approach to the equilibrium will depend upon many other empirical factors like type of storage,the direction and movement of air through the grain. Suffice it to say that paddy and rice will reach EMC sooner or later in any type of storage, the only variable factor being rate of approach of equilibrium. The EMC of paddy is given below in tabular form which is accurate enough for practical applications:-

Table : 7. Hygroscopic Equilibrium for Paddy

Moisture %	Percent Relative Humidity at Temperature of						
	21 C	24 C	27 C	29 C	32 C	35 C	38 C
10	45.4	46.8	48.2	49.6	51.0	52.5	53.9
12	61.1	62.2	63.3	64.4	65.5	66.6	67.7
14	74.1	74.8	75.6	76.3	77.1	77.8	78.6
16	83.5	84.0	84.6	85.0	85.5	86.0	86.4
18	90.1	90.4	90.6	90.9	91.2	91.5	91.8
20	94.2	94.4	94.6	94.7	94.9	95.0	95.2

Source : Paddy Rice Post Harvest Industry : Wimberly IRRI. 1984

2. The EMC is of vital importance to paddy processors and storage managers. It is futile to dry paddy below EMC as it will reach EMC within a short time, the time and effort to dry below the EMC level totally wasted. If.on the otherhand, high moisture paddy is kept in relatively dry air, paddy will lose moisture to reach its equilibrium level. In practical terms in Bangladesh, in winter season Aman paddy will lose moisture in storage as the climatic conditions will, on the average sustain EMC of as low as 12%. But in the Boro season, the average EMC is between 15-17%. In the thick of monsoon.with relative humidity approaching 100%, all paddies will gain moisture, if exposed to ambient air. Storage procedures, like aeration and ventilation, therefore, must take advantage of R/H of atmospheric air for safe storage as well as for reducing moisture content of grains by natural processes.

3. Rice is more prone to lose or gain moisture from atmosphere as it is more hygroscopic in nature. Hard husk over paddy give a natural protection which in case of rice is removed and even the bran layers are polished off in milling processes. Therefore, EMC of rice is much higher than that of paddy. A table is constructed below from isotherm of EMC of rice.

Table : 8. Hygroscopic Equilibrium of Rice

Percent of Relative (%) Humidity	Moisture Content (%) Percent on Wet Basis
40	10.3%
50	11.8%
60	13.0%
70	14.5%
80	16.6%
90	19.2%

Source : Compiled from Graph : Paddy Rice Post Harvest Industry :Wimberly,IRRI,1984

It is to be noted that rice is more prone to gain moisture when exposed to high R/H in air than paddy. In monsoonic climate, the EMC of rice in Bangladesh will vary between 15-17%. If corrective methods are not adopted, safe storage of rice is very unlikely over any length of time. It may now be apparent, why Boro rice spoil quickly and aman rice keep well even under less than ideal storage situation.

(3) Impact of Climatic Conditions On Procurement

1. Owning to the difficulties of grain moisture due to climatic condition of Bangladesh, traditionally,Govt. did not procure any grain during wet season. Procurement was restricted to dry season harvest, Aman only. Said the venerable Paddy and Rice Manual of Department of Food :

"Although harvesting of the early varieties of Aman paddy starts in the province from November, the bulk of the crop is harvested between December and middle of January. Aman paddy which comes to the market in November and December contain excessive moisture. To avoid serious deterioration, in storage of paddy containing heavy moisture, actual purchase by Govt. is not started before January."

Then again :

"Internal procurement is generally made out of the Aman crop. Government do not procure Boro and Aus as these are harvested in the monsoon and do not stand long storage due to heavy moisture content"

Department of Food, Government of East Pakistan, 1966.

Who can claim the conditions have changed or the processing technology has gone for the better in the intervening quarter of a century? The compulsion on the GDF to unload the procured stock within 3 months of procurement in the Boro season stem basically from this objective situation of stock deterioration due to a combination of high moisture, and high EMC, and unsuitable storage condition for high moisture grain. The realities of this condition has visited Bangladesh time and again, most recently in 1990-91 Says the WB.

"With good harvests early FY 91,the rice price in the domestic market did not experience enough of a seasonal upswing to allow the Government to sell at a price that covered costs. A further complication was that the quality of rice deteriorated rapidly due to inadequate post-harvest drying, eliminating the possibility of exporting excess stocks, and undermining their nutritional value in targeted rationing programme" and again,

-----"to reduce losses due to spoilage. This is largely a question of moisture content and storage methods. The Government specifies a 14% moisture content for its procurement, but this is often unenforced, and is probably irrelevant because once purchased, the moisture content will rise to equilibrium level, which is likely to be 15.0 - 15.5 percent in the wet season.
- Food Policy Review, W.B. August 1991

2. With the present state of post harvest technology in Bangladesh, there is little possibility of saving the milled rice in store for a period longer than 2-3 months, when they must be released, sometimes into another procurement and harvest season.

Particularly in Boro season, the problem assumes crisis proportions. This released rice when dumped into already saturated market puts downward pressure on price which the Govt. is trying to shore up by procurement. It is the classic story of firemen pumping water and gasoline simultaneously into a fire by two different hoses. The only technical solution feasible under the circumstances is to procure paddy and not milled rice in this season. Management of such a stock is quite feasible with some modification of present procedures. In any case, there is no other alternative to procurement of paddy, if large unsustainable losses are to be avoided. Besides, the scale of procurement enhances disproportionately with dumping/auctioning of rice of uncertain quality when the aggregate supply increases artificially.

(4) The Indian Case for High Moisture Grains

1. All foodgrains reaching FCI or other public storage units are compulsorily weighed, sampled, analyzed and graded. Stocks are subjected to laboratory tests to determine the commercial quality and storability. Grading is performed as an essential part of warehousing procedures. The maximum moisture level allowed in the procurement of paddy and rice is 18 percent and 15 percent respectively. Composite samples of each lot are retained in small bags and sample slips indicating detail such as deposit number, name and address of the depositor, number of bags,quality, variet etc.

2. In areas with high humidity, the high moisture level paddy is stacked to 10 bags only as compared to normal stacking of 15 - 18 bags stacks. In order to allow the paddy to dry by natural ventilation, the bags are restacked within first two months and ventilation is allowed for 8 hours a day. However, in high humidity areas, this procedure has not proved to be too successful. says Indian experts :

"Under such circumstances, drying has been considered to be the most effective and economical measure tc save grain from spoilage. In high rainfall areas like north eastern and coastal regions of the country ; the relative humidity in the air during the major part of the year is quite high. Under such circumstances, the grain cannot be dried completely under natural sun heat. Therefore, the drying of paddy by mechanical means is assuming great importance.

- Paddy Rice Storage in India, FAO of the UN, 1986.

Among other methods, natural and heated air aeration, in-bin drying and aeration in bulk storage units are some of the modern methods of storage in India. Even in high humidity areas, it is reported that shelf life of grain stored in modern storage structure was upto 5 years without any damage. It also reports "a loss of 1-1.5% in bag. Storage of paddy per year and 0.2 to 0.5% in bulk storage silos irrespective of the period of storage"-but presumably upto 5 years.

VI. PROCESSING TECHNOLOGY

(1) Parboiling

1. Most rice the Bangladesh is parboiled.Such rice is a staple in eastern regions of India, Sri Lanka, Nepal, Nigeria and in regions where a large Indian community reside, like in Malagasi, Surinam and Fiji. It is becoming popular as a process in precooking (more of it later) in USA and Italy. It is a hydrothermal process in which paddy is soaked in cold or hot water and then steamed with saturated steam to gelatinize the starchy endosperms. A rudimentary understanding of parboiling process is felt necessary to appreciate the problems of rice processing in Bangladesh in relation to the question of an appropriate milling ratio for procured paddy. Parboiling process as practiced in Bangladesh are mainly, two :

(a) Traditional (i) Boiling steaming in flat vessels after soaking/steeping

(ii) Steeping in masonry tanks and steaming in steel vats

(b) Modern : Although there are a number of modern mechanized processes, only one method is practiced in Bangladesh. This method as developed by Central Food Technology Research Institute (CFTRI), Mysore, India is practiced in mechanized parboiling plants in socalled "automatic mills" in Bangladesh.

2. Without going into a technical description of these two methods, a brief comparison is made :

Traditional	Modern
1. It is an inexpensive process with little equipment necessary	1. It is a capital intensive process
2. Due to prolonged cold soaking, bad odor or aflotoxins may develop	2. Due to hot water soaking no possibility of devement of bad odor.
3. The moisture content of parboiled paddy is upto 50% making subsequent drying difficult	3. The moisture content remains within 35% with lesser drying time
4. It is not suitable for mechanization or use of a mechanical drier	4. Suitable for mechanization and ideal for use of mechanical drier
5. If soaking time goes beyond 48 hours due to inclement weather, considerable leaching losses occur with subsequent loss of milling recovery and quality	5. Due to soaking time limited to 4-6 hours, practically no leaching loss is experienced if the soak water temp is limited to 60-65^{o}C

6. The rice produced is light amber in color and translucent if parboiling is correctly done	6. Rice produced is deep amber to reddish in color, although the cooked rice is as white as in traditional method
7. It is a time consuming process not suitable for industrial process incorporation	7. It is suitable for industrial process incorporation.

Source : Authors observations and experience.

2. Most rice in Bangladesh is parboiled by traditional method. Because of such variables as duration of soaking time, generation of micro-organisms leading to bad odor and variations of degree of parboiling leading to "white belly",there can not be a standard gradation of traditionally parboiled rice. International rice processing experts visiting Bangladesh in 1990 with a WB team had poorly graded Govt. procured rice. They put the value of such rice at about $150/ton FOB, as compared to Thai 5% broken rice valued at US$ 275-300/MT FOB. DGF procures most of its rice from 1300 or so contract husking/major mills practicing traditional parboiling with only about dozen or so modern (Automatic) mills thrown in for good measure. The value of processing the same grade paddy is evaluated thus :

"It automatic mills could reduce the level of brokens to 15% percent, and if a grading system were strictly adhered to, the resulting quality improvement could probably raise the appropriate reference price to US# 200/MT in coming years"

- Food Policy Review - WB August, 1991.

For an average procurement of 700,000 MT, this enhancement in value adds approximately US$ 35,000,000 to the stock besides quality and nutritional improvements by change of technology alone. It is, therefore, high time that modern (CFTRI) method of parboiling is practiced on a mass scale in Bangladesh.

(2) Drying

1. Drying is the process of moisture removal from the grain to prepare the grain ready for milling process. This process, also known as moisture extraction,is necessary because most paddy is harvested at a high moisture level of upto 26% in dry climate. In Bangladesh, specially in Boro season, rainsoaked paddy some times have moisture content of upto 30% and must be dried immediately, to be saved from deterioration. Parboiled paddy must also be dried to 14-15% moisture for milling. As parboiled paddy contain very high moisture from 35-50% depending upon the type of parboiling practiced, it takes longer time and energy to dry parboiled paddy. Drying rate is determined by the variety, its

moisture content, relative humidity of air, and in case of mechanical drying, temperature and volume of air passing through the grain. The drying method, type of dryer, and efficiency of drying equipment will also affect rate of drying.

2. The are two drying methods practiced in Bangladesh - sun drying and mechanical drying. Most parboiled rice in Bangladesh are sun dried on large concrete or plastered drying yards known as 'Chatal'. A large number of workers, mostly female, continuously turn and mix the wet paddy to obtain rapid and uniform drying. For good results,paddy should be spread evenly about 2.5 cm thick over the drying yard. At this thickness, an acre of concrete drying yard with handle 60 MT of paddy. Depending upon the climatic conditions, the condition of the drying yard, skill of workers etc, it takes 2-4 days to dry paddy by sun drying. Paddy can not be dried too quickly as at will develop fissures and micro-cracks due to unequal moisture movement within the endosperms. It is thus 'tempered' i.e. kept under cover in the afternoon to equalize moisture. Again, during rainy season, there can not be any time schedule to dry paddy by traditional sun drying as it is totally dependent upon weather. But due to high R/H condition during the monsoon, on the average, it will take twice as long to dry paddy as compared to dry (winter) season. In effect, the capacity of a traditional mill halves during the monsoon as drying parboiled paddy is the limiting variable in determination of processing capacity in a mill and not its milling (husking) capacity.

3. Use of mechanical driers to dry parboiled paddy is a very recent phenomenon in Bangladesh. Although some oil fired equipment were introduced in early 70s, they were basically crop-driers and did not operate successfully for a variety of reasons, but mainly for high cost of fuel oil. Mechanical driers of Indian origin were introduced later as part of modern milling units. They were modified LSU (Louisiana State University) type, using husk as fuel. After a period of initial technical problems, a number of them are operating successfully. Some modifications and training of local operators were required to put these unit into use. Although they are far from the latest of drying equipment, they have brought in a new era in paddy processing in Bangladesh. For the first time, drying in Boro season is possible with reasonable certainty. The product is uniform and completely devoid of bad odor. Most important of all, the production rate of a mill can now be based on a scientific basis and not on whims of weather as it has been hitherto.

(3)Milling

1. Milling is the last process of converting paddy into rice. Analyzed in a sequential manner, it consists of a number of distinct steps - cleaning, dehusking, husk separation, paddy separation, bran removal, polishing and as an optional process, grading. There are auxiliary functions of conveying, packing, weighing etc which must necessarily be done along with the major points to accomplish the milling process.

2. In Bangladesh, there are two types of machines used to do the milling-single stage-Engleberg Huller and multi stage mill. Most rice is processed in Bangladesh by single stage mill or steel huller. It is a primitive machine which does all the functions of milling in a single operation. In 'major' or large traditional mills, a number of hullers are used in series to progressively do the essential milling functions. The products of these units are better than single stage units. In case of multi stage, modern or "automatic mills", a number of machines are used to do the operations. Obviously the product is of higher quality and the milling out turn is some what high-with less brokens. A short paper on the milling technology in Bangladesh is attached as Appendix - to these papers.

(4) Typical Nomenclatures

1. In Bangladesh, since most paddy is parboiled, all three processes ie parboiling, drying and milling is normally performed under one premises. This unit is known as a 'mill'. The single machine establishments, found in most rural markets and wayside centers, are known as 'hullers' or "haular" in Bangla adaptation of the term. These single machines do the customs millings of small lots of paddy brought in by farmers or small traders. Other than those, the processing units where all three functions ie parboiling, drying and milling are performed; are classified by DGF into three classes :

(a) Husking Mill (b) Major Mill (c) Automatic Mills. It is curious that no definition as to their equipment, size or even the process exist in DGF literature or circular. It is indeed strange that no basis exist as to the classification, although differential milling commission is paid on the basis of classified "nomenclature" of these mills. From the technological point of view, a brief description of what these terms mean in Bangladesh context are given as under :

(a) Husking Mills : These are the smallest of the milling units.The are normally equipped with facilities to perform traditional parboiling by soaking in masonry tanks and steaming in small steaming vats built of light gauge mild steel plate. Sometimes recycled oil drums are used for this purpose. They are not equipped with standard boilers to generate steam. Home built "boilers" or a series of oil drums are used in makeshift arrangement with husk furnaces to generate low pressure steam. These boilers are not equipped with essential and mandatory safety devices. As a result, frequent explosions take place with resultant loss of life and property. Drying is done on brick soled yards plastered with cement. Milling is done by single machine hullers with one or two aspirators for husk separation. They have some auxiliary equipment like water pump and beam scales for weighing. These are makeshift units with no boiler certificate, standard equipment or machines to mill rice of minimum standard. As a matter of fact, they are not industrial units at all, as they do not possess 'factories' license' essen-

tial under Bangladesh law to qualify as a recognized industrial unit. A description of their boiler equipment and the minimum legal requirements are described in a short paper by the Chief Boiler Inspector, GOB, is attached to these papers as Appendix-C.

(b) Major Mills : Although the technology of these units are similar to those of husking mills, these are large traditional mills with standard boilers. Most of these units were built in pre-independence days in N.W. regions to process large quantities of paddy. They have large traditional parboiling establishment with matching drying yards. A number of hulling machines are used to progressively mill the paddy resulting in better product with less number of brokens. Although, the technology is primitive, these are legal entities with boiler certificate and industrial registration.

(c) Automatic Mills : They represent the most modern paddy processing technology in Bangladesh, though they hardly are the best or the most efficient. These units were mostly imported from India in the late seventies or early eighties, and established with financial assistance from different industrial banks. India has banned the production or operation of huller units since 1970s for their inefficiency and as a result, these advanced equipment are manufactured by several companies in a standardized form. Since they are the most efficient of the available technology, some details as to their equipment and processing methods are described :

(i) Parboiling : Parboiling is normally performed in large steel vats or autoclaves where hot soaking (60-70^{o}C) is performed. The use of hot water completely eliminates bad odor and keep the leaching losses within tolerable limit. Husk fired boiler of standard design are used. By law, these boilers must have mandatory safety devices and other design criteria to be issued with boiler certificates. Moderately high pressure steam is used which results in characteristic amber color to the end product.

(ii) Drying : LSU type recirculating driers are used. Either a steam or a hot flue heat exchanger is used to generate hot air to dry the parboiled paddy. Because of inefficient design and non-standard operating procedures, shortage of husk fuel is a chronic problem in drying operation. As a result, most of these units have built drying yards to supplement the mechanical drying. Owing to high cost of electricity and spares, many of them do not operate their mechanical driers in dry (Aman) season and dry paddy by driers in only monsoonic weather in 'Boro' season.

(iii) Milling : All these units are equipped with multi stage milling machines to accomplish various functions of milling. The principal machines are (a) Scalper/Cleaner (b) De-husker of either under runner disk sheller or rubber roll sheller or both (c) Paddy separator, (d) Polishers both conical or horizontal types.

Besides, these machines, auxiliary machines like elevators, screw conveyors, aspirators, bran sieves, graders etc. are also available. There are principally two designs found in Bangladesh, both standardized in India. One is Shule GmbH, German design, the other Shataka Ltd. Japanese design, both of 1960s vintage. They certainly do not represent the latest in milling technology but is a vast improvement over Engleberg huller, originally designed in 1870 for use in Dutch East Indies (todays 'Indonesia)'

The main advantages of the multi stage system over a single machine is (a) A higher milling ratio of about 1.6% for parboiled rice (b) Less amount of brokens (c) Superior quality in the form of uniform polish, (d) little or no foreign matters and cleaner rice. Beside these primary advantages, modern mills yield (a) pure bran (b) pure husk as milling by products.

(d) Economic Value of Mill by-Products : Rice milling industry produce two major by-products (a) bran (b) husk. Standard hand books list broken rice or brewers rice as a by-product. But in Bangladesh, brokens are never a by-product. It is consumed by people either mixed in the main rice or as brokens itself which is used normally as a breakfast dish. The most valuable by-product in a modern mill is bran which is rich in vitamins, minerals and oil,and is used as an animal feed or as a raw material for bran oil extraction plants. The bran fraction contain 15-20% oil, which can be extracted by solvent extraction process and when refined, is the most expensive vegetable oil, much used as salad dressing oil in Japan and other S.E. Asian countries. In Bangladesh, two oil extraction plants are operating much below capacity due to shortage of raw materials and are refining imported crude soya and palm oils. Traditional huller units do not produce pure bran, but a mixture of bran, husk and brokens which is known as mill-waste in the trade. It is of little value as an animal feed and cannot be used as a raw material for oil industry. Pure husk as produced by rubber-roller units are used as poultry litter, insulating material and as fuel. Very recently, they are being converted as fuel-rods for use in industrial furnaces. Due to inefficiency in most automatic mills, little or no extra husk is produced after meeting its own parboiling needs, although it is possible to save at least 50% of the total husk available with increase in thermal efficiency.

(VII) MILLING RATIOS

1. The preceding discussion about the paddy grain itself, storing and processing lead to the central question - what should be an appropriate milling ratio, specifically for recovery of rice from paddy supplied by or purchased for the Government in Bangladesh. The question is a complex one with numerous variables affecting the ultimate milling recovery. The range of variation is quoted from an authoritative source :

Table : 9. Typical Mill Yields and Composition of Products and By-Products from Rough Rice

Fraction	Yield from rough rice	Production N X 5.95	Crude Fat	Crude fiber, % of dry basis	Crude ash	Nitro-gen free extract	Free sug-ars
Hull	18-28	2-4	0.4-0.8	48-53	15-20	26-34	-
Brown rice	72-82	7-15	2-4	1	1-2	79-90	1.3-1.[illegible]
Bran	4-5	12-17	15-22	9-16	9-16	40-49	6.4-6.5
Polish	3	13-16	9-15	2-5	5-9	54-71	-
Milled rice	64-74	6-13	0.3-.06	0.1-0.6	0.3-0.7	84-93	0.2-0.5

Source : F. Gariboldi : Rice Chemistry and Technology. 1972.

There is one other major variable, whether the rice is parboiled or raw. Since most rice in Bangladesh is parboiled and the DGF procure only parboiled rice now, the subject will be restricted to matters pertaining to parboiled rice only.

(1) Major Variables and Testing Methods

1. The major variables for the purpose of milling ratio are classified as :

(a) Variety as regards intrinsic milling quality
(b) Quality of the paddy, specially initial moisture content
(e) Processing technology used
(d) Percentage of refraction and dockage
(e) Percentage of admixtures of other varieties
(f) Post harvest treatment given to the field paddy prior to commencement of milling process.

As can be seen, it is almost impossible to put a numbered value upon the milling ratio when so much are variable to a given lot of paddy as to its exact rice outturn. Rice traders and millers have developed subjective methods to evaluate the quality of paddy. They bite through the grain to estimate its moisture content, blows to check dockage, evaluates the color and texture of the grain and pass an opinion regarding the expected milling ratio. Inspite of the totally unscientific nature of the test, it is amazing to what accuracy an experienced person can predict the ratios. As for example, the procedure to test moisture without an instrument is given :

"If the grain divide sharply with a cracking sound leaving no residue in between the teeth, the moisture is taken as 11 percent to 12 percent, in case of paddy and 12 percent to 13 percent in case of rice grain. If the sound is dull an there remains a small residue in between the teeth, the moisture is not exceeding 14 percent. If, however, the moisture content is higher, the residue

will be bigger or the grains will get pressed between teeth. while the sound is either too dull or nil".
- (Paddy and rice Manual, Department of Food 1966)

It is difficult to fault the procedure which evidently have been developed with long experience in practical field.

2. However, this type of subjective evaluation can hardly be a sound basis for decisions affecting millions of tons of rice that transit in international trade. Milling yields of paddy are ascertained in well equipped laboratories to determine various factors as described earlier which affect the outturn. First a representative sample is taken from the lot which should be large enough for adequate testing. It should be properly identified and preserved in original condition from the time it is taken until the grade or quality is determined. There are elaborate procedures of obtaining statistically sound method of obtaining samples. Different sound methods exist to obtain representative samples from bagged as well as bulk lots of paddy.
3. A well equipped testing laboratory should be able to evaluate paddy samples for dockage, moisture content, grain characteristics and, most importantly its potential milling outturn of head and broken rice yields. To determine the potential milling yield of paddy, the sample is first put through a dockage tester to remove the impurities. Next the sample is put through a test dehusker to remove the husk. Whitening to remove the bran should be the next stage. The last step is the test-grader to separate the brokens from the head rice. Grain characteristics can be tested for variety, size, shape, uniformity, damage, chalkiness, odor, and admixture of other grains, wild rice and other seeds. All these characteristics are recorded in standard formats of a test report to evaluate the commercial quality of the paddy. Inspite of all these scientific methods, subjective evaluation is still the basis to determine odor, flavor, taste and texture of the potential milled rice. Varietal characteristics are sometimes the basis for estimating these subjective qualities.

(2) Procedures in Bangladesh

1. There is little objective testing done in Bangladesh to determine potential milling ratios of paddy on a scientific basis Traders and millers evaluate paddy on a subjective basis, although all these above criteria are examined. Bangladesh Rice Research Institute (BRRI) have published potential milling out turns on all newly released varieties of BRRI (HYV) rice. These are based on ideal laboratory condition and have little bearing on the actual field situation. The only noticeable factor is the husk fraction of these HYVs which vary from 20-22% by weight. In most mills field paddy with variable moisture content are immediately parboiled and processed. The resultant rice also have variable moisture content, making results of any field report most inaccurate.

2. A number of studies have been done by various research groups on various aspects of paddy processing including milling ratios. As explained earlier, the results of such ad-hoc studies which, in actual fact consist of asking the rice miller in various areas of the country what his milling ratios have been, are not scientifically acceptable. This kind of studies have the following serious errors :-

(a) The miller may over or understate the ratio for various reasons

(b) Most mills do not keep accurate records. In any case, commercial accounts are not designed to scientifically determine ratios or other characteristics of paddy.

(c) Since paddy moisture tend to decrease with progress of the season, the apparent milling ratio will increase, although for a given paddy lot, milling out turns are constant for a given set of processing equipment.

(d) Ratios will vary considerably for equipment, state of maintenance, skill of operator and other inderminable factors.

3. That does not mean that there are no standard method of conducting field trials. Government of India constituted a committee to study the performance of milling industry in 1966. The committee carried out 2 years programme of evaluation studies all over India. Although the object of the inquiry was to determine milling efficiencies of different types of milling equipment, the method adopted was scientifically sound and should be the basis of any field study yet to be conducted in Bangladesh on a sound scientific basis and footing.

(3) DGF Milling Ratios

1. For all the procured paddy by DGF either in paddy form or under Mill Gate Scheme, the Department uses fixed ratios based on (a) season (b) type of mill (c) district of origin.

For Boro season the ratio is fixed for all varieties (traditional Boro, Aus and HYVs) as under :

(a) Parboiled - 60:38 ie 100 : 63.333

(b) Atap (Raw) - 60:36 1/2 ie 100 : 60.833

These is no district wise variation and these ratios are constant throughout the country.

2. For Aman season, the mandatory ratios are variables on the basis of mills and district of origin. It varies from 60:38.10 to 60:39.50 for major mills and 60:38.60 to 60:40.00 for husking mills. The milling ratios as in practice in Pakistani administration and the present milling ratios are given as Appendix - F and Appendix - G to these papers.

The rationale for such variations are not explained anywhere. The venerable "Paddy and rice Manual" has this to say "There are different ratios of resultant rice for mills of different districts, which have been fixed on the basis of quality of produce in a particular soil"

That these ratios were only approximate are borne out by "whenever paddy of one region is allotted to a rice mill situated in another region, the milling ratio for the place of origin of the paddy, as fixed by Government, will prevail, where, however, any miller happens to disagree, Government will have no objection to refix the ratio after test milling."

- Paddy and Rice Manual, 1966. Department of Food, Govt. of East Pakistan.

3. There is an urgent need to rationalize these old milling ratios. For whatever reasons these ratios were fixed, the basic causes for such variations are either redundant or non-existant. Besides sound technical reasons for an uniform milling ratio for the whole country, this system is inherently unfair. Take for example cases of Bogra and Rangpur districts. They are contiguous and produce essentially same varieties of paddy but with mandatory ratios of 60:38.10 and 60:38.60 respectively. For a lot of a 1000 tons, a miller in Rangpur will have to deliver 8.333 MT of additional rice, valued at Tk. 83,000 approximately. Whether there is excess rice out of Govt fixed ratio or he goes short, is not the point. The monetary penalty is there on account of location alone keeping all other factor constant. The reasons for which the variable ratios are no longer relevant,are :

(a) There were no scientific basis to fix these ratios in the first place

(b) With development of infrastructure, paddy now moves freely from one district to another.

(c) Under millgate system, the mill owner may obtain paddy from any where, but has to deliver rice on his mill's location alone

4. As to the variation of ratio on account of type of mill, there is no scientific basis to differentiate between major and husking mills. As explained earlier, they essentially use some milling machine - Engleberg huller. The ratio, therefore, should be the same. In any case, because of poor state of equipment or bad operating procedure, a lower ratio is obtained, Government should not be penalized for such inefficiencies of the mill. It is, then only fair that an uniform milling ratio be fixed for all Government supplied paddy regardless of location or type of mill.

(4) Fixation of a Uniform Milling Ratio

1. In view of the above discussion, it is seen that the variable ratio for Aman season is not based on any scientific grounds. The actual test milling's which the DGF refer are not relevant as to their accuracy unless the methodology of the tests are known. Available literature and practical knowledge dictate no such variation on produce quality based upon the soil of the district on which it was grown. Much more relevant is the actual intrinsic and objective qualities of paddy which do vary on many factors. but perhaps the district of origin is the least influential in paddy quality determination.

2. In view of the above, it is strongly recommended that one single ratio be fixed for Aman paddy regardless of district of origin or the type of mill. What this ratio should be is very difficult to determine. Each lot of paddy will vary greatly in actual out-turn. If fixed too low. it gives an undesirable benefit to the miller. On the other hand. if fixed too high. there may be loss to the miller who will be discouraged to mill Govt. paddy. However from practical experience and considering the quality of average field paddy in Bangladesh. percentage. some what higher than in Boro is fair in case of Aman. because of inherent low moisture of the produce. The actual ratio may be fixed by DGF after taking into accounts all these considerations which include rate of milling commission as well.

(VIII) PUBLIC PROCUREMENT OF FOOD GRAINS IN INDIA

(1) A Short History

1. The Govt. of India started direct intervention in the food grain market in 1943 after the Great Bengal Famine which claimed a million lives. Procurement and distribution by public agencies was formalized after the Food Corporation of India was set up as a statutory body under an Act of Parliament in 1964 and started functioning on January 1, 1965. Besides FCI, procurement of food grains are carried out by various public agencies like Civil Supplies Department, Civil Supplies Corporation, Marketing Federations and a number of co-operatives operated by a number of State Governments. Together,they handle a very large percentage of marketable surplus of major grains like wheat and rice. The bulk of internal procurement of foodgrain in India is made in four northern States of Punjab, Haryana, Uttar Pradesh and Rajasthan. Out of 22 States and 9 Union Territories, these four States together contributed 83.6% of total procurement of wheat and rice in 1983. Though the procurement is highly concentrated in these northern States, distribution is carried out almost uniformly throughout India in consistent with population density.

(2) Objectives

As stated by Govt. of India, the major objectives of internal procurement are :

(i) To substantially increase foodgrain production so that the country will not only be self-sufficient in respect of its own needs but wile have sufficient reserves to meet all eventualities and also to stabilize food grain price.

(ii) To arrange for the public distribution of food grains through Governmental machinery (in addition to making the grains available through private trade) at certain administered prices which are considered fair and reasonable.

Mechanisms of Procurement

1. Wholesale foodgrain marketing in India is done through more than 11,000 principal markets. There are over 5,400 "regulated" markets where FCI and other purchasing agencies enforce their support prices. As per provisions of the Agricultural Produce Market Acts, the Govt. is obliged to procure all the grain brought to these markets at the government announced procurement prices. About these markets, FCI says, "A fully free market cannot exist in this kind of situation and the producer obviously can not obtain the maximum price for his produce. The arrival of several millions of tons of grains into the limited markets in the few states in such a short period as 2 or 3 months creates an unparalleled glut and generates problems in handling, transportation, storage etc."

However, the methods used to procure foodgrains are (a) Collection of levy on producers, (b) Collection of levy on rice millers (c) Collection of levy on traders/dealers (d) Purchase under price support scheme.

2. The compulsory procurement of rice by imposition of a levy on the rice millers has been the major method of procurement by public agencies. The levy rates vary from state to state. For Punjab and Haryana where little rice is consumed locally, a very nigh rate of 90% for coarse and 75% for fine variety is collected. For other states, it various from 25% to 60%. For West Bengal, a 40% levy is imposed on all rice mills operating in that State. In 1983-84, about 42% of all rice were procured from levy, the balance of 58% coming from price-support system. Price support is principally operated in "regulated" markets where all the grain of the specified quality is bought by public marketing agencies. A type of auction takes place in which the private trade may only bid higher prices than the procurement price announced by the Govt. of India, Since there is no procurement target in quantity, only the procurement of price is strictly enforced. One may say that this is truly a "floor price" system

where a price target and not a quantity target is the goal to achieve. After procurement, the paddy thus procured is converted to rice after wards in mills owned by public agencies or in contracted private mills.

3. The available statistics indicate that the price support scheme as pursued by FCI and other agencies are fairly successful. The following figures for the year they are available show the success of Govt of India in procurement for price support.

Table : 10 Rice

Year	Net Production	Market Arrivals		Procurement by Public Agencies	
	(Million of Tons)	Qty in Millions of Tons	Percentage of net production	Qty in Million of Tons	Percentage of market arrival
1975-76	45.04	12.77	28.30	6.32	49.50
1976-77	38.73	11.78	30.40	4.43	37.60
1977-78	48.67	14.48	29.48	4.85	33.50
1977-78	49.69	13.00	30.00	6.33	42.20
4 Years Average	45.53	13.00	29.70	5.48	40.70

Source : Compiled from Bulletin of Food Statistics : Government of India.

Significantly, the public procurement agencies have procured over 40% of market arrivals (marketable surpluses) of rice in 1975-78 period. Figures after this period are not available, but can be assumed to be at par or higher than 40% average of all marketable surplus of rice in India.

(3) Foodgrain Prices and Stabilization

1. Govt. of India considers stability of prices of food grains a high priority item on their economic agenda. Food and food products take up over 60 percent in All India consumer price index for industrial workers and over 75 percent in the consumer price index for agricultural labour. In the wholesale price index, agricultural produce account for more than half of total weight. The production of foodgrains is subject to fluctuations year to year but the demand for the save is generally very inelastic. Therefore, any slump in prices due to excess production or a sharp rise in prices due to limited shortages are both discouraged by the Govt. Interventions in the market by the

public agencies are primarily for price stabilization in India. Says India's Sixth Five-Year Plan document :

"Prices of agricultural commodities exercise a dominant influence on the behavior of the overall or general price level ..... Agricultural production strategies in the Sixth Plan should hence be based on need to increase the production of commodities in short supply, thereby helping in maintain price stability"

2. The price policy for foodgrains adopted by the Govt. of India has two major objectives :

i) To protect the interests of the farming community so that it is not obliged to make any distress sales of its produce and at the same time encourage it to increase agricultural production;

and,

ii) To protect the interests of the consumers, specially the weaker section of the society, so that foodgrains are available to them in adequate quantities at resonable prices.

To those ends, the Govt. announces support prices for foodgrains for three years in advance so that farmers may know the prices well in advance. The yearly price may then be revised upward but never downward. These support prices also form the procurement prices for Govt. purchases. This price is fixed after taking into account the recommendations made by a speialized statutory body - Agricultural Price Commission. In making its recommendations, the Agricultural Price Commission is expected to consider the need for a "balanced and integrated price structure in the perspective of the overall needs of the economy and with due regard to the interests of the producer and consumer" (Sixth Five year Plan Document, Govt. of India). The support prices thus formulated are uniform throughout the country and are applicable in all states. However, some of the producing States have been giving higher prices than the Federal Prices for paddy in their states. Procurmenet prices fixed for the levy rice to be obtained from millers are different in each State. The procurement and levy prices in a few selectes tates are given below :-

Table : 11. Procurement Prices Paddy and Rice : Selected States

Rupees per Quintal

State	Variety	Paddy		Rice	
		1982-83	1983-84	1982-83	1983-84
Punjab	Common	122.00	132.00	204.85	220.65
	Fine	126.00	136.00	217.55	233.85
	Superfine	130.00	140.00	225.80	242.20
Haryana	Common	122.00	132.00	205.85	221.75
	Fine	126.00	136.00	218.60	235.00
	Superfine	130.00	140.00	226.90	243.40
West Bengal	Common	122.00	132.00	192.35	207.30
	Fine	126.00	136.00	200.35	215.55
	Superfine	130.00	140.00	206.35	221.60
Assam	Common	122.00	132.00	194.05	209.55
	Fine	126.00	136.00	203.35	219.05
	Superfine	130.00	140.00	209.60	225.35
Orissa	Common	122.00	132.00	202.30	218.15
	Fine	126.00	136.00	208.65	224.45
	Superfine	130.00	140.00	214.95	230.75

Note : Prices of paddy are fixed by Federal Govt. whereas prices of rice are fixed by State Govt. prices include cost of gunny bags and loading charges.

Source : Bulletin on Food Statistics : Government of India.

3. The foodgrain including rice thus procured is distributed through various channels of PFDS. Without going into details of Indian system of distribution, it is observed that the whole operation is highly subsidized. The coverage is wide ranging and the channels reach even in remote rural areas without any serious interruption or shortages in recent years. It has stabilized the prices to a great extend and encouraged production to the extend that India today is self sufficient in basic foodgrains of wheat and rice. But what has been the cost of such stabilization is another matter which is only beggining to be answered very recently in India.

(4) A Recent Scenario

1. The Govt. of India has recently adopted a more open economic policy in all its operations. Devaluation of currency, removal of restriction on import and foreign investment and to make the rupee fully convertible within 5 years are some of the major reformative decisions. Economic analysts are of the opinion that

within a short time (2-3 years) the beneficial effects of such steps will be felt in all sectors of Indian economy. As reported (on 3rd Feb. 1992) by Press Trust of India (PTI), the Commission for Agricultural Costs and Prices (CACP) has demanded a fresh look on all aspects of the management of food sector and PFDS. The commission has recommended that the GOI should reduce its commitment of foodgrains distribution in a systematic manner in the next few years to cover only a limited proportion of the population which was really poor. It has also called for distribution through PFDS in the anti-poverty programmes. Another major recommendation of the CACP was that the rate of subsidy should be drastically brought down in a phased manner in three to four years. It appears that the policies which were corner stones of every Govt. in India for over four decades are being questioned now at the very least. One should not be surprised if drastic changes take place in Indian food policies with in a very short time.

(IX) A DISCOUNTING SYSTEM : DEDUCTIONS BY "BATTA" &"JALTA"

(1) A need for Allowances : As has been explained earlier, the enforcement of grading system of both rice and paddy is an involved procedure. It requires well equipped laboratory with requisite testing equipment, trained men to operate and pass judgment on the grade in a scientifically acceptable manner. The DGF does not posses such facilities at the field level where most of the procurement take place. Besides, excepting for the moisture which is approximately ascertained by portable moisture meters, other criteria are totally non-enforcable excepting by eye estimation in a most subjective manner. The resistance type moisture meter used to determine grain moisture is an inaccurate instrument which give an approximate value and has built-in tolerance of + 0.5%. The BSTI standard does not allow use of a

moisture meter but describe elaborate laboratory procedure to determine true moisture. All these point to a system in which allowances to these limits of tolerances should be given due consideration. Besides, even if true grading could be accomplished, the limitation imposed by primitive state of post harvest technology in Bangladesh could not deliver the correct grades on the scale of operation of DGF.

(2) Deduction and Discounts: On account of the above difficulties, there was an elaborate system of deductions in procurement procedures of Old Food Department. The relevant Govt. order is enclosed as Appendix - E to these papers. This system allowed flexibility of operation and the imposed penalties encouraged the suppliers/farmers to endeavor to upgrade their produce. The present system of go/no go is unrealistic in real life situation which always allows tolerances, negotiations and solutions. This system is felt most necessary for adjustment for moisture for paddy procurement, specially for Boro Season. For technical reasons, as explained earlier, odds against the attainment of 14% moisture in Boro season is very high indeed. It is perhaps irrel-

evant as the procured grain will eventually reach EMC of 15-16%,more quickly in case of rice for its intrinsic characteristics. The most practical solution other than artificial drying and bulk silo storage, is a flexible system of descending prices or quantity discounts as described below.

(3) Deduction of Price (BATTA): Such a deduction for deviation from a standard grade is the norm in any market place. A standard price is ascertained for a standard product, a lower price for a lower grade so long it is commercially acceptable and till it is rejected. For moisture gradation 14% may be considered standard and upto 17% in case of paddy and 16% in case of rice may be the limiting factor. For paddy price deduction for higher moisture percentage and an additional penalty may be imposed. The pricing table may be as under as an example only :

Deduction of Excess Moisture for Paddy

Percentage of Moisture	Deduction for Moisture
1. Paddy at 14% moisture	No deduction
2. Paddy upto 15% moisture	1% of price + Tk. 5/and penalty
3. Paddy upto 16% moisture	2% of price + Tk. 7/and penalty
4. Paddy upto 17% moisture	3% of price + Tk.10/and penalty
5. Above 17% moisture	Rejection.

This system will allow farmers to sell directly to the Govt. their paddy as the are used to handle. It is to be noted that drying of paddy is hardly practiced as a routine procedure by our farmers. This discount or deduction is know as "Batta" and is a common trade practice is Bangladesh.

2. Deduction of Weight (Jalta): Another common trade practice is widely practiced in primary markets of Bangladesh for high moisture, freshly harvested paddy. It is known as "Jalta", literally meaning "water loss". It is a system of giving higher weights over standard measure to cater for moisture ie "water loss". Thus 'Jalta' of 2-4 seers per maund are common for freshly harvested paddy representing extra weight of 5% to 10% on the nominal measure. Again 14% may be considered as standard with acceptance of upto 17% with additional weight deduction in case of paddy. This weight discounting should only be acceptable for paddy. For rice upto 2% moisture allowance should only be penalized by price deduction. A table may be constructed thus,as example only :

Weight Deduction for Paddy (Jalta) for Moisture

Percentage of Moisture	Deduction of Moisture by Additional Weight Per Maund / Per Quintal
1. Paddy at 14% Moisture	No additional weight
2. Paddy at 15% Moisture	0.8 Seer / 2 Kg (2% additional weight)
3. Paddy at 16% Moisture	1.6 seer / 4 kg (4% additional weight)
4. Paddy at 17% Moisture	2.4 seer /6 kg. (6% additional weight)
5. Paddy at over 17% Moisture	Rejection.

3. Perhaps this deduction by weight is more acceptable for our farmers than money deduction. It is a system widely practiced in rural markets for high moisture paddy. With progress of season, the "Jalta", is proportionately reduced. If the DGF procures moderately moist paddy of upto 17%, the ensuing problem of weight loss can be resolved by this simple mechanism already practiced widely at rural markets. The subsequent weight loss will also be catered for when paddy will lose moisture with passage of time by natural process.

(3) Practical Solution to Paddy Drying Problem

1. The task of procurement of 14% dry paddy in the Boro season is impractical, some would say impossible. India procures paddy of upto 18% moisture in its monsoonic zones for the Khariff season. It is thus not only practical but also advisable to procure paddy at 17% moisture for Boro only. For Aman season dry paddy at 14% moisture is not at all difficult with easy sun drying. The inherent accuracy of the moisture meter of +0.5% should also be considered. When we say 17% it means an instrument reading of 16.5 to 17.5% on the meter. This fact should also be circulated at field level so that farmer's paddy are not rejected on account of this nominal difference. The paddy thus procured should now be milled at the dry season when conditions for efficient milling prevail. The extra weight to correct for moisture will take case of the loss due to natural drying. In this manner, paddy may be procured in Boro season to be milled at Aman (dry) season at no loss or extra cost to the Government. However, it should be noted that this is only an interim stop-gap solution of the problem of wet season procurement. Real and long range solution lies in crop drying by mechanical driers, storage in aerated bulk stores and milling in modern mills. Till such times these infrastructural and technical improvements take place, there seems to be no alternative to procurement of moderately wet paddy.

(X) MILL GATE PURCHASE - ITS WEAKNESSES

1. This scheme of procurement took redoubled effect from 1988-89 before which Govt. procurement was mostly in the form of paddy to be milled later by contract mills. This system is a misnomer in that, although it shows procurement in the form of paddy, in actual fact, it is in the form of rice that procurement is accomplished. In the latest season (Aman - 91-92) over 85% of all procurement was done though this procedure. Therefore, it needs serious study as to its efficacy towards the prime objective of procurement - price support to farmers and as means of efficiency in procurement itself.

(1) Brief Description

1. This system is a package contract for (a) paddy procurement (b) Milling this paddy in rice (c) Transport to nearest Govt. store. A number of contract mills are engaged to procure paddy for the Govt and mill it by a composite contract. The contract format for Mill gate is essentially same as a contract for milling Govt. paddy. In both cases the miller has to put up 60% value of his 15 days milling capacity of paddy in the form of a bank guarantee or other instruments like saving certificates etc. Under the Millgate, the miller now procures paddy which on inspection as to its (a) quantity (b) quality, the DGF pays off the value of upto 15 days processing stock. Point to note is that this milling capacity is determined by DGF inspectors prior to contract. The miller is now contract bound to deliver the FAQ rice within 15 days. He,then,again procures paddy and the cycle goes not till he is no longer capable of supplying paddy at the procurement price.

The mechanism of mill gate then, hinges on the following criteria (a) Processing capacity of the mill - parboiling, drying and milling (b) Putting up requisite security (c) delivery in time of FAQ rice. The built in weaknesses and possible abuses are now itemized :

(2) Major Weaknesses of Mill Gate Purchase Scheme

1. Milling Capacity: As described earlier, these is no scientific way to determine milling-specifically drying capacity of a traditional (Husking and Major) mill. Indian study reveal a sun drying yard's physical paddy holding capacity of 60 MT per one acre of yards at 2.50 cm thickness. But this does not indicate drying capacity which is totally dependent upon weather. By thumb rule drying capacity decreases by 50% during Boro as compared to Aman. There is no basis or procedure in DGF to (a) Determine drying/milling capacity (b) Reduction of capacity by season (c) Essential minimum equipment list of a mill including boiler certificate mandatory under Bangladesh law.

There is a tendency every where to over state milling capacity in the contract to allow (a) sub contracting (b) purchase rice from market and supply to DGF to seek the milling commission and other rents.

2. Supply Time: While the contract stipulates maximum time, it is silent on the minimum time. A miller may supply the rice any time within his contractual 15 days and is entitled to another payment of his contracted quantity by WQSC which,in effect,is cash payment from a designated bank. It is not unusual for mills in N.W. region to have several payments within this 15 days. This is impossible as the stipulated milling capacity can not be theoretically exceeded.

3. Accounting Difficulties: After issuing of the WQSC, the paddy thus bought is entered in DGF stock books as paddy which is not there. It is at the same time issued to the mill to be converted to rice. It is basically bad accounting principle to enter into books an item which is not so. If such a thing is to be done, the stock to be entered in books should be rice, the commodity which eventually will enter DGF stores. This seemingly simple problem has far reaching consequences in stock taking and audit. As a matter of fact,additionally owning to differential ratios, no one knows what should be the exact quantity of rice stock procured and question of audit is irrelevant in such a situation.

4. Advance Payment: The system works basically on advance payment.There is no way to determine the ownership of paddy at the miller's store. It is quite possible to (a) keep stocks belonging to other traders (b) same stock being shown time and again (c) on payment, procure rice from market to be supplied to DGF. That kind of operation is taking place is evident from the fact that rice is supplied before elapse time (15 days) in a number of cases which is not possible, if Govt. paddy is milled.

5. Quality/Quantity Check: DGF, theoretically, buys only FAQ paddy. Unless the paddy is of good quality, resultant rice can not be of acceptable quality. There is little or no check on quality of paddy in millgate purchase. Naturally so, because, covertly here the emphasis is on supply of rice and not paddy. As to the quantity, it is physically impossible to weight the entire allotment quantities in a mill. There are over 1300 contract mills of DGF mostly in the N.W. region. In a single district these are hundreds of husking mills to be regularly checked for quality quantity of stock and state of operation which the contract stipulates. It is quite impractical to do so under actual circumstances. Supervision and control also deteriorate in this situation.

(3) Realities of the Situation:

1. That all is not well is evident from many sources. The poor quality of procured rice has been witnessed by independent experts (WB report). The rapid stock deterioration is another indication of high moisture and poor quality stock. Nagging and adverse press reports are another indications of various abuses in the system. Large quantities of outstanding paddy from various mills also indicate severe difficulties of management. At the end of the IRRI/BORO 1990-91. the situation was thus :

Table : 12. Weekly National Milling Status Report (NMR)

Period Covered : 14-11-91 to 20-11-91

Region	Quantity Issued to Mill(Paddy)	Quantity Received from Mill (Rice)	Expected Recovery (Rice)	Mill Balance (Rice)	Remarks
Rajshahi	16684	447	11123	10676	
Khulna	0	0	0	0	
Dhaka	697	302	465	163	
Chittagong	300	294	200	+94	
Total Current week cumulative	17681	1043	11788	10745	
as from 15.11.91	0	0	0	0	

Source : FAO Reorganization Project, MOF, GOB.

2. These computer print outs of MIS indicate a short fall of 10,745 MT of rice, valued at least Tk. 107.45 million, a staggering figure indeed. It is to be noted that by 15th Oct. there should be no outstanding at the mills and by 15th Nov.another procurement season starts. There appears to be serious lapses in the management of the Mill Gate Purchase way of procurement, with huge quantities of missing stock and consequent loss to the Govt.

(4) Its Impact Upon Price Support: From all indications, the impact of this scheme in the defense of a floor price had been minimal. Various field studies (IFRI-90, WB-91) indicate that the going market rate of paddy was below the procurement price. This is not surprising for :-

(a) The price that the miller pays for paddy must be necessarily bellow procurement prices as it involves a monetary transaction. There can not be a free lunch in real life situation where no -at par transaction take place. This is an inherent weakness of the system.

(b) The necessary transaction cost of the miller for payment by WQSC is recouped in margin between market price and procurement price.

(c) The miller is under no compulsion to pay the procurement price but he must make a profit out of this purchase and sale. For him, it should make no difference whether the buyer is Govt. of another trader.

(d) It is estimated that a difference of at least 5% is about minimum margin between floor price and market price for mill gate to take place. The more the merrier in actual circumstances.

(e) If the margin can not be made up in price, it will be attempted to be made up in quality and high moisture.

In fact, since the contract mills only act as agents for DGF for procurement under this scheme, there must be an agency commission of the services rendered. This "rent seeking" is thus a commission covertly built in the system. Unless the farmer directly receives money from the Govt. for his produce, such roundabout ways just can not ensure price support. All empirical evidence indicate what was always obvious to persons having experience of market operations in Bangladesh that Mill Gate Purchase is definitely not a sound instrument for price support.

4. A Real-Life Case History

"A Shrewd Way of Beating the System :

During our survey, the owner of a rice mill in Bogra District revealed an ingenious method of abusing the Palli Rationing program through the government rice procurement system. Bogra is one of the largest rice procurement areas in the country. The rice-miller, an apparently wealthy and educated man, confessed that he was involved in the deal, and described the method as follows :

a) In the procurement program, the government buys rice through a system known as the millgate purchase contract. The contract rice-miller purchases paddy, and after milling the paddy, sup plies rice to the government at a fixed price that includes the milling charge (Tk. 10,544 per metric ton during the survey). The Officer-in-Charge of the LSD and the Upazila Food Controller sign and issue a Weight Quality Stock Certificate (WQSC) to the contract miller to supply rice. The miller produces the WQSC to a designated bank and receives cash payment for the supplied rice.

b) In this rent-seeking process, however, a portion of the mill gate purchased rice is not supplied by the miller. Instead, this quantity is shown in the allotment of rice in the PR program. A Delivery Order is issued by the food officials to the PR dealer for his full allotment of rice. The PR dealer pays the subsi dized price for the full allotment, but receives a less quantity of rice. Later, the PR dealer gets back the money he paid for the quantity he did not receive.

c) In this process, the government pays a price of Tk. 10,544 per metric ton for a quantity of rice that is not received. In the official record the same quantity is shown as delivered to the PR program at a subsidized price of Tk. 7,340 per metric ton. The difference between the millgate purchase price and the PR issue price (i.e. Tk. 3,204 per ton) is shared by the parties involved in the deal.

An example will give an idea about the magnitude of profit that can be made through this process : The monthly officially record-ed PR rice offtake from a typical LSD in Bogra is about 98 metric tons of rice. If one-half of this quantity disappears in the process described above, then about Tk. 157,000 can be earned in a month in one LSD during procurement seasons.

d) The government also pays for other bills arising from this fictitious transaction. These bills are :

i) Carrying charge of rice from the mill to the LSD (about Tk. 3 per ton per kilometer) paid to the carrying contractor (for the rice that was not carried)

ii) Handling charges at the LSD (about Tk. 2 per bag of rice) paid to the handling contractor (1) to received the millgate purchased rice, and (2) to deliver the PR rice (for the rice that was not handled);

iii) Payment for shortages allowed for storage loss (for the rice that was not stored).

These bills, arising from the false transaction, must be charged to the government to keep the accounting in order."

Source : Operational Performance of the Palli (Rural) Rationing Program in Bangladesh : IFRI Report, April, 1992

(XI) A SUM UP

1. The forecasts for the IRRI/Boro for 1992 is excellent. The agriculture department figures released on 23rd March 1992 show that over 9,11,000 hectares in Rajshahi division alone has been planted with Boro, mostly of HYVs. This is 25% higher than the planned target of the Department for Boro for the 16 districts of the N.W. The Agricultural Extension Service estimates a minimum harvest of 3.37 million tons of paddy ie roughly 2.19 million tons of rice. News papers report record sale of irrigation equipment in these districts. At 40% marketable surplus, the paddy estimated to go through the marketing channels exceed 1.3 million tons in two, at best three short months of June, July and August. The fears of a glut in time and space are very real with expected plummeting prices and sluggish or no sale of rice as other regions will also have their share of production. The DGF will have to procure over million tons of paddy to have any sort of price support to the producer.

2. In such circumstances, the need to develop efficient marketing mechanisms are paramount. With a positive rice balance (with 1 to 2 million tons of imported wheat) the need to change the basic vision of procurement is urgent. The main object can no longer be to supply the PFDS which are a fixed quantity. Here is a classic scenario to take off the surplus to enforce a price target. If that price can not be sustained, the whole effort is wasted. If the stocks can not be kept in good condition, huge losses will be sustained. It the sales are sluggish, the release of stocks will go into another procurement season, nullifying the effect of price support. It is a tricky situation indeed, one which Bangladesh has had little previous experience, not at least in the last fifty years.

3. DGF has recently floated tenders to procure milled rice presumably to satisfy the needs of its PFDS. Although very small quantities are tendered for now, it is expected that with some procedural adjustments large quantities will be offered in future. Admittedly, this rice will arrive from surplus zones, relieving the pressure on supply somewhat. But in the immediate future, the major burden of price stabilization rest solely on the Government. Apart from all other negative factors, the private sector neither has the money nor the infrastructure to absorb this huge quantities of paddy. At a rough count it would need capital outlays of billions of takas to buy a million tons of paddy within 2 to 3 months. Such figures are just beyond imagination of rural banks in Rajshahi Division,even if all other stops are sprung open by some miraculous touch.

4. Now is the time to develop a 'buffer stock' and not a consumption stock. Arrangements for efficient storage, sufficient finance and above all managerial skills are prime need of the hour before the whole system comes to a rude stop. Planning for export is to be given most serious considerations. How big will be the buffer stock, how it is to be managed, what if the next harvest is equally big or even bigger, are some of the basic questions

which must be faced now. The ready relief -valve is export, which is ofcourse easier said than done. Some of the problems and prospects of export will be dealt with briefly later, but suffice it to say that a whole new orientation is to be made to successfully export rice from Bangladesh. To give an effective price support, there is no real option than to buy paddy now. Major consideration to procure paddy will be to relieve pressures of releasing milled rice within 3 months of procurement into another harvest season at dumping prices. The need to develop further storage units, preferably silos for paddy, should be given urgent considerations. A fresh look into all aspects and need to conduct further realistic research into the various intermingling factors of the food management in Bangladesh has never been more urgent.

(XII) CONCLUSIONS AND RECOMMENDATIONS

1. Bangladesh is passing through a transition period so far as food production and management of food is concerned. After decades of chronic shortages, for various reasons, a self sufficiency in rice production has already been achieved. With increasing production, minor surpluses are being experienced with innumerable difficulties in the marketing operations. The Government polices, formulated for a time of deficiencies and fulfill the needs of PFDS are becoming increasingly irrelevant and redundant in these changed circumstances. The prime policy objectives now should be to encourage and sustain these increased production if only to increase the nutritional in-take of the people. At the same time, in an imperfect capital and marketing situation, owning in part to Govt's own hoary policies, the need for intervention can not be just ignored.

2. In this transitory situation, an evolutionary process of change is in order if only not to make too much disturbances in an already fragile agro-economic scene.Any disruption in the present environment will surely have negative repercussions on this delicate balance. Special mention must be made of technical difficulties of post harvest specifically in wet season harvests. It is all the more urgent since most growth is taking place in the wet season production which must be sustained, if surpluses are to be a norm and not an exception to the rule in Bangladesh's food sector. The present system of procurement was never meant to be a price-support mechanism. It was a device to supply the Govt. for its PFDS needs. In recent years, with self sufficiency and looming surpluses, the need to modify and rationalize these methods has taken new poignancy.

3. The ways, means, difficulties and possible solutions were reviewed in a brief manner in the preceding pages. Of necessity, some technical aspects of the problems were discussed in a rudimentary manner. It should be noted that all of rice marketing is a technically oriented subject. Commercial or administrative decisions must stem from sound technical grounds. No amount of administrative action will correct technical faults which happen so regularly. Given the premise that procurement is necessary and

desirable as an instrument of price support, much can be done even within the primitive technology of post harvest in Bangladesh, to enhance its efficiency and reduce the staggering budgetary costs sustained now. The major recommendations are thus itemized, the reasons and rationales for those were discussed in the preceding pages.

4. Recommendations

(a) Form of Procurement: There is no option, when price support is the objective, than to procure in the form of paddy. For the Boro season, paddy is the only possible form of procurement, unless huge losses in the form of stock deterioration and subsequent sale/auction at any price is to be avoided.

(b) Mill Gate Purchase: This scheme has outlived its usefulness, if ever it had any. Mismanagement and abuses are built in the complex operations of the system. Besides, it does nothing to give price support to the farmer. This system should be canceled as soon as possible and replaced by direct purchase of paddy from growers.

(c) Avoidance of Spoilage: This is basically a question of moisture. In Boro, procurement of milled rice should be stopped except by tender to service PFDS. All procurement should be done in the form of paddy to be milled in dry season. Our present technology is inadequate to mill and store rice in the wet season. Adequate storage space and form of storage is to be provided to store paddy on a most urgent basis.

(d) Moisture : It is recommended that paddy upto 17% moisture and rice upto 16% moisture may be procured. These commodities can be safely stored in present system of storage upto those moisture levels. A system of discounting/deduction by price or weight should be introduced to procure these moderately moist grains. This system of discount will ensure that no additional cost is incurred by the Govt. for purchase of this paddy.

(e) Milling Ratios : Milling ratios should be rationalized. Differential ratios are not scientifically based. Uniform ratios should be introduced for the whole country. What these ratios should be is an administrative decision tied, in part, with the milling commissions paid. But ratios for Aman is always higher than Boro which is presently 100:63.333 somewhat higher uniform ratio for all types (husking, major, automatic) of mills can be fixed right now. These should be no differentiation of ratio between types of mill and different districts of Bangladesh.

(f) Rice and Paddy Procurement: It is recommended that these two commodities be procured by two different means as they serve two different purposes. Rice for PFDS should be procured by competitive tender at centers of consumption. Paddy for price support should be procured at centers of production. Thus a balance will be maintained. As the quantum of tendered rice will increase eventually, the paddy quantum will reduce in step.

(g) Buffer,Reserve of Security Stock: In the near future, or right now, if the indications are right, the major portion of procurement is taking the shape of a buffer stock. Management of such a stock is primarily different from a distribution or a current stock. Long range storage without loss of quality is the first prerequisite. Appropriate technical solution to this problems needs to be addressed.

5. Perhaps, the foregoing paper has raised more questions than have offered solutions - if at all these solutions are stop gap ad-hoc or of a temporary nature. That is so,because, the situation now unfolding in food sector in Bangladesh has never been experienced, before. The policies, procedures and precedence are becoming increasingly irrelevant in these changed circumstances. New and fresh economic, marketing, financial and technological polices are need of the hour. But to formulate such policies need basic and applied research, sadly deficient hitherto at least in the food sector. Some of the urgent research programs to find solutions or make policy recommendations will be :

Need for Further Research

(a) The Export Scenario: To maintain the momentum gained in rice production, sustained demand is a basic need. With surpluses generated year after year, the surplus stock must be exported. The research into this unexplored field may be :

(i) Research on possible markets
(ii) Information of type and processing needs
(iii) Financial and other aspects.

(b) Technological Changes: Technical improvements in drying, parboiling and milling are most necessary to produce standard grade rice. The need for research will be :

(i) To develop an appropriate technology in drying,parboiling and milling
(ii) Storage technology
(iii) Carrying and transportation

(c) Socio-Economic and Financial: Since rice is a basic measure of wealth in this predominantly agro-based society, the changes in socio-economic sectors will be far reaching. Much research is necessary to discern the various parameters to evolve rational polices for :

(i) Poverty alleviation
(ii) Nutritional upgrading
(iii) Income distribution

(d) Govt. Policies and Marketing: The urgent changes and reforms in Govt's policies and changes in the marketing are another sector which needs urgent consideration. Further research is necessary to develop a rational policy mix to obtain the desirable results.

(XIII) ADDENDUM

Rice-Exports

Some of Technological Possibilities
Rice Processing and Value Addition

1. Rice processing in Bangladesh is still in a most primitive state of development. Ever the most modern mills use a technology that was developed at least 40 years ago in Europe and Japan. To tap the export market, where quality gradation is supreme to dictate both demand and value, some major points are touched briefly, if only to indicate the state of the art.

(a) Variety : Fine varieties are much in demand. Pakistani 'Basmati' and Indian 'Patna' fetch high prices in the international market. In the USA, Belle Patna, Blu belle, Labelle and Starbonnet are comparable. There is an urgent need to develop fine quantities of rice for export. The emphasis now should be on quality and not quantity.

(b) Processing; There is little demand for parboiled rice. Most rice in international market are white milled (raw rice). To produce high grade white rice with low broken percentage need premium grade paddy. This will necessitate sound post harvest treatment and immediate cleaning and crop drying. Refinements such as polishing, size and color grading will add value to the final product.

(c) Precooking: Precooked rice is sold as ready to eat products like Minute Rice and Milled Rice in the USA. Italy is a world leader in high quality precooked rice which is produced from parboiled rice. Rice is first-cooked and then de-dydrated by either freeze-drying or heat de-hydration process and then packaged. This needs high cost special plants, but the value addition is manifold over basic rice.

(d) Canning : Specially for the military, parboiled rice is processed as a canned; cooked product. Canned cooked rice is also used as an ingredient for soups. The rice is boiled for 5 minutes, cooked, packed in can and passed through a retort to complete the cooking and sterilization.

(e) Rice Products: Rice is used for noodles, usually mixed with starch or corn grits. Rice is a basic product for baby food cereal mix where upto 80% by weight is made up of rice. Incidentally, an international baby food manufacturer, setting up plant in Bangladesh, got the commercially available rice analyzed for ingredient in his cereal. Not one passed the minimum requirements. This author had a sample specially milled to match the specs, which it did, in the company's Head Quarter in Switzerland.

Use of By Products

(a) Bran ; Bran oil extraction by solvent process is well established in USA and India. When refined for human consumption, it is the most expensive salad oil in South Korea and Japan. However, mostly it is used in crude form as an industrial oil for problems of lipase activity.

(b) Husk or Hull : Is of prime importance as fuel, although other usable chemicals like silicon etc are extracted on experimental basis. For Bangladesh, it is the greatest source of renewable energy source which has been sadly underutilized. It is possible to operate a parboiling mill run entirely on the husk produced without any external power. Much research is necessary to enhance the thermal efficiency of existing mills to save this valuable energy source.

Wheat Production and Procurements

1. Some analyses indicate that Bangladesh has no comparative advantage in wheat production as opposed to rice. International wheat prices are likely to decline in coming years, the outlooks for Bangladesh wheat is not bright. This has an important bearing upon food policies in that procurement of wheat is not cost-effective. Additionally, the effects of wheat procurement is largely counteracted by distribution of large volumes of wheat for food for work and other public distribution in wheat producing areas in the procurement season.

2. It is to be noted that the areas where wheat grow in Bangladesh are prime land for production of upland rice. Fine quality upland rice can be grown instead of wheat in these areas. When processed for essentially export market, these products will fetch much higher exchange rate. In such a barter, ratio of 1:3 is not unusual between fine rice and wheat. All these indicate need for further research, oriented towards value and not crude quantities of food grain. No such study or research has been conducted yet, though the value of such a swap should be self explanatory.

INDEX OF APPENDICIES

			Page
1.	Appendix - A	Glossery of Terms in Post-Harvest Industry of Paddy	1
2.	Appendix - B	Choice of Rice Milling Technology in Bangladesh	6
3.	Appendix - C	Observations on Boiles/Steam Generators Used in Paddy Processing Units of Bangladesh	20
4.	Appendix - D	Preservation of Paddy and Rice for Bangladesh	23
5.	Appendix - E	Discounted (Batta) Pricing Procedure (Govt. of East Pakistan 1966)	31
6.	Appendix - F	Milling Ratios (1963)	42
7.	Appendix - G	Excerpts of Milling Ratios (1980)	44

APPENDIX - A

Glossary of Terms in Post-Harvest Industry of Paddy

Agriculture engineers and practical millers use many terms of trade in the rice processing industry. Regrettably, they are not fully standardized. Where as terms used in rice trade are more or less standardized by many international bodies under the auspices of United Nations special organs like FAO, there has been little effort to standardize technical terms used in the rice processing industry. However, the International Rice Research Institute, Philippines, has used these terms in the context of the meanings shown. Author's explanation and elaboration is shown in brocket. In the absence of an internationally recognized glossary of terms and nomenclatures the following may be considered standard which are based upon IRRI terms and has been used throughout the preceding report in those senses.

Abrasive Polisher : (Also polisher, whitener) A machine used to remove bran layer from brown rice to produce milled rice using abrasive action between kernel and the emery stone. (May be of conical or cylindrical design).

Aeration : The forced movement of air through stored grain at a low airflow rates (generally between .07 - .28 m^2/min per ton) for the purpose other than drying, to maintain or improve its quality. (In low humidity condition, aeration does remove small quantities of moisture from stored grain).

Angle of Repose : The angle between the horizontal surface and the side of grain formed by a natural pile.

Aspiration : A process of cleaning by moving large volumes of air through a thin layer of grain, to separate the particles lighter in wright than the grain itself.

Bag Storage : Storing of paddy or other produce in bags, usually made of jute (gunny, burlap) or (less frequently) polyethylene.

Bran : The outer layer of the rice kernel after husk is removed. It is removed during milling process (Specifically, Polishing).

Brokens : Pieces of rice kernel that are less than 3/4th the size of full kernel.

Brown Rice : (Also cargo rice) Dehusked paddy, often referred as unpolished rice.

Bulk Storage : (Also Bin Storage) Storage of paddy or rice in loose form in a large solid container, without the use of bags

BTU : British Thermal Units : Amount of heat required to raise the temperature of one pound (lb) of water (H^2O), one degree Fahrenheit (QF), 1 BTU = 252 calories.

Calorie (Cal) : Amount of heat required to raise the temperature of one gram of water one degree centigrade/celcius (oC). (Being a very small unit for practical purposes,it is usually used in units of a thousand ie one thousand calories. usually shown as Kcal - Kilo calories).

Chalky Grain : Kernels of grain which have some portion as opaque or milky white in color. (not to be confused with white belly grain which is characteristic of imperfect parboiling. Chalky grain is found only in raw rice).

Cleaning : The process of removing foreign material or impurities from paddy or rice.

Conveying Equipment : Equipment used to move paddy or rice from one place to another by mechanical means. (Usually belt or screw conveyor are used to more paddy horizontally and up small inclines. Bucket elevators are used to more paddy vertically and if necessary, then horizontally).

Cyclone Separator : Large, round, cylindrical tank like structures, usually metal, used to separate particles carried in an airstream.

Degree of Milling : Expression used to indicate the amount of bran removal in the milling process.

Dehusking : Process of removing the husk from paddy during milling. (also known as shelling).

De-Stoner (Also Stoner, specific gravity Stoner) : A machine that removes or separates stones of same or smaller size as the paddy or rice grain.

Discolored Grain : Paddy or rice grains which have changed to a yellowish or brownish or black color because of heat damage during storage or imperfect parboiling. (In Bangladesh it is frequently due to damage by micro - biological action owing to storage of wet paddy (above 14% moisture) and are only visible after parboiling).

Dockage (Also, Refraction) : The amount of foreign matters or impurities found in a sample of paddy, usually expressed as percent.

Drying : The process of reducing the moisture content of grain,(by natural ie sun drying or artificial drying ie by use of a drier machine).

Dunnage : Wood (or bamboo or other non-prous material) frames used on concrete (or brick soled) floors for stacking bags of grain. Prevents direct contact between grain and floor (and thereby prevents migration of moisture from ground to grain).

Contd. Appendix - A

Equilibrium Moisture Content (EMC) : The moisture content of the paddy/rice after it has been exposed to a particular environment for a long time. It is dependent upon the humidity and temperature conditions of the environment. The equilibrium moisture content determines the minimum moisture content to which paddy can be dried under a given set of air temperature and humidity conditions. (It is of vital importance to millers and storagers of rice as it is futile to dry paddy below EMC as it will gain moisture subsequently to reach EMC in storage).

Flat Storage (Godown in S.Asian Context) : Flat floored, bag type storage, but could also be bulk storage (if so designed).

Foreign Matter : other things such as stones, sand, chaff, straw dried soil etc. mixed with paddy or rice. (All materials found in paddy/rice other than those derived from paddy).

Friction Polisher : Type of whitener machine using the friction between the rice grains to remove part or whole of bran layers.

Fumigation : The process of using chemicals to control insect pests in the grain.

Gelatinization : The process by which starch granules in kernel change to gelly-like form, and fill the voids in the grain and cement the fissures together, during parboiling.

Gelatinization Temperature : The temperature at which gelatinization takes place in kernel. It is between 55^{o}C to 75^{o}C depending an variety of paddy.

Godown : (Flat Storage). A warehouse used for storing paddy or rice either in bulk (very rarely) or in bags (usually).

Grading : The separation of broken rice grain from unbroken rice grain: and separation of brokens into different sizes.

Grader : A machine to do the grading process of rice, usually the last machine in a multi stage mill.

Head Yield : The amount of head rice obtained when paddy is milled. It is total rice less the brokens.

Holding Capacity : The amount of paddy in a continuous flow drier at any one time, however it is not necessarily the drying capacity nor the through put capacity of the drier.

Hull or Husk (Also Chaff) : Outer covering of the paddy grain.

Husking (De-husking, Hulling, Shelling) : The process of removing the husk from the paddy grains during milling.

Immature Grain : Paddy grains which are under developed or not

fully developed, sometimes referred to as unripe. They lack in size and weight compared to a fully mature grain. (High percentages of immature grain are found in Boro paddy due perhaps to lack of water or soil moisture during maturing phase. Known as "Chita" in Bangla, they contribute to low milling recovery and poor quality of milled rice as there is no known process of separating them during processing) . Leaching (Leacing loss) : Out wand diffusion of hydrosoluble constituents of the paddy kernel into soak water during parboiling process. (It is most pronounced in cold soaking used in traditional system of parboiling).

Medium Size Brokens : Broken pieces of the rice grain, between one fourth and one half of a kernel size.

Milled Rice : Rice obtained from paddy after the husk and bran has been removed.

Milling : A general term representing the process of converting paddy into rice.

Milling Yield or (Milling Outturn, Milling Ratio) : The amount of rice obtained from a quantity of paddy after the milling process. (Normally expressed in percentage indicating rice obtained from one hundred units of paddy e.g. 65% meaning 65 units of rice out of 100 units of paddy).

Moisture Content : Amount of water in grain. Expressed as percentage based on wet or dry ie.

$$\text{Moisture Content (Wet Basis) Wb} = \frac{\text{Weight of moisture in grain sample}}{\text{total weight of the grain sample}} \times 100$$

Paddy : Rice kernel with husk, also known as rough rice.

Parboiling : Hydrothermal treatment of paddy before milling including soaking, heat treatment and drying.

Raw Rice : Rice which has not been parboiled.

Rough Rice : Paddy

Rubber Roll Husker : (Also known as Rubber Roll Sheller, De-Husker).
Rubber Roll Huller) Machine used to remove the husk from the paddy grain by passing the grain between two rubber roll operating at differential peripheral speeds. (It is the standard modern method of de-husking paddy).

Scalping : Rough cleaning of paddy by removing most foreign matters prior to drying, storage or parboiling.

Contd. Appendix - A

Screening or Sieving : Separation of different size particles by using a wire mesh or perforated sheet in moving pattern. allowing

the smaller size particles to fall through the openings and the larger size particles to remain on top.

Soaking or (Steeping) : Allowing paddy to remain in water (either hot or cold) to increase its moisture content during parboiling, subjecting the soaked paddy to heat treatment by passing steam through the paddy mass. This process causes the rice to gelatinize.

Tempering : Temporarily holding the paddy between drying passes allowing the moisture content in the centre of the grain and that on the surface of the grain to equalize.

Through put Capacity (or Capacity) : The amount of paddy which flows through a continuous flow dryer in one hour.

Total Milling Yield (or Milling Ratio) : Total rice including head rice and the broken rice milled from paddy. Usually expressed as a percent.

Trier ("Bonga" in Bengali) : Small metal probe for taking samples of paddy or rice from bags or from bulk containers.

Under Milled Rice : Milled rice which has less bran removed than normal.

Under Runner Disk Sheller (or Disk Sheller) : Machine used to remove husk from paddy grain. It consists of two horizontal disks, the top one stationery and the lower one rotating : (The disks are covered with cast emery stones).

Warehouse: (Storage Depot, Godown) : Building with flat floor for storing paddy and rice in bags.

White Belly : Kernel with white or milky colored portions.(It is a characteristic of parboiled rice when the process has not been perfectly accomplished.)

Whitening (or Polishing) : Process of removing bran layer during milling.

Whole Rice : (Also Head Rice) : A full kernel or piece of kernel which is 3/4th size or larger.

APPENDIX - B

Choice of Rice Milling Technology in Bangladesh

- Mahfoozur Rahman

Introduction

Milling process is the last of the processes in the complex system of post harvest technology of paddy/rice. It is the most visible of the changes that the paddy undergoes before being converted into edible rice. The present paper has been abstracted from a study report prepared by the author (Rahman 1988) on problems and prospects of Rice Processing Technologies in Bangladesh. Here a critical review will be made on the various options, problems and some of the possible solutions to those problems in evolving an efficient rice milling technology in Bangladesh context. In the process the possible benefits of such choices will be discussed in brief.

Objects

The primary objectives of any milling process is to (a) remove the husk from the paddy grain with a minimum of damage to bran layer and without breaking the brown rice (b) separate the husk from the brown rice without removing any brown rice, brokens or immature grains (c) separate the paddy still unhulled from the resultant admixture (d) remove the bran layer from the brown rice to a degree desired without further brokens (e) to produce an end product rice of a standard quality.

The secondary objectives are (a) To have as little brokens as possible so as to produce maximum head rice (b) to remove all foreign matters i.e. bran, husk and paddy so as to produce pure polished rice (c) to produce rice of a quality preferred by the consumers e.g. under milled or glossy variety etc. (d) To produce pure bran without any impurities as a valuable by-product (e) To maximize total yield or milling ratio by milling all the grains including the undersized or immature grains which are always a part of commercial lots of paddy.

The Processes

Although milling is a generic term used to describe the processes of converting paddy into rice, it includes many processes which may be done in a series of machines ideally or even in a single machine. The major processes are :

Paper presented to a workshop on "Paddy Processing Technology in Bangladesh", attended by expert level participants. The workshop was organized by Institute of Appropriate Technology, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh on 8th December 1988.

Contd. Appendix - A

(a) Pre-cleaning (Essential)

- Removing foreign matters and refractions such as particles of sand, straw, stone, etc. from the paddy to be milled.

(b) Specific Gravity and Magnetic Separation (Optional)

- For removing small foreign matters like stone chips which are equal or smaller in size than paddy grains, special separation systems are required. For removing ferrous matters, electro or permanent magnets are used. These separations are required for saving the rubber roller and to produce higher quality products free from small stones..

(c) Dehusking and Husk Separation (Essential)

- Removing the husk from the paddy with a minimum of damage to grain and separation of husk from paddy. An additional refinement is to remove dead and immature grains as well.

(d) Paddy Separation (Descriable)

- Separation of dehusked paddy from any remaining paddy grain. Most shellers will remove husk of about 90% grains. Mixture of various size grains make this process most desirable.

(e) Bran Removal or Polishing (Essential)

- Removing all or part of bran from brown rice to produce polished rice.

(f) Grading (Desirable to Essential)

- Separating brokens from whole rice. Both the whole grain and the brokens are also sized into various grades. Essential if export is contemplated as international standards demand such grading.

(g) Glazing (Optional)
- Most consumers prefer highly polished and bright rice. Remaining loose bran on the rice is removed by glazing process.

Technical Options

Generally two types of machines are used in Bangladesh to achieve the objectives of milling process (1) Single machine or Huller (2) Multistage machines. The former is a primitive machine which does all the functions in a single run and the latter being more complex and therefore, expensive, do the same in a controlled stage by stage process. As this discussion is held for persons with prior knowledge and experience in the various aspects and technicalities of milling, the subjects will be restricted to a critical review on the various machines only.

Main Advantages and Disadvantages of Steel Huller

Advantages	Disadvantages
1. In-expensive and easy to manufacture	1. Has the lowest recovery and milling ratio
2. Parts are easily available	2. Has highest percentages of brokens
3. Needs little space to locate and operate	3. The barn is a mixture of bran,germs,powered and delete broken husks and small brokens and therefore unfit for many uses which pure bran has.
4. Low skill is required to operate the machine	4. Unit wise, has higher power requirement.
5. Being rugged in construction break-downs are rare	5. There is little control on degree of polish to be imparted.
6. Can be operated by electric motor, diesel engine, steam engine or by a prime mover attached to power tiller	6. The consumption of imported bearings is prodigal

Multi-Stage Mill

Since the multi-stage mill has a complex series of individual machines, the main types and their advantages and disadvantages wherever applicable will be described very briefly : The possibility of their manufacture in Bangladesh is also opined in the light of actual experience.

(a) Cleaners: Pre-cleaners are simple machines which are mainly oscillating sieves and aspirator combinations. Rarely drum types are used. They should be self-cleaning to improve efficiency. Additional equipment like cyclone separators increase their efficiency as well as keep the working environment clean and healthy.

They can be easily produced in Bangladesh in any reasonably well equipped work-shop.

(b) Specific Gravity Separator: Our field paddy contain foreign matters of various random sizes, separation of stones are most desirable to avoid damages to the rubber rolls in the next series. The principle of the machine is to impart momentum to individual particles and because the stones are more dense i.e. higher specific gravity than paddy, they separate by traveling.

Upward on an inclined oscillating plane.

It is an intricate machine. Special indented and perforated steel sheets are required. It may be possible to produce this machine in a well equipped engineering shop with some imported parts.

(c) De-Husker: Two main types of de-huskers are the, rubber-roll sheller and the under runner disk. The latter, is rapidly going out of use. Therefore,we should concentrate on the rubber roll sheller which is the prime machine to de-husk in all the rice producing countries of the world.

Rubber roll-shellers de-husk by unequal pull i.e. friction on the paddy grain. Two rolls rotate in opposite direction and at differential speeds. This difference in the linear velocity impart great tearing stresses on the grain but do not damage it as only the soft rubber comes in contact with the grain. The rolls gap is also adjustable to cater for wear and tear and for different sizes of paddy.

Mainly two type drive mechanisms are used i.e. belt drive and the gear drive. The belt drive is cumbersome, relatively inefficient and use much V-belts. The gear drive is light weight, complex and more reliable but with many moving parts.

The author has manufactured all the components of a gear drive including gears excepting the casing. There is no reason why such machines can not be mass produced in Bangladesh.

Attempts are being made to manufacture rubber-rolls in Bangladesh. With trial and error, it is felt that rolls can be manufactured shortly. With official encouragements and some incentives, the process can be hastened.

Husk separator is a modified aspirator which, although intricate, is easy to fabricate by sheet metal and induced draft fan/fans.

(d) Paddy Separator : Paddy separators are of three types : (a) Compartment Type (b) Tray Type (c) Screen Type. The first two are intricate and expensive machines. The screen type is a simple and inexpensive machine but not very efficient as compared to the other two. But as most of the rice in Bangladesh is parboiled higher polishing stresses can be imparted without incurring unacceptable broken percentages. Therefore, very high efficiency separator is not needed.

The author is using a screen type separator for many years without much difficulties. This type may be easily fabricated in Bangladesh.

(c) Polishers: Polishing of brown rice is the most critical part of the milling process. Many types of machines are used, the major classifications are :

Contd. Appendix - B

(i) Vertical Polishing Machine: This type of machine is most common in South Asia. They are rugged, heavy machines made mainly of cast iron. The cone consists of a cast Iron core with an abrasive coating of carborundum stone. Rice polished by abrasive action of the stone and M.S. perforated sheets which are fixed around the rotating cone. Control of friction is achieved by adjustment of rubber brakes. Both the machine and the stone can be manufactured in Bangladesh. Rubber brakes can also be developed indigenously.

(ii) Horizontal Polishers: These are high speed, light weight machines of precision engineering design. They are most useful in milling raw and delicate type rice. The stones used can not be cast at site as they need special heat treatment.

These machines are of advanced design, and are not suitable for manufacture in Bangladesh.

(iii) Jet Pearler : It is a combination whitener, pearler machine of advanced design. A stream of high pressure air is blown through the rice to cool and remove any loose bran powder. Special hexagonal screens and cast sheet cylinders are used.

Not suitable for either use or manufacture in Bangladesh.

(iv) Conveying Equipment: Many types of conveying equipment is used in milling process e.g. bucket elevators, pneumatic, belt conveyors, screw conveyors etc. From many years of operation the following are standardized :-

(a) Paddy & Rice: Bucket elevator and then by gravity flow .

(b) Husk & Dust : Pneumatic which can be either suction or blowing, the former being more efficient

Due to very abrasive nature of paddy, the life of all pipes and ducts will be increased considerably by :-

(i) Having higher slopes (not less than 60^{o}) to reduce friction

(ii) To have rubber linings on all bends specially on the outside

(iii) Wooden pipes and ducts are most durable if, however, they can be kept dry and no insect attack takes place.

Contd. Appendix - B

Major Advantages and Disadvantages of Multistage Modern Mills in Bangladesh

Advantages	Disadvantages
1. There is a considerable increase in milling out turns. The increase is very marked in case of raw and slender varieties of paddy.	1. They are expensive equipment. Also needs larger space and mill house.
2. The percentages of brokens are considerably less in comparison to hullers. Again the difference is more marked in case of raw rice.	2. Since they are imported, there is a problem of imported parts.
3. Electricity consumption per unit weight of paddy processed is less them huller units	3. Needs higher level of operating skills than huller.
4. Pure bran is produced which is a most valuable raw material for oil extraction or in the raw form as animal feeds	4. Needs larger quantity of paddy as being of higher capacity to run economically.
5. Pure husk is produced which is used as poultry litter in the absence of other cheap agricultural wastes.	5. The cost of rubber rolls is considerable and may be a high percentage of production cost.
6. Since in most of the cases such mills are associated with mechanical driers, the production is unaffected by weather.	
7. Rice produced is of higher quality having negligible or no foreign materials and of controlled polish & quality.	
8. The system is suitable for larger scale and automation. Because the above mentioned and some other difficulties outlined else-where (Rahman 1988), the modern mills established in Bangladesh are in some difficulties. Most of them are operating at much below capacity, some are even shut down or laid off.	

Contd. Appendix - B

Rice Milling Experiences in India

In 1968 the Government of India published the results of a study of the out-turns of three types of rice mills. They were described as :-

- Traditional huller mills.

- Disc-sheller rice mills containing a cleaner, under-runner disc-sheller, paddy separator, vertical cone-polisher.

- Modern mills (1968) consisting of new model of cleaners, rubber roll huskers, paddy separators, vertical and horizontal polishers with grading and conveying equipment (Shule FRG, GDR and Satake, Japan Mills).

The study was conducted with utmost care. A very large statistical base was established covering many states and long period of time. The results are shown in Table 1.

We quote the conclusions from the Indian Report :-

"The modern mills have an overall increase in total rice out-turn averaging 2.5% over sheller type units and 6.6% over huller units with respect to raw-paddy. In the case of parboiled paddy, the corresponding increase in total rice yields from the modern mills averaged 0.81 over the sheller mills and 1.6% over huller units.

The increase in head rice yield for raw paddy in modern mills as compared with existing sheller units averaged 6.1% as compared with huller mills with a corresponding average increase of 5.1%. For parboiled paddy, the corresponding increase over sheller units averaged 1.3% and over huller mills 4.1%.

Apart from giving significantly higher outturn of total edible rice and head rice, the modern mills yielded rice of superior quality with less brokens and a negligible incidence of foreign matters".

Contd. Appendix - B

Table : 1.

The Mean Average of Additional Out-turn of Total Rice Obtained in Modern Mills Compared with Traditional Mills in Each Area.

Area and Location of Mill	Parboiled Paddy Additional Percen Outturn in Modern Mill Over		Raw Paddy Additional Percent Outturn in Modern Mill Over	
	Sheller	Huller	Sheller	Huller
Tamil Nadu	-	-	4.2	5.3
Madhya Pradesh	0.9	2.5	2.7	12.5
Mysore	0.4	2.5	0.8	10.4
West Bengal	-	0.3	2.3	6.8
Andhra Pradesh	0.8	-	2.9	-
Orissa	1.3	1.5	1.8	1.8
Bihar	-	1.4	-	2.6
Mean average percentage of additional rice of all areas	0.8	1.6	2.5	6.6

Contd. Appendix - B

'IRRI further adds: "The difference of out-turn is attributable to two major factors (1) the use of rubber roll sheller instead of disc-shellers and (2) the greater efficiency of modern mill machinery (cleaners, separator and whiteners). This significant difference in total rice out turn offsets the increased investment costs of a modern mill. The additional cost of modern mill over the traditional sheller is nearly offset after the 1st year of operation.

Probably as important as the annual return to a rice miller is the increased quantity of rice available to a country after losses caused by obsolete rice mill machinery are reduced. James Wimberly : Paddy Postharvest Industry in Development Country. Irri. Manila.

Some Special Problems for Rice Milling in Bangladesh

Some technical problems encountered by rice mill operators of Bangladesh are :

(a) In Bangladesh most rice is parboiled. The imported mill machinery are rarely optimized for parboiled paddy.

(b) The field paddy in Bangladesh contain very large percentages of admixtures. Large commercial lots of pure variety is rare.

(c) High incidence of immature grains.

Milling of parboiled paddy needs special attention and equipment due to sticky nature of bran which contain larger percentages of oil as compared to raw rice bran. In some varieties, oil quantity may be as much as 30% by weight of bran. This high oil content create the following problems :

(a) The screen of the polisher may be clogged due to sticky nature of parboiled rice bran.

(b) It needs higher scouring force hence more power to remove the same bran.

(c) Due to rise in rice-temperature owing to applicatirn of higher scouring force, brokens may result. It also creates secondary problem of cooling the rice before packing otherwise balls will form in the stored bags.

However, since most of the paddy husk is cracked if the parboiling has been properly done, de-husking is easier. Further,it may even be cheaper to mill parboiled paddy as easy flaking of husk due to splitting in parboiled process.

The problem of jammed polisher is solved by having number of polishers in series, which increase the sieving time of the bran.

Mechanical scouring force is applied progressively and less brokens result. This however, increases capital cost.

Mixed Paddy

Most of the commercial lots contain a mixture of different size paddy which may be due to impure seeds. The percentages of immature and dead grains are also very high specially in Boro season perhaps due to inadequate input of fertilizers or/and submersion due to floods. Dead and immature grains cause considerable problems in modern mills.

As the rubber rolls are adjusted for a specific paddy size, the smaller varieties pass through the rolls, gets separated in paddy separator and are put into the roll again. They go on round and round till removed by some other means. This reduces output as well as incidence of paddy in milled rice. The immature grains can not be milled at all and must be separated and milled in a huller or disk-sheller.

The solution to the above problem is to have another rubber roll which should be adjusted for smaller variety of paddy. The paddy from paddy separator and the immature grains should be milled by the second sheller and then put back into main-stream. This will require additional conveying equipment and modification to material flow pattern.

The ideal multistage milling unit for Bangladesh paddy should have at least two shellers, three or four polishers the last of which may be jet type. These additional equipment will enhance production and product quality. The capital cost will be about 15% higher than standard. The additional cost will however be recovered by added output and quality of product.

The Choice

The milling technology as yet in mass use in Bangladesh is primitive and inefficient. There is no doubt that the huller units output is about 2% less than those possible by technology already in operation here. Even the less than ideal technology will produce over 400,000 tons of edible rice valued at over US$ 160,000.000 by simply improving the milling technology. In this regard we quote IRRI as under :-

".....consider Bangladesh, which produces 20 million tons of paddy annually, a 5% saving would add one million tons annually which at 1979 prices would be worth more than 300 million". Paddy Rice Post Harvest Industry in Developing Countries. J.E. Wimberly.

The percentages of additional rice is higher due to higher envisaged efficiency in total post-harvest out of which about 2% is due to milling.

Perhaps introduction of modern industrial milling complexes at a mass scale is unrealistic at one go. Indian experiences show that it took over 30 years of efforts with a very large industrial base and full legislative backing (hullers are banned in India) to establish the modern mills on a large scale. However, the phase wise programme may well be as follows :-

(a) Maximize production of existing modern units with up-grading of their equipment.

(b) Phase wise modernization of huller units :-

(i) Improved hullers

(ii) Huller-polisher combinations

(iii) Up-grading of huller mills to rubber rolls-polisher mills in a fixed time scale e.g. 3-4 years.

(iv) Stoppage of production and establishment of all new huller units.

(c) Establishment of industries to produce spares, consumable parts and eventually complete units. This however in only possible after implementation of (a) and (b).

Imperatives of Selected Policies

The need for reforms and implementations of policies based on object realities are pre-requisite to any success. The neglect to post-harvest phases of our food policies is having telling effects on the productivity ultimately. The object of all our agricultural policies is to produce maximum quantum of rice (not paddy) per unit of inputs i.e. land, labour, water, fertilizers, insecticides etc. That would command an efficient milling industry as much as it needs efficient seeds and fertilizers. Besides, milling end deals with paddy in stock and not paddy to be harvested which entails endless variables like weather, cyclones, floods etc. Therefore, resources put in milling is surer investment than, resources put in pre-harvest. Of course that certainly does not mean lesser in put at pre-harvest. In fact both are complementary, what is needed is a balance vis-a-vis our resource availability and priorities as a function of national objectives.

Implementations:

To implement an objective policy to achieve a stated goal of (say 1% additional rice-recovery) a number of steps can be taken. First of all, three sets of conditions may be identified namely :-
(a) Farmers end : For consumer-producers with small lots of paddy for custom milling an improved huller with a huller polisher combination be evolved. It is unnecessary to go into technical

details as such machines may be easily developed with available resources if policy directives are given. Since the lots are every small (say 1/4th of a ton) a 1% saving is scarcely felt. However the cumulative results will be staggering. Additional benefits will be better bran which will have incalculable benefits as animal feed to the farmers.

(b) Commercial-Small Traders End: Small traders with few tons of paddy may be serviced at such intermediate mills. They will be quick to appreciate the benefits, at least by higher returns of their superior quality rice and bran. Here rubber roller-polisher combination mills can be very easily introduced. They will replace/upgrade present major mills. Installation of mechanical drier at a later stage will ensure their year round operation.

(c) Large Trader-Modern Mills: The mills of 2T or multiple of 2T/hr. capacity are already established in many places. Many of them are not technically optimized and are therefore, inefficient. A survey may be undertaken to make them up-to-date with some investment. New ones may be established wherever situation demands. Their continued functioning at the present stage may be ensured by :-

(i) Alloting them sufficient paddy by the Government Food Department. Of course they must fulfill all the pre-requisities of the Department.

(ii) To establish a definite policy to mill all the Govt. Procured paddy by modern mills and only the excess quantity may be allotted to lower category mills.

(iii) By standardizing commercially marketable rice (by moisture and other criterion), competitive edge for their survival may be given, besides ensuring consmmer-protection by ensuring only standard rice.

(iv) Encourage establishment of rice-bran extraction and feed mill industries which will create market demand for high quality bran. This will have a beneficial effect on the whole milling sector.

(v) Sufficient working capital backed by realistic industrial yardstick should be provided to the Mills by commercial banks.

It should be understood that any additional out-turn in rice is not only the gain of the mill-operator, such additional out-turns will contribute to reduce food deficits. It will also reduce price in the market-place by increasing supply, demand being the same. Therefore, ensurance of operation of such modern mills is a national imperative and the problem should be evaluated from such an angle.

Contd. Appendix - B

Conclusion

The technologies of rice milling in Bangladesh need urgent re-consideration. Given our socio-economic set of conditions. the choice is clear. Any technology which recovers higher quantum of rice from the same quantum of paddy must be our choice.

Practical problems and constraints. however. preclude us from rushing head long into such ventures. A wise phasewise programme is called for. About 30% of harvested paddy is commercially traded. and therefore. may be termed as marketable surplus. The implementation of appropriate technology in this 'surplus' is easy and immediate. if policy decision are taken. The producer consumers end is more difficult but certainly not insurmountable.

We have seen the technology of green revolution in the form of seed-irrigation-pesticide and its beneficial results. Another technology of rubber roll-seperator-polisher which is of the same vintage (1960s) but yet to be ushered in our country. The sooner we do it. the better it is as without it the effect of green revolution will not be fully exploited. The dream of self-sufficiency may yet be achieved if the full circle is turned. Pre and post harvest are two sides of the same coin.one is meaning-less without the other.

Contd. Appencix - B

Quality of Average Paddy and Milled Rice in Bangladesn

Sample collected from Shuvo Automatic Rice Mill Savar, on 8.9.11.22 and 23 August 1988.

Variety : Mixed Boro

1. Quality of Paddy :

(i)	Moisture content	- 15.6% (Wet basis)
(ii)	Dust, stone, straw etc	- 1.6% (By weight)
(iii)	Immature paddy	- 17.1% (By weight)
(iv)	Black paddy	- 0.9% (By weight)
v)	Insects : Live	- 90 nos/kg.
	Dead	- 92 nos/kg.

2. Quality of Milled Rice :-

(i)	Moisture content	- 14.6% (Wet basis)
(ii)	Broken rice	- 3.0% (By weight
(iii)	Black rice	- 1.3% (By weight)
(iv)	Immature rice	- 2.2% (By weight)
(v)	Paddy	- 0.6% (By weight)
(vi)	Broken husk,bran etc	- 0.4% (By weight)
(vii)	Degree of milling	- 6% (Observation)
(viii)	Color	- Mixed Color
(ix)	Smell	- Normal

Remarks : Paddy was a mixed boro variety. It contained high proportion of immature grain (17.1%) and insects (182 Nos/kg). The broken percentage in rice is very low which is encouraging. The black rice percentage is very high (1.3%) due to higher percentage of immature grain in the paddy. Care should be taken to discard immature paddy during procurement.

Note : The above mentioned paddy is Government procured stock. This is a typical Boro season paddy from Sylhet low lying area. The difficulties of efficient milling of such paddy has been described in detail. It is imperative that we develop milling technology to suit the paddy. As no such ready made mill exists, development effort should be directed towards that end.

Analysis : Analysis of paddy and milled rice was done by Bangladesh Rice Research Institute (BRRI) in Aug. 1988.

69

APPENDIX - C

Observations on Boilers/Steam Generators Used in Paddy Processing Units of Bangladesh*

Md. Abdullah
Chief Inspector of Boilers
Government of the Peoples' Republic of Bangladesh

The study report on Assessment of Rice Processing Technologies in Bangladesh with Emphasis on Milling Technology has covered a wide range of issues related to post harvest processing of paddy. As requested by the organizers of workshop I shall limit my comments of boilers/steam generators used in different paddy processing units.

Existing Situation

A boiler/steam generator is an essential component of paddy processing unit. It is generally used for parboiling of paddy. Generated steam is also used for dying of paddy in large rice mills. High pressure steam can also be used to generate mechanical power and the low pressure steam can be used for heating. In rice mills, rice husk is used as fuel.

In Bangladesh there are 242 large rice mills, 46 automatic rice mills and about 10-15 thousands small parboiler cum huller units. Standard boilers are used in large and automatic rice mills. Steam generators used by parboiler cum huller units are not standardized.

Empty oil drums are used as steam generator. The average life of these oil drums are from six months to one year. These drums are used without any safety measure (safety valve). No pressure gauge are provided for measuring the pressure developed inside the drum. As the drums are fabricated only for oil carrying and storing purpose and the thickness is not sufficient, so it is not permitted to use for the generation of steam under pressure from the safety point of view. And from our practical experience, we can see that it is very dangerous for human life and as a result every year many innocent people are being killed by fatal accident occurred in these steam generators.

---

* Prepared for the workshop on "Paddy processing Technologies in Bangladesh", Organised by the Institute of Appropriate Technology, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh 8 December, 1988.

Contd. Appendix - C

Because of public safety reason, the operation of steam generators used by roadside huller units is not authorized under Boiler Act. I shall now give you a brief description about the 'Act' 'Regulations' and 'Rules' enforced in the country regarding land boilers.

Boiler Acts/Regulations and Rules

(a) Boiler Act, 1923

Section 6 of the Act provides prohibition of use of unregistered or uncertified boilers and Section 23 prescribes penalties for illegal use of boilers. There is a provision in the Act for framing Rules and Regulations for the purpose of administration of the Act.

(b) Boiler Regulation, 1951

This formal control Regulations were framed by a high powered technical Board called Central Boilers Board. The Regulations prescribe the standard of design, drawings, specifications, materials, process of manufacturing for Boilers, for the boilers to be imported or locally fabricated. There is also provision in the Regulations for inspection and registration procedure of newly installed boilers.

(c) Boiler Attendant's Rule, 1953

The Rules were framed for certifications of boiler Operators. Rule 2 of the said Rules prescribes that "the owner of a boiler shall not use the same or permit the same to be used unless the boiler is in under the direct and immediate attendance and charge of a fit and proper person. "A Board of Examiners consisting Chief Inspector of Boilers as Chairman is to conduct examination for issuance of certificates to boiler Attendants'.

(d) Boiler Rules, 1961

The Rules were framed to specify the duties of the Chief Inspector of Boilers and Inspector of Boilers and methods for calculation of inspection and registration fees. The Rules also prescribe the procedure for grant of provisional orders and certificates to boilers after inspection.

Government Programme

Under boiler act it is not possible to give certificate to these unauthorized non-standardized steam generators. On the other hand, suddenly stopping the operations of these steam generators would affect the employment of thousands of people and also would cause inconvenience to large number of users of these units. In this context, the Government has decided to fabricate low cost small boilers suitable for the parboiler cum huller units. Bangladesh

Contd. Appendix - C

Steel and Engineering Corporation (BSEC) has been entrusted to design and fabricate small boilers (steam generation = 500 kg/hr.. Pressure = 7.5 kg/cm^2) at Chittagong Dry Dock.

I feel that there is adequate local facilities and technical capabilities to fabricate small boilers by private entrepreneurs also. BUET can provide necessary technical support if necessary. However, these boilers will have to be fabricated and tested as per standard procedures.

Once the standard models of small boilers are available institutional arrangements are to be made for the use of these units by the small rice processors. Bank loan is to be made available for the procurement of the units, technical supports are to be provided for installation, repair and maintenance.

Concluding Remarks

Close co-operation of different organisations would be necessary for the successful diffusion of this technology to the small rural industries. I can assure you that the office of the Chief Inspector Boiler would do the useful in this regard.

APPENDIX - D

PRESERVATION OF PADDY AND RICE FOR BANGLADESH

Feasibility of drying paddy as a step towards efficient storage and processing of paddy

- Mahfoozur Rahman

1. Introduction

Bangladesh is on the verge of a break-through. At long last, she is approaching self sufficiency in food grain production with only about 10% shortages on aggregate demand. Inspite of all the constraints, the production figure of paddy is showing steady growth, nominally outstripping population growth. Such gains are most pronounced specially in the Boro production.

But this progress is nullified by colossal losses at the post harvest phase. In our estimate, upto 20% losses are encountered in the boro season alone due mainly to neglect and lack of a concerted programme to reduce these losses.

The major loss occur due to damage to paddy caused by absence or poor drying and storing. Therefore, the need to address to this problem is immediate and urgent.

2. Some Problems of Wet Season Harvest

Traditionally, the major crop in Bangladesh was harvested in the Aman season in winter. This period is characterized by low humidity, temperature and uninterrupted sunshine. Absence of mud and slush also provided adequate drying yards to dry the paddy.

With the advent of HYV mainly planted at the once neglected Boro (Autumnal) season, major problems cropped up. Some of them are itemized.

- Inherent genetic weakness of HYVs like proneness to shatter, low dormancy, non-resistance to local pests, relatively thin husk etc.

- Onset of floods or the fear of it comples framers to harvest sooner than later, resulting in unmanageable stocks in time scale.
- High humidity, high precipitation and above all, lack of solar radiation make the problem of drying acute.
- Lack of metaled drying yard adds to the problem.
- With genetic problems inherent with HYV, those physical constraints result in colossal losses to the harvest.

Outline paper presented to IFRI, Dhaka in Nov. 1991 to highlight the urgent need to solve or minimize post-harvest losses in Bangladesh

- Lack of storage is another issue. Traditional methods which serves the Bengal rice growers well for a millennium are quite useless in these new circumstances.

- Since most rice are parboiled, necessarily, paddy are to be dried twice, one after harvest, another, and a more difficult one, after parboiling.

Although, these difficulties are enormous, they are not insurmountable.

3. Special Needs of Parboiling and White Milling

About 90% of paddy in Bangladesh are parboiled. This process requires additional energy to soak, steam and dry parboiled paddy with upto 50% moisture. The problems of parboiling are itemized.

- It takes about treble the energy to dry parboiled paddy.

- It needs concrete yards, at the very least, to dry by sun drying in the wet season.

- Solar energy reduces to about 60% in the wet season.

- Mechanical driers are expensive in terms of capital, fuel and needs much technical know-how to operate.

- Maintenance problems rendered them quickly in-effective in our situation.

- High moisture rice due to inadequate drying spoil quickly.

- High humidity needs higher drying temperature which again demand higher energy.

- Too high a temperature will result in cracks in milled rice and loss of total yield and head rice.

The problems of white milling are also acute as :

- Raw rice requires higher quality grain with least dockage, which is difficult to obtain in boro season.

- Raw rice milling needs low moisture grain.

- Any incorrect post harvest handling will result in micro-cracks and fissures in the endosperms which will result in much breakage.

- Drying of paddy to be processed as raw-rice needs most careful handling.
With all these special problems, price of raw-rice is much higher in Bangladesh than parboiled rice which is reverse of what is in other markets like SE Asia and USA.

4. Drying of Paddy

It is now seen that there are two, some times three stages of drying namely :

- Dying of field paddy for storage

- Drying of field paddy for white milling

- Drying of parboiled paddy

In the last case, paddy is to be dried twice.

Drying may be affected by any of the following methods :

- by manual sum drying

- by mechanical means which again may be classified as below :

- Large commercial drying centre

- Small community drying which is yet to be introduced in Bangladesh on a large scale.

5. Needs for Fuel

Unless some unlikely break-through take place in terms of more efficient use of solar energy, the fuel used for drying are :-

- Natural gas

- Fuel oil like furnace oil or kerosene

- Coal

- Husk fuel

The comparative cost with heat equivalent for the low-cost fuels are given below :-

Contd. Appendix - D

Fuel	Cost per kg at Dhaka	BTU. Value per lb
a) Low grade Bhutanese Coal	Tk. 4.5	10.000 BTU (60% efficiency)
b) Fire Wood	Tk. 2.1	6.000 BTU (50% efficiency)
c) Rice Husk	Tk. 1.0	5.500 BTU (40% efficiency)

Natural gas may well be used to fuel driers although we are not aware of any installation in operation yet. Besides, the main paddy surplus area of NW region are not supplied with gas.

The need to develop rice husk as a major fuel source is urgent. With more efficient installations, supply of husk should increase, resulting in a further decline in prices as well as availability of this appropriate fuel. One should remember well that you don't have to carry this fuel, wherever there is paddy, there is husk.

6. Need to Develop Appropriate Models

The story of mechanization of paddy drying in Bangladesh is a sad one. The first mechanical drier of Japanese origin was established in 1970 using kerosene fuel. It predictably failed owing to high cost of fuel input.

In 1988, a team of British Consultants modified this unit to husk fire financed by a UNDP grant. With inadequate experience, the unit was badly designed and installed. After a short period, the unit is now abandoned. Needless to say, this unit is in the public sector (Co-operative Ministry). Very recently, it has been sold to a private firm at a salvage value.

A number of Japanese oil fired driers were imported by Japanese grants but they too are abandoned by the DGF department for many reasons, the chief among these is high cost of fuel oil.

A large number of commercial units imported from India had many initial difficulties. But now the expertise has some-what developed. With necessary modifications, balancing and training of operators, many of them are operating. It is note-worthy that they all belong to the private sector. Of course, they are still inefficient and not operating to their full capacity.

A scheme to develop appropriate driers may be itemized as below :

a) Drier Cum-Storage Bins

To dry and hold small lots (upto 10 tons) of paddy to be used by surplus farmers or co-operative groups like Gramin Bank Clients.

Contd. Appendix - D

b) Small Batch Driers

To be used by small traders and mills with a capacity to dry upto 2-5 tons per day.

c) Small Recirculation Driers

Small scale industrial driers of upto 0.5 tons per hour ie daily capacity of 8 tons to be used by medium scale trader/miller at union level.

d) Medium Recirculating Driers

Medium scale industrial drier of upto 48 tons per day to be used by commercial millers. It is a point to note that this is an efficient scale as it will have surplus husk after parboiling needs to feed the types A,B & C, which necessarily are thermally inefficient.

e) Large Scale Drier

These are large machines with through put capacities ranging from 10 Ton to 200 Ton per hour.

There is little need to develop such large driers in Bangladesh situation unless we enter into export market for rice.

An action research programme to development all these models are imperative to fully exploit the bounty of the green-revolution. This research, of necessity, has to be a multi-disciplinary exercise with adequate attention given to :

- development of indigenous technology and fully utilize local materials to further develop linkage industry. Specially, use of rice husk as basic drier fuel is to be standardized either with a steam or flue gas heat exchanger.

- Social costs are to calculated at every level

- Special attention will be given to maximize employment to :

- build such units

- employment of operator

- generation of trade

- an adequate training programme to fully utilize, repair and maintain these units

- environmental cost benefit will also be computed and environmentally expensive design discarded.

77

Contd. Appendix - D

7. Storing after Drying

It is no good to dry paddy efficiently, if it is not stored efficiently. The present method of storing in gunny bags in flat godowns are a legacy of the Civil Supply Department of the colonial days. Like all other systems, the Food Department continues to use this wasteful method and is copied by the trade who know no better. This method is wasteful for :

- It is an inefficient user of space volumetrically

- It is expensive for use of gunny bags alone

- It is prone to attack by pests like rodents, birds and insects

- It is difficult to fumigate

- It needs much manual labour which is under utilized.

There is no way to control humidity, and temperature which is essential for modern storage procedures.

Efficient bulk storage units at every level using indigenous material and local skills are absolute necessity.

8. Carriage and Distribution

Again, carrying by gunny bags are wasteful. The FD allows upto 5% loss by railway which is an impossible figure. WB reports that 100,000 MT of grain was written off recently as an accumulated carrying loss. This only indicates the magnitude of the problem.

Bulk carriage methods need to be developed on an urgent basis. Gunny bags are an efficient packaging material to be used at the last stage for distribution alone. All grain handling should and can be done in bulk now.

9. Milling

Parboiling and milling can be made efficient with known technology. Yield of total rice of at least 2% and head rice of 5% can be grained right now with change of policy alone.

10. Rice Storage

Efficient aerated storage to keep well milled rice for upto 2-3 years can be developed with little cost. The operating costs will be lower in terms of wastage as compared to gunny storage as practiced by FD for 3 month period.

118

11. Implementation

The whole programme of paddy-rice drying, processing,storing and distributing is a social phenomenon in Bangladesh. Only the concerned people can implement it adequately. It is neither the job nor the need of the Govt. of induce efficiency. We have seen in the past the inefficiency, corruption and waste wrought by them. Any programme of this nature can only be implemented by voluntary participation of the people themselves who grow, store, mill and market rice in Bangladesh.

Perhaps organizations like Gramin Bank, US AID, and Krishi Bank may organize financial and technical support to the interested people. It is well recognized now that the greatest input to the agricultural production is education. Besides, energetic, efficient and educated management cadres are prerequisite to usher in efficiency. They must be self-employed and earn their keep in a free market.

It is note worthy that although doctors, lawyers, and engineers are practicing their profession privately, there is no independent agriculture technologist or agriculture engineer in Bangladesh. They all seek cushy Govt. jobs where the "take" is freely available. Therefore, adequate incentive should also be encouraged to attract the young, the talented and the ambitious to the agricultural sector without whom any program is doomed to failure.

Profit is the wage of the capital and hence lubricant to progress. Honest profit earned in a freely competitive market will usher in its own efficiency. The collective genius of a whole people who earn their livelihood by paddy and rice, must surely be superior to any "wise" decision reached in an air-conditioned chamber of Bangladesh Secretariat.

12. Conclusion

The need to develop adequate drying technology specially for Boro paddy is urgent in Bangladesh. Even if the post harvest losses can be minimized to about 10%, theoretically, there should not be any food shortage right now, keeping all other factors equal.

It is well within our means to develop drying technology at every level, from village to medium scale milling industry.

There is little or no need to import either materials or know how to do this. Employment generation will be done by added benefits accruing out of additional goods in terms of saved paddy. The semi-industrial or industrial sectors will employ large number of unemployees at a time when there is little job in the wet season. The drying yards' limitations of dependence on solar energy render thousands of nominally employed women jobless in the rainy season. With mechanical or semi-mechanical drying,

Contd. Appendix - D

year round employment is possible.

Any jump in technology has always created employment, not reduced them. Therefore, the value additional, linkage industry, more efficient storage and carrying will all create additional wealth which will be distributed at every level. Besides, it will generate purchasing power to create further economic activity by enhancing aggregate demand.

80

APPENDIX - E

DISCOUNTED (BATTA) PRICING PROCEDURE

(Government of East Pakistan - 1966)

Procurement Prices, Batta and Payment :

1. Procurement prices are fixed every year. The basic price is the price of paddy. The considerations which influence the level at which procurement prices should be fixed are cost of production, current market trend and prospects. In the olden days prices varied from region to region to make them more realistic. Due, however, to the administrative difficulties in administering varying prices, the system of uniform price for the entire province took root in 1950. The procurement price for paddy has gradually risen from Rs. 6.00 per md. in 1947 to Rs. 13.00 in the hinterland and Rs. 13.50 in the border-belt per md. in 1966. The prices of rice are calculated according to a set formula.

2. For the procurement of Aman crop of 1965-66, the following prices were fixed :-

	Border-belt.	Hinterland
	Per md. Rs.	Per md Rs.
(1) Paddy	13.50	13.00
(2) Rice -		
(a) Medium ...	22.49	21.71
(b) Coarse ...	22.12	21.34

These prices are for fair average quality (FAQ) paddy and rice.

3. Deduction is made for admixture, moisture content and foreign matters, etc. within the prescribed limits of tolerance. Stocks, the quality of which is beyond the limits of tolerance are rejected.

4. The limits of tolerance are as follows :-

PADDY

Free Tolerance Limits of Re-tractable Items for Paddy (F.A.Q.)

	Per cent
1. Admixture of coarse and medium grains	9
2. Moisture content	11
3. Foreign matters (such as dust, sand, silica, wild seeds, chaff and empty husk)	1.5
4. Damaged, off-coloured, heated and immature grains	0.5

Contd. Appendix - E

Procurement Prices. Batta and Payment

RICE (Parboiled)

Free Tolerance Limits of Re-tractable Items for Rice (F.A.Q.)

	Per cent
1. Admixture of coarse and medium grains	10
2. Moisture content	12.5
3. Pins and points (below 1/4th size)	3
4. Broken (below 3/4th size down to 1/4th size)	17
5. Under-milled grains	5
6. Under-boiled grains	3
7. Over-boiled/heated grains	2
8. Husk and brans	0.5
9. Paddy content	0.5

5. Paddy and rice which are below Fair Average Quality (FAQ) are subject to deductions in price in accordance with the following rates :-

Rates of Deduction in the Price of Paddy Below Fair Average Quality

1. Deduction for admixture of coarse and medium paddy grains.

Percentage of Admixture	Rate of Deduction (Per maund)
Above 9 percent and upto 15 percent	12 paisa
Above 15 percent and upto 20 percent	19 paisa
Above 20 percent and upto 25 percent	25 paisa
Above 25 percent and upto 35 percent	37 paisa
Above 35 percent and upto 50 percent	50 paisa

(The above rates are total and not additional)

Contd. Appendix - E

2. Deduction for excess moisture content

Percentage of moisture content	Rate of Deduction (Per maund)
Above 11 percent and upto 12 percent	13 paisa
Above 12 percent and upto 13 percent	26 paisa
Above 13 percent and upto 14 percent	50 paisa
Above 14 percent	Rejection

(The above rates are total and not additional)

3. Deduction for foreign matters (such as dust, sand, straw, silica, chaff, wildseeds and empty husk).

Percentage of foreign matters	Rate of deduction (per maund)
Above 1.5 percent and upto 5 percent	13 paisa for every additional 1 percent
Above 5 percent and upto 10 percent	19 paisa for every additional 1 percent
Above 10 percent	Rejection

(Detected defect falling in a slab, minus free allowance, will be assessed at 'Batta' rate prescribed for that slab)

4. Deduction for damaged, off-coloured, heated and immature grains

Percentage	Rate of deduction (per maund)
Above 0.5 percent and upto 1 percent	13 paisa
Above 1 percent and upto 3 percent	19 paisa for every additional 1 percent
Above 3 percent	Rejection

(Detected defect falling in a slab, minus free allowance, will be assessed at 'Batta' rate prescribed for that slab)

Contd. Appendix - E

Rate of Deduction in the Price of Rice Below Fair Average Quality

1. Deduction for admixture of coarse and medium rice grains.

Percentage of admixture	Rate of deduction (per maund)
Above 10 percent	11 paisa for every additional 1 percent

2. Deduction for excess moisture content.

Percentage of moisture content	Rate of deduction (per maund)
Above 12.5 percent and upto 13 percent	12 paisa
Above 13 percent upto 14 percent	25 paisa
Above 14 percent	Rejection

(The above rates are total and not additional

3. Deduction for pins and points.

Percentage of pins and points (below 1/4th size)	Rate of deduction (per maund)
Above 3 percent and upto 6 percent	22 paisa for every additional 1 percent
Above 6 percent and upto 10 percent	44 paisa for every additional 1 percent
Above 10 percent	Rejection

(Detected defect falling in a slab minus free allowance will be assessed at 'Batta' rate prescribed for that slab)

4. Deduction for brokens.

Percentage of brokens (Below 3/4th size down to 1/4 size grains)	Rate of Deduction (per maund)
Above 17 percent and upto 25 percent	11 paisa for every additional 1 percent
Above 25 percent and upto 30 percent	22 paisa for every additional 1 percent
Above 30 percent	Rejection

(Detected defect failing in a slab minus free allowance will be assessed at 'Batta' rate prescribed for that slab)

84

Contd. Appendix - E

5. Deduction for under-milled grains.

(Rice grains having more than 3 or 4 red/brownish streaks are to be treated as under-milled grains).

Percentage of under-milled grains	Rate of deduction (per maund)
Above 5 percent and upto 10 percent	11 paisa for every additional 1 percent
Above 10 percent	Rejection

Note - In case of milling of Government paddy, if percentage of under-milled rice is noticed higher than 10 percent the stock shall be repolished by the miller and delivered after re-assessment.

6. Deduction for under-boiled grains

Percentage of under-boiled grains	Rate of deduction (per maund)
Above 3 percent and upto 7 percent	11 paisa for every additional 1 percent
Above 7 percent and upto 10 percent	15 paisa for every additional 1 percent
Above 10 percent	Rejection

(Detected defect failing in a slab minus free allowance will be assessed at 'Batta' rate prescribed for that slab.)

Note - Slight white bellied grains should be ignored.

7. Deduction for over-boiled and heated grains.

Percentage	Rate of deduction (per maund)
Above 2 percent and upto 5 percent	11 paisa for every additional 1 percent
Above 5 percent and upto 10 percent	15 paisa for every additional 1 percent
Above 10 percent	Rejection

(Detected defect falling in a slab minus free allowance will be assessed at 'Batta' rate prescribed for that slab)

85

Contd. Appendix - E

Note - Sprinkling of slightly brownish grain shall be ignored when free from bad odor.

8. Deduction for husk and brans.

Percentage for husk and brans	Rate of deduction (per maund)
Above 0.5 percent and upto 1.5 percent	2 paisa
Above 1.5 percent	Rejection

Note - In case of rice from Government paddy, the husk and barns when in excess of 1.5 percent, shall be removed by the miller and accepted after necessary re-assessment.

9. Deduction for paddy content.

Percentage of paddy content	Rate of deduction (per maund)
Above 0.5 percent and upto 1.5 percent	22 paisa for every additional 1 percent
Above 1.5 percent and upto 3 percent	27 paisa for every additional 1 percent
Above 3 percent	Rejection

(Detected defect falling in a slab minus free allowance will be assessed at 'Batta' rate prescribed for that slab)

10. Deduction for bad odor with or without discoloration

(Discoloration means change from waxy white color which is normal color to brown/reddish brown color)

(i) In case of voluntary procurement no rice having any bad odor should be procured.

(ii) In case of rice from Government paddy, it should be accepted with Batta ranging from 25 paisa to 87 paisa per maund according to the extent of defects.

(iii) Slight discoloration without bad odor should not call for any 'Batta'.

11. For calculation of 'Batta' defective grains or others below 0.5 percent is to be ignored and 0.5 percent and above is to be reckoned as 1 percent.

86

Contd. Appendix - E

12. Standard weight of a maund means a maund of 40 seers and a seer is equal to 80 toals. [Notification Nos. 17-FD(IP) and 18-FD(IP), dated 3-12-65]

6. The prices hold good for all internally procured stock irrespective of the method of procurement. They differ for the border-land and the hinterland in as much as procurement price of paddy for border-land was, in 1966, Rs. 13.50 and that for the hinterland was Rs. 13.00 per maund only. This difference was first introduced in 1963, when the border price was one rupee higher. Since 1966, however, difference of .50 paisa is considered adequate compensation for the fact that procurement in the border area is of compulsory nature.

7. Assessees of the border-belt delivering their assessed stocks at the purchasing centers of the hinterland are entitled to the prices applicable to the border-belt. This entitlement will not be available to sellers other than assessees. Assessment of stocks are made by the Purchasing Officer, who must prepare assessment report cautiously and accurately, so that no over-payment or under-payment is made to any seller due to wrong assessment of 'Batta' and of prices. Purchasing Officers are liable to be penalized if the Chief Inspectors concerned find their assessment incorrect, during subsequent scrutiny of the assessment report.

8. Payment was normally made by Subdivisional Controllers of Food by operating P.L. Accounts with local treasuries. The local food officers obtained sanction for funds periodically from Government through the usual channel, namely, the Director of Procurement, Distribution and Rationing, Food Department and the Finance Department. After sanction had been obtained the Accountant-General, East Pakistan, would authorise the Treasury/Sub-treasury officers to transfer the sanctioned amounts from the Provincial Revenues to the P.L. Accounts of the respective food officers as detailed in paragraph 19 below. All payments in connection with Internal Procurement were made from this account by cheque.

9. A direct seller, if he so liked, was paid by cheque on the P.L. Account, from the office of the officer operating the P.L. Account. In that case, the WQSC was to be issued in the name of the seller for the stock delivered by him and the seller was to produce the WQSC for receiving his payment.

10. Payments to AGDs, Shroffs, Handling Agents or all other Agents or Contractors were made by cheques on the P.L. Account. They were to submit bills for the purpose along with all supporting vouchers. Payments on account of handling transport and freight for gunnies used for procurement purposes were also to be made by cheque on the basis of the relevant bills, submitted by the party concerned.

91

Contd. Appendix - E

11. Payment in cash at the purchasing centers was made to the seller by the shroff, appointed for the purpose @ Rs. 2.50 per Rs. 100.00 advanced. The Purchasing Officer was to issue a payment order, on the stock delivered by a seller in the prescribed form and the shroff had to make over the requisite money to him for making payment to the direct seller under proper receipt. In any case, no payment should be made by the shroff to a seller directly.

12. In heavy procurement Subdivisions, where shroffs were not available, arrangement for making cash payment to the direct seller on the spot was made through the Disbursing Officers/Paying Officers not below the rank of a Chief Inspector. Cash was drawn from the treasury by the officer operating P.L. Account (S.C. Food) on self-drawn cheque and handed over to the Disbursing Officer/Paying Officer on proper receipt for disbursement to the seller on the spot. The money had to be kept in a strong cash box in sealed bag and escorted by a police party throughout the entire transaction.

13. Payment through shroff and Disbursing Officer being somewhat a difficult proposition, the system of cash payment through the A.G.Ds was on the whole all to be satisfactory and popular too. Moreover, the system, with its inherent defects, was found to be comparatively easier to implement. Under this system, sellers beyond 2 miles of the purchasing centers, deliver their stocks through the A.G.Ds who make payment to them on the spot. In such cases, the Weight-Quality-Stock-Certificates (WQSCs) are issued in the name of the Approved Grain Dealers (A.G.Ds) in order to enable them to get refund of the money, so advanced by them, from the Paying Agent. The A.G.Ds are however not entitled to any other extra remuneration for their work, beside their usual commission of 25 paisa per maund. [Circular No. 38-FD(IP), dated 8-12-65].

14. Payment through the abovementioned systems took time. Moreover, as the accounts were opened at the Subdivisional headquarters, there was no question of payment anywhere else. The growers had to come to the Subdivisional headquarters to receive payment for stocks delivered at the L.S.Ds. In order to ensure on-the-spot payment to growers a departure was made in 1966. A scheduled bank was appointed as Paying Agent of Government and a Paying Officer was posted at each purchasing centre. The Paying Agent was made responsible for payment to individual sellers and A.G.Ds at all purchasing centers, including new ones, which may be opened by the Deputy Commissioners. The Paying Agent maintained a Cash Superviser at each purchasing centre and kept him in funds. The Cash Supervisor verified 'A' copy with 'B' copy of the WQSC and also the signature/thump-impression of seller/AGD on the back of the 'B' copy of the WQSC and made necessary payment. After making payment, he put "paid" stamp both on the "A and "B" copies

88

of the WQSC and thus complete transaction with each seller/AGD. This simplified the procedure for payment and there were few complaints of delay in payment. On the whole, the system of payment through agent worked very well and gave satisfaction to all concerned particularly the growers. Along with this, the system of payment through the AGD also remained operative side by side, but only beyond a radius of 2 miles of the purchasing centers. [No. 59-FD(IP), dated 16-12-1965]

15. Before a payment is made, the Paying Officers attached with each and every purchasing centre, would check the quantity actually received by purchasing officers, fix the net amount to be paid and efface pay order on the "A" copy of WQSCs issued to the direct sellers. He would then pass it on to the Cash Supervisor of the Paying Agent sitting side by side for payment, in which case identification of the seller would be easy. Similarly, the Paying Officer would give pay order and arrange payment in respect of the items mentioned in the following paragraph.

16. The Paying Agent was not only to pay the price of procured stock but was also responsible for payment on account of other items payable but of the Personal Ledger Accounts of the Subidvisional Controllers of Food. This simplified the procedure and payments in respect of the following six items were also made through the Paying Agent :-

(1) AGD's Commission

(2) Handling charges of paddy delivered by assessees and voluntary sellers direct

(3) Handling and transport charges of internally procured stock

(4) Milling Commission of paddy

(5) Price of rice procured from major rice mills under monopoly purchase order.

(6) Frieght charges of gunny bags other than those paid against R/R. The only item of expenditure, in connection with the procurement operation, which was not paid through the Paying Agent was the carrying and handling expenses for gunny bags. [Memo No. 14 FD(IP) dated 8-1-1966 and Memo No. 130 FD(IP) dated 2-3-1966].

17. When the tempo of payment diminishes and new-purchasing centers are closed down and offers at the old purchasing centers begin to fall, it is not necessary to continue the system of payment on-the-spot, namely, at the purchasing centers. Instead arrangement is made for payment at the Subdivisional headquarters.

18. As has been observed earlier in this Chapter the system of payment by the Food Department officers was suspended in 1966 and a scheduled bank was employed as Paying Agent to ensure on-the-spot payment to the farmers at the 400 and old purchasing centers. This proved useful to the Department and beneficial to the farmers. The success of the experiment would lead one to presume that employment of a Paying Agent was likely to continue for so long as the procurement operation went on. When procurement practically stopped, it may not be worthwhile for the Paying Agent to continue in service. Then the P.L. Account will have to be operated for the settlement of claims. Moreover, even when the Paying Agent is employed the Subdivisional Controllers of Food will continue to pay, out of their personal ledger accounts, for items not specifically covered by arrangements made with the Paying Agent. Again, if for any reason it is decided not to employ a Paying Agent in any particular year or if the Paying Agent is not able to work in any particular area, then the system of payment through P.L. account will have to be resumed and the procedure detailed in the paragraph following will apply.

19. Since Independence the internal procurement of food grains has been made by operating P.L.Accounts with local treasuries by the officers of Food Department authorized for the purpose. The local Food Officers viz., Subdivisional Controllers of Food) operating P.L. Accounts for internal procurement of food grains within the Province place their demands for funds periodically according to the programme of procurement to the Directorate of Procurement, Distribution and Rationing. Their demands are then submitted to the Finance Department through the Food Department for sanction. On receipt of necessary sanction from the Finance Department, the Accountant-General, East Pakistan, Dhaka, authorizes the Treasury/Sub-Treasury Officers to transfer the sanctioned amounts from the Provincial Revenue to the P.L. Accounts of the respective Food Officers operated under "85-A-Capital Outlay, etc., A-Grain-Purchase Scheme-A-4-Suspense Personal deposit". On presentation of a single receipted bill by them to the Local Treasury/Sub-treasury Officers by debit to "85-A-Capital Outlay, etc. -A-Grain Purchase Scheme-A-3-Advances", the Local Food Officers obtain the P.L. Account cheque books from the treasuries on indents after depositing the price thereof to the said Treasury in order to make payment to the suppliers of food grains. On receipt of the bills from suppliers (direct sellers A.G.Ds. etc) duly supported by 'A' copy of WQSC issued by the Receiving Officer, the bills are scrutinized by the S.C., Food concerned with reference to the 'C' copy thereof. Thereafter payments are made to the party from P.L. Accounts for the purchase of rice and paddy, commission charges, incidental charges for handling, carrying and milling charges of internally procured paddy, etc. by means of cheque drawn on the local treasury/sub-treasury. For the purpose of complete records of all transactions in connection with internal procurement the S.C. Food concerned maintains a Cash Book (and a subsidiary Cash Book when payments are made by Cash drawn against self-cheques for the

convenience of the sellers) wherein all receipts and payments on this account are entered day to day. At the close of the month, a copy of the P.L. Account Cash Book with a closing balance certificate from the treasury and a reconciliation Memo, along with all paid vouchers are submitted to the Directorate of Accounts. On receipt of the monthly P.L. Accounts from the local Food Officers the vouchers are checked and irregularities in payments when detected are reconciled through correspondence with the local officers by the Directorate of Accounts. After necessary accounting of the transactions in the Directorate of Accounts the P.L. Account vouchers and copy of Cash Book, etc. are submitted to the Accountant-General, East Pakistan, for further necessary action. The authority for the operation of the P.L. Accounts by the local food officers is derived from Finance Department's orders issued from time to time under S.R. 410(b) read with S.Rs. 434 and 435 of the East Pakistan Treasury Rules, Vol-I.

APPENDIX - F

MILLING RATIOS
(1963)

Government of East Pakistan
Food Department
Eden Building, Dhaka

No.Sec.VII/1M-13/62/1191(72)-FD, dated the 4th Oct.1963

From - A. RASHID, Esq.
Section Officer, Government of East Pakistan,

TO - ALL REGIONAL CONTROLLERS OF FOOD,
ALL DISTRICT CONTROLLERS OF FOOD
ALL SUBDIVISIONAL CONTROLLERS OF FOOD

Subject : Fixation of milling rates and the commission thereof.

In supersession of all previous orders issued on the subject Government have been pleased to fix up the milling rates of paddy on Government account at different places as follows :

Region I

1. Mills from Chirirbandar to Biral on the Metre Gauge	38 srs.	Per 60 srs.
2. All mills on Ruhea Line	38 ,,	,, 60 ,,
3. Mills from Manmathapur West on the Metre Gauge	38 1/2 ,,	,, 60 ,,
4. Rangpur Mills	38 1/2 ,,	,, 60 ,,
5. Broad Gauge Dinajpur Mills	38 1/2 ,,	,, 60 ,,
6. Rajshahi Mills except Rohanpur	38 1/2 ,,	,, 60 ,,
7. Rohanpur Mills	38 ,,	,, 60 ,,
8. Bogra Mills	38 ,,	,, 60 ,,

Region II

1. Dacca Mills	38 1/2 ,,	,, 60 ,,
2. Mymensingh Mills	38 1/2 ,,	,, 60 ,,
3. Sylhet Mills	38 1/2 ,,	,, 60 ,,
4. Tippera Mills	38 1/2 ,,	,, 60 ,,
5. Noakhali Mills	38 1/2 ,,	,, 60 ,,
6. Chittagong Mills	38 1/2 ,,	,, 60 ,,
7. Chittagong Hill Tracts Mills	38 1/2 ,,	,, 60 ,,

Region III

1. Bakerganj Mills	39 ,,	,, 60 ,,
2. Faridpur Mills	39 ,,	,, 60 ,,
3. Khulna Mills	39 ,,	,, 60 ,,

72

2. The ratio fixed herein shall be treated as minimum outturn in all F.A.Q. paddy and will be applicable with effect from 12th February 1958. As regards the outturn from non F.A.Q. paddy, no reduction should be given for moisture and admixture. if, however, a lot contains foreign matters in excess of the allowable limit of 1.5 percent the total quantity delivered to a mill may be regarded as reduced by the additional percentage and the outturn may be calculated on the reduced quantity. For example if a lot of 100 mds. of paddy contains 2.5 percent of foreign matters 100 mds. of paddy will be counted as 99 mds. F.A.Q. and the outturn should be calculated accordingly.

3. The millers will be entitled to a milling commission of 0.62 paisa per md. of paddy and 0.12 paisa per md. of paddy on account of bagging, sewing, marking, handling and other incidental charges including supply of sutli on account of which the Millers will be 0.01 paisa per bag.

4. The Millers will be entitled to this commission after fulfilment of the terms and conditions laid down in the agreements executed with them.

A. RASHID,
Section Officer

93

APPENDIX - G

EXCERPT OF MILLING RATIOS OF DGF Dated 26-1-80

Sub : Revised milling ratio of milling of Govt. Paddy and Instructions thereon.

Govt. have been pleased to refix the following milling ratio of Aman paddy arrived at on actual test milling conducted in 1979 and 1980 in various Major and Husking Mills of the country, and recommended by the review Committee :

Paddy from Area	Revised Ratio for	
	Major Mills	Husking Mills
RAJSHAHI DIVISION		
1. Rajshahi District :		
(a) Rajshahi Dist. except Nawabganj Subdivision	60:38.60	60:38.60
(b) Nawabganj Subdivision	60:38.10	60:38.60
2. Dinajpur District :		
(a) Parbatipur,Phulberi, Nawabganj,Ghorachag Hili P.S.	60:38.60	60:39.10
(b) Dinajpur Dist. except area mentioned at 2(a)	60:38.10	60:38.80
3. Rangpur District :		
(a) Rangpur	60:38.60	60:39.10
4. Bogra District :		
(a) Bogra	60:38.10	60:38.60
5. Pabna District :		
(a) Pabna	60:38.60	60:39.10
Dhaka Division :		
6. Dhaka District	60:38.60	60:39.10
7. Faridpur District	60:38.10	60:39.60

Contd. Appendix - G

8. Mymensingh District	60:38.60	60:39.10
9. Jamalpur District	60:38.60	60:39.10
10.Tangail District	60:38.60	60:39.00
Chittagong Division :		
11. Chittagong District		
(a) Perboiled [Sic]	60:38.60	60:39.10
(b) Atap	60:38.00	60:38.00
12. Chittagong Hill Tracts		
(a) Perboiled [Sic]	60:38.60	60:39.10
(b) Atap	60:38.00	60:38.00
13. Noakhali District	60:39.10	60:39.60
14. Sylhet District		
(a) Perboiled [Sic]	60:38.50	60:39.00
(b) Atap	60:38.00	60:38.00
15. Comilla District	60:38.60	60:39.10
Khulna Division		
16. Khulna District	60:39.50	60:40.00
17. Barisal District	60:39.50	60:40.00
18. Patuakhali District	60:39.50	60:40.00
19. Jessore District	60:38.60	60:39.10
20. Kushtia District	60:38.60	60:39.10

21. (a) The above ratio will be applicable to all mills irrespective of their sizes & capacities.

(b) Ratio as stated above shall be in corporated in the agreements for milling of paddy. In incorporating this ratio the source of paddy supplied to the mill should be adhered to ;

Contd. Appendix - G

22. Paddy must not be supplied to mill exceeding one month's milling capacity at a time. Resultant rice must be lifted immediately on completion of milling within 30 days from the date of supply of paddy. In making allotments storage capacity as well as milling capacity of the mill shall be taken into consideration.

23. Agreement shall be executed in the name of and by the Proprietor of the mill and written authority shall be taken from the proprietor regarding employees and others who shall be treated as accredited representatives of him if any for receiving paddy and delivery of resultants rice. No agreement shall be made in the name of the mills.

24. Prompt action shall be taken by the District Controllers of Food/Subdivisional Controllers of Food on complaints received from mills regarding quality of paddy alleging non-FAQ in accordance with the terms of agreement.

25. No agreement shall be executed with a miller whose past performance has been unsatisfactory and with whom previous accounts have not been finalised.

26. Security deposit may be realised for the millers at the rate shown below :

a) Major Rice Mill - Tk. 30,000.00

b) Husking Rice Mill - Tk. 15,000.00

27. Earlier security deposit may be transferred towards security deposit of current year subject to finalisation of previous years milling accounts.

28. Under no circumstances the District Controller of Food shall allot paddy to any individual mill whether Major or Husking in excess of 15,000 mds. in a financial year without prior permission from the Directorate of Procurement in writing.

29. The rice ratio herein shall be treated as minimum outturn in all F.A.Q. paddy as regards the outturn from non-F.A.Q. paddy no reduction.

96

BIBLIOGRAPHY

Published

1. Annymous : 1966 Internal Procurement of paddy and Rice Manual
Department of Food, Government of East Pakistan

2. Annymous : 1986 Paddy and Rice storage in India.
FAO of the United Nations, Bangkok

3. Annymous : 1987 In-Farm Paddy storage in the Republic of Korea: An Assessment of the In-Bin Drying System

4. Annymous : 1986 Paddy and Rice storage in China:
FAO of the United Nations - Bangkok

5. Ahmed, Mohiuddin: 1988 Assessment of Rice Processing Technologies in Bangladesh with Emphasis on Milling Technology.
Institute of Appropriate Technology, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

6. Abbott,J.C.,et al: 1972 Rice Marketing
FAO of the United Nations, Rome

7. Araullo E.V.et al: 1985 Rice Post Harvest Technology
Oxford and IBH Publishing Co.
New Delhi

8. Annymous : 1989 Directory of Internal Procurement (in Bangla)
Ministry of Food,Government of Bangladesh, Dhaka.

9. Annymous : 1982 Increasing Access to Foodgrain Supplies by the vulnerable section of the population in South Asian Countries. FAO of the United Nations, Bangkok

10. Beagle, E.C. : 1978 Rice-Husk, Conversion to Energy;FAO
FAO of the United Nations, Rome

11. Hall,D.H.et.al : 1970 Handling and storage of Foodgrains in Tropical and sub-tropical Areas
FAO of the United Nations, Rome

12. Jalil.Abdul et.al: 1991 The Estimates of Seed, Feed and Post Harvest Wastage of Foodgrains Crops in Bangladesh.
Food Planning and Monitoring Unit
MOF, Govt.of Bangladesh

13. Rahman.Mahfoozur : 1988 Problems and Prospects of Rice Processing Technology in Bangladesh
Institute of Appropriate Technology,
Bangladesh University of Engineering and Technology, Dhaka

14. Whistler.Roy.L. : 1984 Starch: Chemistry and Technology
(Rice Starch: Production, Properties and uses)
Academic Press Inc, USA

15. Gariboldi, F. : 1972 Rice Chemistry and Technology
Academic Press Inc, USA

16. Wimberly, J.E. : 1983 Paddy Rice : Post Harvest Industry in Developing Countries. International Rice Research Institute, Los Banos, Philippines

Unpublished

1. Ahmed.Raisuddin et.al:1991 (Draft Report)
Determination of Procurement Price of Rice in Bangladesh.IFRI Dhaka.

2. Ahmed,Akhtar et.al :1991 (Draft Report)
Cost of Public Food Distribution in Bangladesh, IFRI, Dhaka.

3. Annymous :1991 (Draft Report)
Procedures for Milling,
FAO of the UN, Reorganization Project, MOF, GOB, Dhaka.

4. Annymous :1991 (Draft Report)
Procedures for Intenral Procurement
FAO, Reorganization Project,
MOF, GOB, Dhaka

5. Goldstein,Ellen etal :1991 Bangladesh Food Policy Review : Adjusting to the Green Revolution
Vol-I and II.